Open Science Philosophy

Open science encompasses unrestricted access to scientific research articles, access to data from public research, and collaborative research enabled by information and communication technology tools, models, and incentives. Broadening access to scientific research publications and data is at the heart of open science. The objective of open science is to make research outputs and its potential benefits available to the entire world and in the hands of as many as possible:

- Open science promotes a more accurate verification of scientific research results. Scientific inquiry and discovery can be sped up by combining the tools of science and information technologies. Open science will benefit society and researchers by providing faster, easier, and more efficient availability of research outputs.
- Open science reduces duplication in collecting, creating, transferring, and re-using scientific material.
- Open science increases productivity in an era of tight budgets.
- Open science results in great innovation potential and increased consumer choice from public research.
- Open science promotes public trust in science. Greater citizen engagement leads to active participation in scientific experiments and data collection.

Open Science Index

The Open Science Index (OSI) currently provides access to over thirty thousand full-text journal articles and is working with member and non-member organizations to review policies to promote and assess open science. As part of the open science philosophy, and by making open science a reality; OSI is conducting an assessment of the impact of open science principles and restructuring the guidelines for access to scientific research. As digitalization continues to accelerate science, Open science and big data hold enormous promise and present new challenges for policymakers, scientific institutions, and individual researchers.

OSI is helping the global scientific research community discover, evaluate, and access high-quality research output. Renowned for its editorially curated and refereed collection of the highest-quality publications, OSI has always been and will remain free-of-charge.

OSI provides an efficient and thorough discovery process to the open science research database and provides links and free access to full-text articles. There are 50 open access journal categories that are curated and refereed by international scientific committees, the in-house editorial team, and trusted partners. Since its inception in 2007, OSI has made more than thirty thousand peer-reviewed open access full-text journal articles (PDF versions) freely available online without cost, barriers, or restrictions.

Open Science Access

With the Open Science Index, researchers can discover and access trusted peer-reviewed open access fulltext scientific research articles with confidence. OSI helps researchers find appropriate non-profit open access journals to publish their work.

OSI gives one-click access to online full-text PDFs and expands the reach to global society by giving users free access from anywhere around the globe. Through cutting-edge open science collaboration, in an innovative public partnership, the non-profit OSI is devoted to making science open and reusable.

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Open Society

An open society allows individuals to change their roles and to benefit from corresponding changes in status. Open science depends to a greater or lesser extent on digital technologies and innovations in structural processes by an open society. When realized, open science research and innovation can create investment opportunities for new and better products and services and therefore increase competitiveness and employment. Open science research and innovation is a key component of thematic open science priorities. Central to the open science digital infrastructure is enabling industry to benefit from digital technology and to underpin scientific advances through the development of an open society. Open science research and innovation can also contribute to society as a global actor because scientific relations can flourish even where global relations are strained. Open science has a critical role across many areas of decision making in providing evidence that helps understand the risks and benefits of different open science choices. Digital technology is making the conduct of open science and innovation more collaborative, more global, and more open to global citizens. Open society must embrace these changes and reinforce its position as the leading power for science, for new ideas, and for investing sustainably in the future.

It is apparent in open society that the way science works is fundamentally changing, and an equally significant transformation is taking place in how organizations and societies innovate. The advent of digital technology is making research and innovation more open, collaborative, and global. These exchanges are leading open society to develop open science and to set goals for research and innovation priority. Open science goals are materializing in the development of scientific research and innovation platforms and greater acceptance of scientific data generated by open science research. Open science research and innovation do not need help from open society to come up with great ideas, but the level of success ideas ultimately reach is undoubtedly influenced by regulation, financing, public support, and market access. Open society is playing a crucial role in improving all these success factors.

Open Science

Open science represents a new approach to the scientific process based on cooperative work and new ways of diffusing knowledge by using digital technologies and collaborative tools. These innovations capture a systemic change to the way science and research have been carried out for the last fifty years. Science is shifting from the standard practice of publishing research results in scientific publications after the research and reviews are completed. The shift is towards sharing and using all available knowledge at an earlier stage in the research process. Open science is to science what digital technology is to social and economic transactions: allowing end users to be producers of ideas, relations, and services and in doing so, enabling new working models, new social relationships and leading to a new modus operandi for science. Open science is as important and disruptive as e-commerce has been for the retail industry. Just like e-commerce, the open science research paradigm shift affects the whole business cycle of doing science and research. From the selection of research subjects to the carrying out of research, to its use and re-use, to the role of universities, and that of publishers are all dramatically changed. Just as the internet and globalization have profoundly changed the way we do business, interact socially, consume culture, and buy goods, these changes are now profoundly impacting how one does research and science.

The discussion on broadening the footprint of science and on novel ways to produce and spread knowledge gradually evolved from two global trends: Open Access and Open Source. The former refers to online, peer-reviewed scholarly outputs, which are free to read, with limited or no copyright and licensing restrictions, while open source refers to software created without any proprietary restriction and which can be accessed and freely used. Although open access became primarily associated with a particular publishing

or scientific dissemination practice, open access already sought to induce a broader practice that includes the general re-use of all kinds of research products, not just publications or data. It is only more recently that open science has coalesced into the concept of a transformed scientific practice, shifting the focus of researchers' activity from publishing as fast as possible to sharing knowledge as early as possible. Open science is defined as the idea that scientific knowledge of all kinds should be openly shared as early as is practical in the discovery process. As a result, the way science is done in the future will look significantly different from the way it is done now. Open science is the ongoing evolution in the modus operandi of doing research and organizing science. This evolution is enabled by digital technology and is driven by both the globalization of the scientific community and increasing public demand to address the societal challenges of our times. Open science entails the ongoing transitions in the way research is performed, researchers collaborate, knowledge is shared, and science is organized.

Open science impacts the entire research cycle, from the inception of research to its publication, and on how this cycle is organized. The outer circle reflects the new interconnected nature of open science, while the inner circle shows the entire scientific process, from the conceptualization of research ideas to publishing. Each step in the scientific process is linked to ongoing changes brought about by open science, including the emergence of alternative systems to establish a scientific reputation; changes in the way quality and impact of research are evaluated; the growing use of scientific blogs; open annotation; and open access to data and publications. All institutions involved in science are affected, including research organizations, research councils, and funding bodies. The trends are irreversible, and they have already grown well beyond individual projects. Theses changes predominantly result from a bottom-up process driven by a growing number of researchers who increasingly employ social media in their research and initiate globally coordinated research projects while sharing results at an early stage in the research process.

Open science is encompassed in five schools of thought:

- o the infrastructure school, concerned with technological architecture
- the public school, concerned with the accessibility of knowledge creation
- the measurement school, concerned with alternative impact assessment
- the democratic school, concerned with access to knowledge
- the pragmatic school, concerned with collaborative research

According to the measurement school, the reputation and evaluation of individual researchers are still mainly based on citation-based metrics. The h-index is an author-level metric that attempts to measure both the productivity and citation impact of the publications of a scientist or scholar. The impact factor is a measure reflecting the average number of citations to articles published in an academic journal and is used as a proxy for the relative importance of a journal.

Numerous criticisms have been made of citation-based metrics, primarily when used, and often misused, to assess the performance of individual researchers. These metrics:

- are often not applicable at the individual level
- \circ do not take into account the broader social and economic function of scientific research
- \circ are not adapted to the increased scale of research
- o cannot recognize new types of work that researchers are performing

Web-based metrics for measuring research output, popularized as altmetrics, have recently received much attention: some measure the impact at the article level, others make it possible to assess the many outcomes of research in addition to the number of scientific articles and references. The current reputation and evaluation system has to adapt to the new dynamics of open science and acknowledge and incentivize

engagement in open science. Researchers engaging in open science have growing expectations that their work, including intermediate products such as research data, will be better rewarded or taken into account in their career development. Vice-versa, the use, and reuse of open data will require appropriate codes of conduct requiring, for example, the proper acknowledgment of the original creator of the data.

These ongoing changes are progressively transforming scientific practices with innovative tools to facilitate communication, collaboration, and data analysis. Researchers that increasingly work together to create knowledge can employ online tools and create a shared space where creative conversation and collaboration can occur. As a result, the problem-solving process can be faster, and the range of problems that can be solved can be expanded. The ecosystem underpinning open science is evolving very rapidly. Social network platforms for researchers already attract millions of users and are being used to begin and validate more research projects.

Furthermore, the trends towards open access are redefining the framework conditions for science and thus have an impact on how open innovation is produced by encouraging a more dynamic circulation of knowledge. It can enable more science-based startups to emerge thanks to the exploitation of openly accessible research results. Open science, however, does not mean free science. It is essential to ensure that intellectual property is protected before making knowledge publicly available in order to subsequently attract investments that can help translate research results into innovation. If this is taken into account, fuller and broader access to scientific publications and research data can help to accelerate innovation. Investments that boost research and innovation in open science would benefit society with fewer barriers to knowledge transfer, open access to scientific research, and greater mobility of researchers. In this context, open access can help overcome the barriers that innovative organizations face in accessing the results of research funded by the public.

Open innovation

An open society is the largest producer of knowledge, but the phenomenon of open science is changing every aspect of the scientific method by becoming more open, inclusive, and interdisciplinary. Ensuring open society is at the forefront of open science means promoting open access to scientific data and publications alongside the highest standards of research integrity. There are few forces in this globe as engaging and unifying as science. The universal language of science maintains open channels of communication globally. Open society can maximize its gains through maintaining its presence at the highest level of scientific endeavor, and by promoting a competitive edge in the knowledge society of the information age. The ideas and initiatives described in this publication can stimulate anyone interested in open science research and innovation. It is designed to encourage debate and lead to new ideas on what and open society should do, should not do, or do differently.

An open society can lead to a research powerhouse; however, open society rarely succeeds in turning research into innovation and in getting research results to the global market. Open society must improve at making the most of its innovation talent, and that is where open innovation comes into play. The basic premise of open innovation is to open up the innovation process to all active players so that knowledge can circulate more freely and be transformed into products and services that create new markets while fostering a stronger culture of entrepreneurship. Open innovation. This original notion of open innovation was primarily based on transferring knowledge, expertise, and even resources from one company or research institution to another. This notion assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as they seek to improve their performance. The concept of open innovation is continually evolving and is moving from linear, bilateral transactions and collaborations

towards dynamic, networked, multi-collaborative innovation ecosystems. This means that a specific innovation can no longer be seen as the result of predefined and isolated innovation activities but rather as the outcome of a complex co-creation process involving knowledge flows across the entire economic and social environment. This co-creation takes place in different parts of the innovation ecosystem and requires knowledge exchange and absorptive capacities from all the actors involved, whether businesses, academia, financial institutions, public authorities, or citizens.

Open innovation is a broad term, which encompasses several different nuances and approaches. Two main elements underpin the most recent conceptions of open innovation: the users are in the spotlight and invention becomes an innovation only if users become a part of the value creation process. Notions such as user innovation emphasize the role of citizens and users in the innovation processes as distributed' sources of knowledge. This kind of public engagement is one of the aims of open science research and innovation. The term 'open' in these contexts has also been used as a synonym for 'user-centric'; creating a wellfunctioning ecosystem that allows co-creation and becomes essential for open innovation. In this ecosystem, relevant stakeholders are collaborating along and across industry and sector-specific value chains to cocreate solutions for socio-economic and business challenges. One important element to keep in mind when discussing open innovation is that it cannot be defined in absolutely precise terms. It may be better to think of it as a point on a continuum where there is a range of context-dependent innovation activities at different stages, from research to development through to commercialization, and where some activities are more open than others. Open innovation is gaining momentum thanks to new large-scale trends such as digitalization and the mass participation and collaboration in innovation that it enables. The speed and scale of digitalization are accelerating and transforming the way one designs, develops, and manufactures products, the way one delivers services, and the products and services themselves. It is enabling innovative processes and new ways of doing business, introducing new cross-sector value chains and infrastructures.

Open society must ensure that it capitalizes on the benefits that these developments promise for citizens in terms of tackling societal challenges and boosting business and industry. Drawing on these trends, and with the aim of helping build an open innovation ecosystem in open society, the open society's concept of open innovation is characterized by:

- combining the power of ideas and knowledge from different actors to co-create new products and find solutions to societal needs
- o creating shared economic and social value, including a citizen and user-centric approach
- $\circ\;$ capitalizing on the implications of trends such as digitalization, mass participation, and collaboration

In order to encourage the transition from linear knowledge transfer towards more dynamic knowledge circulation, experts agree that it is essential to create and support an open innovation ecosystem that facilitates the translation of knowledge into socio-economic value. In addition to the formal supply-side elements such as research skills, excellent science, funding and intellectual property management, there is also a need to concentrate on the demand side aspects of knowledge circulation, making sure that scientific work corresponds to the needs of the users and that knowledge is findable, accessible, interpretable and reusable. Open access to research results aims to make science more reliable, efficient, and responsive and is the springboard for increased innovation opportunities, e.g. by enabling more science-based startups to emerge. Prioritizing open science does not, however, automatically ensure that research results and scientific knowledge are commercialized or transformed into socio-economic value. In order for this to happen, open innovation must help to connect and exploit the results of open science and facilitate the faster translation of discoveries into societal use and economic value.

Collaborations with global partners represent important sources of knowledge circulation. The globalization of research and innovation is not a new phenomenon, but it has intensified in the last decade, particularly in terms of collaborative research, international technology production, and worldwide mobility of researchers and innovative entrepreneurs. Global collaboration plays a significant role both in improving the competitiveness of open innovation ecosystems and in fostering new knowledge production worldwide. It ensures access to a broader set of competencies, resources, and skills wherever they are located, and it yields positive impacts in terms of scientific quality and research results. Collaboration enables global standard-setting, allows global challenges to be tackled more effectively, and facilitates participation in global value chains and new and emerging markets.

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Scholarly Research Review

The scholarly research review is a multidimensional evaluation procedure in which standard peer review models can be adapted in line with the ethos of scientific research, including accessible identities between reviewer and author, publishing review reports and enabling greater participation in the peer review process. Scholarly research review methods are employed to maintain standards of quality, improve performance, provide credibility, and determine suitability for publication. *Responsible Peer Review Procedure:* Responsible peer review ensures that scholarly research meets accepted disciplinary standards and ensures the dissemination of only relevant findings, free from bias, unwarranted claims, and unacceptable interpretations. Principles of responsible peer review:

- Honesty in all aspects of research
- Accountability in the conduct of research
- Professional courtesy and fairness in working with others
- Good stewardship of research on behalf of others

The responsibilities of peer review apply to scholarly researchers at all stages of peer review: Fairness, Transparency, Independence, Appropriateness and Balance, Participation, Confidentiality, Impartiality, Timeliness, Quality and Excellence, Professionalism, and Duty to Report.

Scholarly Research Review Traits:

• Scholarly Research Review Identities: Authors and reviewers are aware of each other's identity

• Scholarly Research Review Reports: Review reports are published alongside the relevant article

• Scholarly Research Review Participation: The wider academic community is able to contribute to the review process

• Scholarly Research Review Interaction: Direct reciprocal discussion between author(s) and reviewers, and/or between reviewers, is allowed and encouraged

• Scholarly Research Pre-review Manuscripts: Manuscripts are made immediately available in advance of any formal peer review procedures

• Scholarly Research Review Final-version Reviewing: Editorial revision of the language and format is conducted on the final version of the manuscript for publication

• Scholarly Research Review Platforms: The scholarly research review process is independent of the final publication of the manuscript and it is facilitated by a different organizational entity than the venue of publication

All submitted manuscripts are subject to the scholarly research review process, in which there are three stages of evaluation for consideration: pre-review manuscripts, chair-review presentation, and final-review manuscripts. All submitted full text papers, that may still be withstand the editorial review process, are presented in the conference proceedings. Manuscripts are tracked and all actions are logged by internal and external reviewers according to publication policy. External reviewers' editorial analysis consists of the evaluation reports of the conference session chairs and participants in addition to online internal and external reviewers' reports. Based on completion of the scholarly research review process, those manuscripts meeting the publication standards are published 10 days after the event date.

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Open Science Award

The International Research Conference (IRC) is an open science research organization dedicated to promoting advancement of science, engineering, and technology. The IRC's open science award program is pleased to announce research awards which are available to distinguished researchers who are currently based at or affiliated with a research university.

The purpose of this award is the recognition of open science research and publications. The award program coordinates and develops high impact scholarly research which seeks to promote multiscience approaches. The open science originates with the premise that universal scientific knowledge is a product of collective scholarly efforts. The social collaboration involves all stakeholders and knowledge belongs to the global society. Scientific outputs generated by public research are public good that should be available to all at no cost and without any barriers or restrictions.

The open science award is granted annually for outstanding achievements and excellence in scientific research. Any researcher who is interested in this award can submit their own and /or the colleagues' scholarly research articles for consideration for this honor. All respected researchers are warmly welcome to submit their research works for potential award consideration and evaluation. Qualitative and quantitative assessment of the open access articles submitted and published for consideration will be evaluation criteria for the award. The award emphasizes open science contributions, collaborations and communication, and the open publication of scholarly research knowledge.

This annual award will be given to one and up to three honorees (or research groups) in recognition of exceptional contributions to open science in the following three distinct research categories: Social Sciences, Life Sciences, and Physical Sciences. The selection committees (waset.org/Committees) are responsible for selecting the recipient(s) of the named award. The members of the open science award committee will promote excellence and transparency, allow broad input, recognition, diversity and commitment to equity so that the open science award is sufficiently representative of distinguished research groups.

Assignment of the open science award committee is performed primarily through the online submission and review system. The annual event is held to present awards and to celebrate distinguished researchers for their open science contributions.

Open Science Award Deadlines

Online Nomination Deadline: January 01, 2020 - December 31, 2020

Scoring Deadline: January 01, 2021 - March 31, 2021

Selection Deadline: April 30, 2021

Award Ceremony Date: June 30, 2021

Application Procedure

Applicants must submit the following to <u>https://waset.org/profile/messages</u> with the email subject line reading "OSA_surname_given name," e.g., OSA_Smith_John.

Please include the following attachments to your email application:

- 1. Applicants should hold, at a minimum, a Ph.D. or its equivalent degree.
- 2. Cover letter to the Award Committee indicating interest in the award.

3. Curriculum vitae.

4. Research statement. Please include a description of your research accomplished (not more than two pages, single spaced), and published full text original research article in pdf format.

5. Two letters of recommendation. The applicant must request the letters (or the dossier service).

6. High-quality copies or scans of transcripts showing degrees (Bachelor, Masters, and Doctoral) and coursework.

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Postdoctoral Fellowship Award

The International Research Conference (IRC) is an open science research organization dedicated to promoting the advancement of science, engineering, and technology. The IRC's postdoctoral fellowship award is pleased to announce Fellowships which are available for postdoctoral researchers who are currently based at or affiliated with a research university. The postdoctoral fellowship award coordinates and develops high impact scholarly open science research which seeks to promote multiscience approaches. In addition, the fellowship award presents a unique opportunity for researchers who want to influence the future of open science through collaboration, communication, publication and data sharing within the global science community.

This postdoctoral fellowship award is looking for researchers with a passion for open science, open sources, open publications and data sharing. Applicants should already be working to promote research practices in a more collaborative, iterative and open dimension. Fellows will spend four months starting in June of 2020 as community catalysts at their own institutions creating, disseminating, and mentoring the next generation of open science community. Throughout the fellowship term, Fellows will receive training and support from the open science postdoctoral Fellowship award to develop and hone their skills around open science, open sources, data sharing, open science policy and licensing. Fellows will also craft policies and codes, write curriculum, teach their institutional peers, and be engaged in helping their local open science communities learn about open sources and open data practices.

Expectations: The open science postdoctoral Fellowship award anticipates applicants who:

- Create change within their university or other institution throughout open science, research, data sharing, and article publications.
- Create knowledge, policies and codes, curriculum and educational resources to promote open science.
- Participate in open science research workshops, symposia, conferences, and other activities.
- Participate in and help to lead regular open science research community call for proposals or papers.
- Serve as open science mentors and leaders within their research communities.
- Serve as reviewers for submitted open science abstracts and research papers for scholarly journals and conferences.
- Promote open science by communicating, publishing and sharing their high impact peer-reviewed research on an ongoing basis.

Note: Fellows are encouraged to continue their personal research for up to 20% of their time during the course of their fellowship (i.e., one day a week). Fellowship applicants must have buy-in from their advisors in advance and include their advisors' contact information on the application. The applicant's advisors will be interviewed should the applicant move on to the second round, and their support will be a critical consideration for the awarding of Fellowships.

Fellowship Terms and Conditions

Award Scholarship Description

Application Deadline: April 30, 2020

- Fellowships are awarded to enhance the concept of open science and are open to scholars from all fields of science, engineering, and technology.
- The selected Fellow will receive a monthly stipend of \$500.00 for four months during 2020 (June, July, August, and September). Fellows are responsible for remitting all applicable taxes and other government charges as required by their country of residence and by law.

Nationality: Fellowships are available to postdoctoral researchers in any country.

Requirements:

Fellows must:

• At a minimum, hold a Ph.D. or its equivalent by June 1, 2020, and should not have received the degree before 2018.

• Applicants should have working proficiency in the English language and should demonstrate their ability to read, write, and speak English.

- Applicants should be full-time academics or affiliated with a research university or institute.
- Funding will be direct to the Fellow and not distributed through their institution.
- Be able to travel.

• Obtain support from their advisors. Fellows will be based at their home institutions. Please note that a letter of support from the advisor is mandatory for consideration.

• Have experience participating in open science research.

Application Procedure:

Applicants must submit the following to <u>https://waset.org/profile/messages</u> with the email subject line reading "Postdoc_surname_given name," e.g., Postdoc_Smith_John.

Please include the following attachments to your email application:

- 1. Cover letter to the Search Committee indicating interest in the position.
- 2. Curriculum vitae.
- 3. Dissertation abstract.

4. Research statement. Please include a description of your proposed research that would be accomplished during the fellowship (not more than two pages, single spaced).

5. Two letters of recommendation. The applicant must request the letters (or the dossier service).

6. High-quality copies or scans of transcripts showing degrees (Bachelor, Masters, and Doctoral) and coursework.

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Article	TABLE OF CONTENTS	Page
1	Perceptions about Preconception Health in Indonesian Women Who Have Been Pregnant and Have Never Been Pregnant Siti Nurunniyah	1 - 1
2	Perception of Hearing Loss and Hearing Aids in Hearing-Impaired Patients and Their Caregivers in Singapore Go Teck Wah William, Wong Lok Hang, Quek Li Xian, Ng Yu Shuang, Ho Eu Chin	2 - 2
3	Communication Vulnerability within a Healthcare Setting: A Perceptual Comparison between Patients, Caregivers, and Healthcare Workers <i>William Teck Wah Go, Hoi Tong Mok, Li Xian Quek, Eu Chin Ho</i>	3 - 3
4	Lateral Internal Anal Sphincterotomy Following Botolinum Toxin Injection for Chronic Anal Fissure Tia Morosin, Marie Shella De Robles	4 - 4
5	A Retrospective Study to Assess the Influence of Anaesthetic Type on Incomplete Excision Rate of Non-Melanoma Skin Cancers Daniel Page	5 - 5
6	The Learning Curve in Microsurgery: Improving Safety and Efficient Learning with a Simulation Model Karima Medjoub, Katarzyna Wielechowska, Tom Harris, Alain Curnier, Jamil Ahmed	6 - 6
7	Biophysical Features of Glioma-Derived Extracellular Vesicles as Potential Diagnostic Markers Abhimanyu Thakur, Youngjin Lee	7 - 7
8	Sexual Rights in Tunisia: A Necessity for the Democratic Transition Process Giovanni D'Auria	8 - 8
9	The Peace Diplomacy, Negotiation, and National Security Issues in Sri Lanka (2002-2009) Isuru Premarathna	9 - 9
10	Flipped Learning in the Delivery of Structural Analysis Ali Amin	10 - 10
11	Reuse of Grey Water in Rural Area by Natural Polymeric Biofilter System Shohreh Azizi, Shamila Rouhani, Malik Mazza	11 - 11
12	Identifying Critical Issues in Construction Industry Using Pareto Analysis Saurabh Chhajed, Harsh Jain, Manish Kabra, Namdeo Hedaoo	12 - 12
13	Formal and the New Normal: An Investigation in Approach towards Housing in Emergent Global Cities Saurabh Barde, Asif Ahmed Syed	13 - 13
14	Termite Brick Temperature and Relative Humidity by Continuous Monitoring Technique Khalid Abdullah Alshuhail, Syrif Junidi, Ideisan Abu-Abdoum, Abdulsalam Aldawoud	14 - 24
15	MhAGCN: Multi-Head Attention Graph Convolutional Network for Web Services Classification Bing Li, Zhi Li, Yilong Yang	25 - 32
16	Performance Analysis of Traffic Classification with Machine Learning Htay Htay Yi, Zin May Aye	33 - 38
17	Bio-Inspired Opto-Responsive Nociceptor Based on Memristor Device Built on Two-Dimensional Hetero-Structured Oxides Serge Zhuiykov, Mohammad Karbalaei Akbari	39 - 42
18	Microneedle Application of Vertically Aligned Carbon Nanotubes Osman T. Gul	43 - 43
19	Symmetric Notches Induce Notch Strengthening in Metallic Glasses Yun Teng, Zhendong Sha	44 - 44
20	Extracting Business Methodology: Using Artificial Intelligence-Based TOR Method Sritha Zith Dey Babu, Er. Sandeep Kour, Saurabh Verma, Chirag Verma, Vishali Pathania, Anubhav Agrawal, Vishesh Chaudhar	45 - 45 y, Albin Manoj Puthur, Rajat

Article	TABLE OF CONTENTS	Page
21	Hybrid Extraction of Detecting Breast Cancer with Fuzzy Sritha Zith Dey Babu	46 - 46
22	Indoor Airborne Microplastics Quantification in Sydney-Australia and Its Potential Health Impacts Neda Sharifi Soltani, Mark Patrick Taylor, Scott Paton Wilson	47 - 47
23	Irrigation Water Quality Evaluation Based on Multivariate Statistical Analysis: A Case Study of Jiaokou Irrigation District <i>Panpan Xu, Qiying Zhang, Hui Qian</i>	48 - 52
24	Irrigation Water Quality Evaluation in Jiaokou Irrigation District, Guanzhong Basin Qiying Zhang, Panpan Xu, Hui Qian	53 - 59
25	Management Practices, Performance and Constraints of Camel Production in Kebri Dahar District, Somali Region, Ethiopia <i>Abdulahi Ibrahim</i>	60 - 60
26	Biotransformation of Monoterpenes by Whole Cells of Eleven Praxelis clematidea-Derived Endophytic Fungi Daomao Yang, Qizhi Wang	61 - 66
27	Challenges in the Last Mile of the Global Guinea Worm Eradication Program: A Systematic Review <i>Getahun Lemma</i>	67 - 67
28	Factors Affecting the Investment Returns of Listed Financial Institutions: A Study Based on Colombo Stock Exchange Mahesh Samaradiwakara	68 - 68
29	Challenges of eradicating neglected tropical diseases Marziye Hadian, Alireza Jabbari	69 - 69
30	Buddhism and Origin of Untouchability Anup Hiwrale	70 - 70
31	Future of Electric Power Generation Technologies Abdulrahman Bahaddad, Mohammed Beshir	71 - 78

Perceptions about Preconception Health in Indonesian Women Who Have Been Pregnant and Have Never Been Pregnant

Siti Nurunniyah

Abstract— Background: The preconception period is important in preparing health for a healthy pregnancy, childbirth, and baby. Health services during preconception allow early detection of health problems for mothers and allow women of childbearing age for family planning earlier. But the preconception health has not received enough attention from the government. Based on preliminary studies women of childbearing age are not equipped with special preconception health, both for women who are newly married or already have children, pay less attention to health when planning a pregnancy.

The concept of preconception health services is important to develop. Developing this concept of preconception health services, information is needed regarding the description, perception, and expectations of suburban women towards preconception health services.

Objective: This study aims to determine the perception of women of childbearing age-related to preconception health so that it can be used as input and basic data to build preconception health service concepts

Method: This research is qualitative research with an in-depth interview method in nulliparous and primiparous

Results: The majority of the study participant was not yet approved concerning preconception health. Women of childbearing age have positive perceptions and expectations about premarital health.

Conclusion: the results of this study can be used as a material for the development of preconception health service concepts.

Implications to the field: The results of this study can be used to evaluate people's perceptions and expectations regarding preconception health. The preconception period also can be used for family planning counseling.

Keywords— preconception health, women perception, indonesia, qualitative studies.

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Perception of Hearing Loss and Hearing Aids in Hearing-Impaired Patients and Their Caregivers in Singapore

Go Teck Wah William, Wong Lok Hang, Quek Li Xian, Ng Yu Shuang, Ho Eu Chin

Abstract—Hearing aid (HA) is an effective rehabilitative medical device for presbycusis. However, the decision for patients to seek help and to commit to aural rehabilitation is often influence by other subjective factors.

Objective: This study examines subjective factors and shared decision-making associated with HA uptake among adult and elderly patients and their caregivers in Singapore.

Design: Prospective cross-sectional study. The 6 constructs of the health belief model (HBM) were used to develop questions examining perceived severity/susceptibility, barriers/benefits, self-efficacy, and cues to action. Items on Understanding and Willingness-To-Pay were included.

Study sample: 136 hearing-impaired patients (mean age: 69) and 84 patient caregivers (mean age: 51) were recruited at a tertiary hospital's ENT outpatient clinic between July to November 2020.

Results: 82% of patients surveyed agreed that hearing loss will affect how they communicate with others, while only 57% of them also agreed that this may strain their relationship with friends and family. The same sentiment was amplified by their caregivers, with 96% believed that communication will be impacted, and 78% of them believed that relationships will be affected. Our data also highlights a strong discrepancy between the kinds of hearing difficulties patients had reported versus what caregivers had observed and experienced. While only 48% of patients responded with difficulties hearing phone conversations, 92% of caregivers had noticed patient's communication difficulties with 81% of them having to communicate on the patient's behalf. Interestingly, 83% of caregivers had experienced anger or frustration when conversing with the hearingimpaired patients they were caring for, with 98% of them having to adapt their communication with patients before seeking professional help. This perceptual discrepancy continues in how they thought they will be perceived by other, with 70% of patients felt that they will be judged as less capable with work, while only 41% of caregivers shared the same sentiment.

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Conclusions: Hearing-impaired patients' increasing dependence on their caregivers, coupled with the complexity of healthcare services could contribute to the perception of caregivers' indispensable role as intermediaries. These findings accentuate the need to further investigate how patients and their caregivers can be supported and enabled in shared decision-making regarding aural rehabilitation that meet the patient's needs.

Keywords— aural rehabilitation, health belief model, perception, shared decision-making

Communication Vulnerability within a Healthcare Setting – a Perceptual Comparison between Patients, Caregivers, and Healthcare Workers

William Teck Wah Go, Hoi Tong Mok, Li Xian Quek, Eu Chin Ho

Abstract—Many patients may enter a hospital in a 'Communication Vulnerable' (CV) state or become so by virtue of their condition or treatment. It is generally recognized that patients need to be able to communicate fully with their healthcare providers to ensure receipt of effective care. However, communication difficulties can, and often do, create huge barriers between patients and healthcare workers.

Objective: This study examines the perceptual differences between patients, their caregivers, and healthcare workers with regards to their perceived communication vulnerability and communication needs in a geriatric outpatient setting.

Design: Prospective cross-sectional study. The Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) Survey was adapted into outpatient questionnaires. The adapted version retained aspects on "Communication with nurses and doctors" and "Communication about medicines or treatment" with modifications. Respondents were asked to rate the frequency they have encountered for the described situations. Selected elements from the Domains Of Subjective Extent (DOSE) Non-Adherence Measure were incorporated into the questionnaire to probe the extent of nonadherence to medication. The final version for the patients and caregivers survey is a 20-item study questionnaire. The healthcare workers' version consists of additional items on the management of CV patient. Both English and Mandarin versions were made available.

Study sample: 39 patients (mean age: 74), 25 caregivers (mean age: 75), and 30 frontline healthcare workers were recruited at a tertiary hospital as survey respondents.

Results: 44% of patient and 100% of caregiver surveyed responded with difficulties communicating with healthcare workers during their visits, with 29% of patients and 25% of caregivers cited poor hearing in noisy situations as their primary communication barrier. Over 93% of the healthcare workers surveyed had experienced challenging situations when communicating with CV patients, citing poor vision, poor hearing, and poor understanding of patients as the main barriers of communication. Respectively, 85% of patients, 96% of caregivers,

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and 100% of healthcare workers surveyed agreed that further improvements are necessary to minimize communication barriers in healthcare settings to improve the quality of healthcare communication.

Conclusions: This study has demonstrated a high tendency for healthcare workers to encounter patients with relatively less visible disabilities, which may negatively affect patient's ability to communicate with people who are less familiar to them. The Joint Commission 2011 has recommended that "hospital can determine the best way to promote two-way communication between the patient and his or her providers in a manner that meets the patient's needs". The onus is on healthcare providers to bridge this communication gap to improve patient care.

Keywords—barrier, communication, healthcare settings, vulnerable.

Lateral Internal Anal Sphincterotomy Following Botolinum Toxin Injection for Chronic Anal Fissure

T. Morosin, M. S. De Robles

Abstract- Lateral sphincterotomy (LS) for chronic anal fissure (CAF) is considered a gold standard for surgical management. However, it is an invasive treatment and has an associated risk of incontinence, making Botulinum toxin injection (BT) into the anal sphincter currently a more acceptable option for first-line management. This study aims to describe the natural history of CAF in a cohort of patients, and to assess the long-term results of LS after failed BT in a consecutive series of patients with CAF treated by a single surgeon. 251 consecutive patients treated with either BT or LS for CAF by a single surgeon were reviewed. Primary outcomes analysed included faecal incontinence and recurrence rates. The recurrence rate in the BT group was twice as much compared to the LS group (16% vs. 8%, p=0.047). At the initial six week follow-up, there was no significant difference in faecal incontinence between the BT and LS groups (6% vs. 7%, p=1.0). Long term follow-up of these patients has shown improvement and resolution of symptoms. This study demonstrated high success rate for curing CAF post LS, with associated rapid pain relief and minor short-term incontinence rates, usually flatus. Long term follow-up of patients showed no substantial risk to faecal incontinence. LS remains an excellent treatment for CAF after failed BT. Additionally, it may be offered as first-line of treatment in selected patients, even if pharmacologic treatment failure has not been confirmed.

Keywords—Botox, Chronic anal fissure, Incontinence, Recurrence, Sphincterotomy.

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A Retrospective Study to Assess the Influence of Anaesthetic Type on Incomplete Excision Rate of Non-Melanoma Skin Cancers

Daniel Page

Abstract- Purpose: Australia has the highest incidence of nonmelanoma skin cancers (NMSC) in the world, estimated to be 2448/100,000 population, with the state of Queensland carrying the highest burden. Surgical excision is the primary treatment and makes up a large proportion of general surgical lists in regional Queensland, where they are typically removed using either local anaesthetic (LA) alone, local anaesthetic and sedation (LAS), or general anaesthesia (GA). There is little in the literature to suggest if anaesthetic type affects the rate of involved margins. The purpose of this study is to establish if anaesthetic type impacts the rate of positive excision margins in regional hospitals in Queensland. Methodology: A retrospective audit was performed, incorporating a total of 194 squamous and basal cell carcinoma lesions excised between October 2019 and October 2020 at two hospitals in regional Australia. Data was recorded for the type of anaesthetic used and the histopathology of the lesions, including the type of lesion and microscopic margin involvement. Results: Of the 194 excised lesions, 39 of them had involved margins (20.1%). The rate of involved margins under LA, GA, and LAS where found to be 19.79%, 18.52%, and 22.73%, respectively. When comparing these modalities with each other: LA vs. GA, LAS vs. GA, and LA vs. LAS, no significant difference was found in involved margins for excision of NMSC with p-values (< 0.05) of 1, 0.624, and 0.8225, respectively. Conclusion: Modality of anaesthetic used for excision of NMSC does not affect the outcome of margin involvement.

Keywords— non-melanoma skin cancers, treatment, anaesthetic, margins, surgical excision.

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The Learning Curve in Microsurgery: Improving Safety and Efficient Learning with a Simulation Model

Karima Medjoub, Katarzyna Wielechowska, Tom Harris, Alain Curnier, Jamil Ahmed

Abstract— Purpose: Learning a new surgical technique can be a daunting experience for both the teacher and the learner. In high stake surgery such as microsurgery, it is even more crucial to identify safer and more effective ways to educate our learners. Raising free flaps is a complex process, and our aim is to find out whether using hi-fidelity simulation on cadavers can make the learning faster and safer. This is not a new concept, but our aim to perform this study mixing simplification whilst maintaining realism. This is demonstrated in changing and emphasising the colours of the vessels and establishing controlled perfusion. Think of Kolb's learning cycle: we are trying to make the concrete experience more powerful. Materials and Methods: We used fresh frozen cadavers according to our local protocols. In the first stage of the study, we used three upper limbs using different dye techniques. This pilot included raising the following flaps, including posterior interosseous flap, radial forearm flaps, and second dorsal metacarpal flap. The flap harvest was performed by a senior plastic surgery trainee. The second stage: We will use of the cadavers in a course for new trainees. We collect photo and feedback evidence to examine the ease of the new steps of learning how to harvest the flaps, the realism and whether it made the first steps of learning faster in comparison to previous courses. Results: To a novel learner, we found that following the initial dissection of 3 limbs, the use of a bright green dye might be an important factor in making the first steps of learning easier and faster. This is perhaps due to the simplification of the most important step, which is identifying and protecting the perforators. We found that it made understanding the concept of free flap raising much faster when clarified with colour. To an experienced trainee/consultant: We found teaching the concept of perforators easier, the ease of finding the perforators would probably raise the confidence of the novel trainees. Conclusions: Using simple tricks such as colour changes can make initial learning more efficient, which translates into a cheaper and safer process. It is interesting that it goes against increasing fidelity with the perfusion, which also made a difference in the ease of flap harvesting. We suggest combining the two concepts in an intelligent and pedagogical manner to achieve our ultimate goal: safe and efficient risk-free training.

Keywords— microsurgery, simulation, patient safety, education.

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Biophysical Features of Glioma-Derived Extracellular Vesicles as Potential Diagnostic Markers

Abhimanyu Thakur, Youngjin Lee

Abstract— Glioma is a lethal brain cancer whose early diagnosis and prognosis are limited due to the dearth of a suitable technique for its early detection. Current approaches, including magnetic resonance imaging (MRI), computed tomography (CT), and invasive biopsy for the diagnosis of this lethal disease, hold several limitations, demanding an alternative method. Recently, extracellular vesicles (EVs) have been used in numerous biomarker studies, majorly exosomes and microvesicles (MVs), which are found in most of the cells and biofluids, including blood, cerebrospinal fluid (CSF), and urine. Remarkably, glioma cells (GMs) release a high number of EVs, which are found to cross the blood-brain-barrier (BBB) and impersonate the constituents of parent GMs including protein, and lncRNA; however, biophysical properties of EVs have not been explored yet as a biomarker for glioma. We isolated EVs from cell culture conditioned medium of GMs and regular primary culture, blood, and urine of wild-type (WT)- and glioma mouse models, and characterized by nano tracking analyzer, transmission electron microscopy, immunogold-EM, and differential light scanning. Next, we measured the biophysical parameters of GMs-EVs by using atomic force microscopy. Further, the functional constituents of EVs were examined by FTIR and Raman spectroscopy. Exosomes and MVsderived from GMs, blood, and urine showed distinction biophysical parameters (roughness, adhesion force, and stiffness) and different from that of regular primary glial cells, WT-blood, and -urine, which can be attributed to the characteristic functional constituents. Therefore, biophysical features can be potential diagnostic biomarkers for glioma.

Keywords— glioma, extracellular vesicles, exosomes, microvesicles, biophysical properties.

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Sexual Rights in Tunisia: A Necessity for the Democratic Transition Process

Giovanni D'Auria

Abstract— The theory of the universality of certain rights such as sexual rights still finds strong hostility today in countries with a muslim tradition, which, on the contrary, insist on cultural specificity. This scientific contribution photographs the reality of sexual rights in Tunisia, a modern country oriented towards a peculiar democratization process, identifying freedom of conscience as the common denominator useful to avoid any form of fundamentalism in democratic societies.

Keywords— Human Rights, Democratization, Freedom of Coscience, Muslim Tradition, Tunisia.

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The Peace Diplomacy, Negotiation, and National Security Issues in Sri Lanka (2002-2009)

Isuru Premarathna

Abstract— There are threats to national security on the devastation caused by terrorist conflicts. Conflict over the 2002 ceasefire agreement between the government of Sri Lanka and the LTTE and the subsequent failed peace process has been exacerbated during the civil war. The conflict between the Sri Lankan government and the Liberation Tigers of Tamil Elam (LTTE) lasted close to 30 years and is one of the longest civil wars in Asia. The Ceasefire Agreement (CFA) that was contracted in February 2002 and the peace process that it ushered in was the result of several components. As mentioned by many commentators the peace process emerged out of a mutually hurting stalemate as neither the religious doctrine, nor the LTTE was able to make a strategic victory over the other and found themselves in a precarious politicoeconomic state of affairs. The main objective of this research is to study the issues about Sri Lanka's diplomatic negotiations, peace, diplomatic negotiations during the civil war, and its impact of the Sri Lanka civil war and to study the problematic points of diplomatic peace talks and the peace process during 2002 and 2009. The data triangulation method was used to gather secondary data from multiple electronic and print sources, including books, journals, the Web, reports, historical documents, and treaties. Qualitative content analysis was used as a literature review and content analysis assesses the texts of the documents and tests the theoretical relevance for a more complete and scientific understanding of the data. It will test dominant theories in different contexts by comparing categories for different parameters. According to the research, the international impact on the peace diplomacy process in Sri Lanka is significant. Research can confirm national security dilemmas and security strategy issues, the impact of diplomatic peace talks, and the strengths and weaknesses of the ceasefire agreement. Also, the ongoing political conflicts have affected the maintenance of peace and national security. The negative response to the political conflict and the negative impact of diplomacy and the media have had a direct and indirect effect on national security and peace.

Keywords— The peace diplomacy, negotiation, national security issues, Sri Lankan Civil War.

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Flipped Learning in the Delivery of Structural Analysis

Ali Amin

Abstract— This paper describes a flipped learning initiative which was trialed in the delivery of the course: structural analysis and modelling. A short series of interactive videos were developed, which introduced the key concepts of each topic. The purpose of the videos was to introduce concepts and give the students more time to develop their thoughts prior to the lecture. This allowed more time for face to face engagement during the lecture. As part of the initial study, videos were developed for half the topics covered. The videos included a short summary of the key concepts (< 10 mins each) as well as fully worked-out examples (~30mins each). Qualitative feedback was attained from the students. On a scale from strongly disagree to strongly agree, students were rate statements such as 'The pre-class videos assisted your learning experience', 'I felt I could appreciate the content of the lecture more by watching the videos prior to class'. As a result of the pre-class engagement, the students formed more specific and targeted questions during class, and this generated greater comprehension of the material. The students also scored, on average, higher marks in questions pertaining to topics which had videos assigned to them.

Keywords— flipped learning, structural analysis, pre-class videos, engineering education.

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Reuse of Grey Water in Rural Area by Natural Polymeric Biofilter System

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Abstract—South Africa is ranked as the 30 the driest country in the world and the country faces a range of challenges with respect to water management, including increasing demand for water and resource shortages. It is estimated demand for water in South Africa will reach 17.7 billion cubic meters in 2030. However, between 2015 and 2033, the water demand in South Africa will exceed supply and the supply will not be able to cope with the anticipated population growth, consumption. In South Africa, municipal water use, which includes domestic water and water used in the garden, is indicated at being 27% of the total water used. With increased population growth and development, there is a need to critically look at alternative approaches to ensure water availability.

In this regard, The Natural polymeric Biofilter system (NPBS) offers a novel system for greywater treatment based on decentralized system in Makwana village in Limpopo province. The greywater from household will be collected, treated through the Natural polymeric biofilter system (NPBS) and the outlet will be used for toilet flushing and irrigation. The system includes conventional (sand, gravel) and non-conventional (*Magnetic DAR-cross linked nano chitosan*) adsorbent .Therefore , The combination of conventional and non-conventional adsorbent in the reactor would overcome to all the disadvantages of conventional biofilter wastewater treatment system .The drive for this technology will be a result of the decreasing availability of water, with the increase in demand for water and decent sanitation.

Keywords— Decentralized wastewater system, adsorbent, greywater treatment, Biofilter system

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Identifying Critical Issues in Construction Industry Using Pareto Analysis

Saurabh Chhajed, Harsh Jain, Manish Kabra, Namdeo Hedaoo

Abstract— Abstract--- The small construction companies are experiencing several challenges, for example, improper resource management, lower productivity due to unorganized activities, and weak labor productivity. These challenges result in higher cost, wastage of resources, inferior quality, among others. However, with the implementation of Total Quality Management (TQM) principles, one can mitigate these effects to achieve higher productivity. The paper focuses on 'Factual Approach to Decision Making,' which is one of the eight principles of TQM. Five major factors affecting the construction industry were identified through a literature survey. These are Resource Wastage, Material Wastage, Casting Problems, Inadequate Safety Practices, Financial Hindrances. With this in focus, a survey was conducted in a construction company to identify the most critical problem amongst these. Analysis of the survey results was performed using Pareto Analysis, which is a statistical technique for decision making. This resulted in the principle finding that two problems, Material Wastage, and Financial hindrances are the major obstacles in the progress of the surveyed company. The research effort identified these causes to be a result of lack of coordination among the members, inadequate labor training, and lack of commitment toward TQM.

Keywords— Fish Bone Diagram, Efficeiency, Pareto Analysis, TQM- Total Quality Management.

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Formal and the New Normal: An Investigation in Approach towards Housing in Emergent Global Cities

Saurabh Barde, Asif Ahmed Syed

Abstract— The new paradigm is due to be tested in these times where an unprecedented growth is estimated across various urban centres in India. In times of rapid industrialization, the quest for a proletarian house in a city providing work opportunities is no longer a delusion. With the migrant population always headed towards earning opportunities, housing becomes a by-product more than a need. Exponential growth in population within the cities has put enormous stress on infrastructure and resources, resulting in leading to developing informal settlements which are devoid of basic facilities and sanitation. Urban agglomerations in India stem from very different roots when compared to American or European cases. They have layers of past so well intertwined that it is interesting to decipher them before contemplating future growth patterns. With more than 150 cities in India having population of more than 100 thousand, substantial proportions of the population dwells in these informal setup set in high population densities. In India a conscientious effort to address these issues have be contemplated in various formats. Whether the experiment of House and Housing by self-build opportunities was allowed by Architect Planner Prof. B. V. Doshi in his experimental Aranya layout in Indore or the exercise of Restructuring of Housing services by Himanshu Parikh, an engineer, in Slum Networking project visualized in the same city sets examples of an exemplary catalogue to imply an advisory to design or propose a redevelopment of such formal-informal settlements especially in an urban context. The research initiates itself setting up a methodology in which the case evaluation process of these precedents is argued on an empirical source in which estimation of informality and its implied character is quantified. The research further evaluates conditions in such prototype cases in India where settlements and its lay is analysed through previously conducted surveys. The findings establish a procedure to diagnose cases of where an implied corrective redevelopment or selective restructuring of services can be experimented. In its findings, the informal housing examples derive an inclination of community living and a high degree of sustenance in the form of exploitation of minimum resource usage. The research raises questions whether the informal can be understood as the new normal. The research evaluates conditions on plans and layout, which can blur the lines between formal and informal definitions. Investigations indicate a module which could be implemented in such densely populated conditions wherein the core value of life and lifestyle can still be maintained during the restored morphosis. These modules of settlements be regarded as continuously evolving biological phenomena where public participation be seen as a way forward in developing urban forms democratically integrated with the practice of architecture/engineering and public service in a reconfigured system.

Keywords— densely populated, housing, prototype, urbanization.

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Termite Brick Temperature and Relative Humidity by Continuous Monitoring Technique

Abdullah AlShuhail Khalid, Junidi Syrif, Abu-Abdoum Ideisan, Aldawoud Abdulsalam

Abstract—For the intention of reducing energy consumption, a construction brick was made of simulated Termite mound soil which will is known as termite Brick (TB). To calculate the thermal performance, a real case model was constructed by using this biomimetic brick for testing purposes. This paper aims at investigating the thermal performance of this brick during different climatic months. Its thermal behavior was thoroughly studied over the course of four months by using Continuous Method (CM_m). The main parameters were the temperature and relative humidity. It was found that the TB does not perform similarly in all four months, and/or in all orientations. Each four-month model study was deeply analyzed. By using the CM_m method, model was also examined. The measuring period shows generally that internal temperature and internal humidity are higher in Roof within 2 degrees and lowest at north wall orientation. The relative humidity was also investigated systematically. The paper reveals more interesting findings.

Keywords—Temperature, relative humidity, continuous monitoring, termite model, orientation, wall.

I. INTRODUCTION

BIOMIMICRY is a study of nature and its process which then draws lessons learned and applies them in various methodical disciplines [1]. In construction industry many architects and engineers applied the principles of biomimicry and succeeded to achieve better performance especially in building envelope [2]. There is always a need to find innovative construction materials to reduce the natural consumption and lower the impact on the environment [3]. This paper aimed at studying the Termite mound and get inspiration from its saliva. A clay modifier was created to mimic the saliva function which has impressive adhesive property [4]. The biometric brick (Table I) was used to construct a real model (Fig. 2) in Sharjah, United Arab Emirates (UAE) which is characterized by hot and humid climate which requires the construction material to be highly resistant to temperature and humidity [5].

TB Specifications

The procedure of making this brick was thoroughly explained in ref. [7] Furthermore, the optimization process was also presented. The optimum brick was made by mixing 6% cement with 1% Date Palme Fiber and with the addition of clay modifier ratio 0.31% to get the value of the TB-strength 2.26 N/mm², TB-density 1.354 kg/m³ and TB-optimal water absorption 15.7%. The new material used to create this brick was the clay modifier that was inspired by Termite saliva. According to Portland Cement Association [6], the efficiency of the clay modifier, or occasionally called "admixture" relies on many factors; for instance, type and quantity of cement, water percentage. Thus, careful consideration was taken preparing this brick until reached the perfect performance and now it is ready to test it in real life. Table I displays the TB specifications.

	TABLE I	
Doromotor	Value	Imaga
Parameter	value	Image
Dimensions	250x125x65 mm	
Compressive Strength	2.26 N/mm ²	
Hollow Diameter/	45 mm/75 mm	
distance		
Thermal Transmittance	$0.48 \text{ W/m}^2/\text{K}$	
Blocks Source	Designed and created inside the	
	lab	
Dry Density	1.354 kg/m ³	
More specifications	Stabilized termite soil with	-
	Saliva and natural fibber (DPF)	

II. DESIGNING THE CAST STUDY MODEL

In this research, the "zones" of four experimental case study models were planned. The plan was conceived by AutoCAD with the author's architectural skills as shown in (Fig.1). The model has external dimensions of 4.15 m length x 2.50 m width x 3.35 m height in addition to the internal dimensions $(3.75 \times 2.10 \times 2.60 \text{ m})$. Inside the model there is a covered opening of 0.60 m x 0.60 m on the celling for the air to escape. This model has a door 0.80 m x 1.20 m with two windows 0.30 m x 0.60 m on the south wall elevation.

Overflowing of Parameter Measurement

1. Temperature and Relative Humidity Top Roof.

Four temperature and humidity measurement instruments were installed to research the overall assessment of the roof of the model. On the top of the roof, the first device is outside and the other three were placed inside, one in the center of the model from the inside and one device on the far right on the east side and the other on the left side of the west side. As shown in (Fig.2), the combined results of the four location points.

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Fig. 1 Model Design stages

The continous method CM_m reading at four different points. The study demonstrated the significance of reading each poit and its distinction from another point. Note that both the far right and the far left are not equal to the internal temperature and internal humidity and slightly higher in the center point of roof. The east point of the roof reaches higher than the west point.



2..Temperature and Relative Humidity of East and West Walls

Four external and internal measuring devices were positioned in the center of the two directions to measure and compare the east wall and the west wall of the model. As shown in Fig.3, the CM_m reading includes four months of internal and external in East and West Wall Termite model to show any orientation in the model that is important and having the differences in readings. The measuring period shows that generally the internal temperature and internal humidity results are close to each other. The internal temperature slightly higher in east wall higher than the west wall.



Fig.3: TB East and West Wall Comparison

3. Temperature and Relative Humidity North and South Wall

Four external and internal measuring instruments have been positioned in the center of both directions to measure and compare the model's north wall and south wall. As shown in Fig 4, the CM_m reading including four months for both North

Wall and South Wall model. Reading to illustrate some significant orientation in the model and the variations in the readings. The measuring period shows that generally the internal temperature and internal humidity are not equal to north and south wall. The internal temperature of the south wall is significantly higher than the north wall.



Fig. 4 TB North and South Wall Comparison

III. ANALYSIS

Comprehensive Model

The model analysis is considered to test the whole model instead of five different walls through the measurement point in the middle of the model internally and the measured in the periphery. As shown in Fig. 5, for continuous measurement methods, measurements were carried out for three consecutive months in September, October, and November (autumn season). In line with the change in weather, temperature decreases about 10% indoor and outdoor, Additional steady humidity (mid-day) from September until November.





Fig. 5 TB Comprehensive Model evaluation

Five Wall Orientation Performance.

In the top roof, east wall, west wall, north wall and south wall TB model, the internal reading by continuous monitoring system CMm was carried out within 3 months. Assessment and examination of five walls to illustrate some major orientation in the model and the variations in readings, as shown in Fig. 6a. The measuring period shows that generally the internal temperature and internal humidity are equal in east wall, west wall, and south wall. The measuring period shows that generally the internal temperature and internal humidity are higher in roof with 2 °C and lowest at north wall orientation.



Fig. 6(a) TB-Five Wall Evaluation

TB Model Numerical Analysis

As illustration, from the data of September month CM_m measurements of 10 locations, the results are analyzed in two different ways: first by boxplot of whole month in each location and second by boxplot of 24 hours daily in all 30days. Both ways go along for external and internal temperature and relative humidity as shown in Fig. 6b.

TB *East wall* Model *External* temperature in September ranged from 25.6 °C to 52.6 °C with interquartile range (IQR) 29.9 °C to 40.9 °C and median/average values 32.8/35.1 °C. *East wall* B4- Model *Internal* temperature ranged from 28.8 °C to 39.3 °C with IQR 33.1 °C to 36.6 °C and median/ average values 34.4/34.7 °C.

TB West wall Model External temperature in September ranged from 25.7 °C to 52.4 °C with IQR 30.2 °C to 39.7 °C and median/average values 32.9/35.2 °C. West wall B4- Model Internal temperature ranged from 28.4 °C to 40.7 °C with IQR 33.0 °C to 36.1 °C and median/average values 34.4/34.6 °C. RH% ranged from 10% to 71% with IQR 33% to 59% and median/average value 45/45%.

North wall TB-*external* RH% ranged from 10% to 90% with IQR 30% to 66% and median/average value 45/47%. North wall TB-*internal* RH% ranged from 10% to 78% with IQR 33% to 60% and median/average value 45/47%.

Top Roof TB*-external* RH% ranged from 10% to 94% with IQR 25% to 72% and median/average value 47/49%. Top Roof-1*-internal* RH% ranged from 10% to 71% with IQR 30% to 58% and median/average value 45/45%.

Based on above first analysis method IQR of all location in different walls internally of temperature range from 32.0 °C to 37.0°C and relative humidity 30% to 60% closed to the as whole Model. We can conclude that it is almost the 5 walls location that can represents by the single internal or external value of the model.

TB South wall Model External temperature in September ranged from 25.8 °C to 55.3 °C with IQR 30.3 °C to 43.7 °C and median/average values 33.2/36.4 °C. South wall B4-Model Internal temperature ranged from 28.3 °C to 40.7 °C with IQR 33.1 °C to 36.4 °C and median/average values 34.7/34.9 °C.

TB North wall Model External temperature in September ranged from 25.7 °C to 45.6 °C with IQR 29.9 °C to 37.9 °C and median/average values 32.7/33.8 °C. North wall B4-Model Internal temperature ranged from 27.8 °C to 39.5 °C with IQR 32.7 °C to 36.0 °C and median/average values 34.2/34.3 °C.

TB *Top Roof* Model *External* temperature in September ranged from 22.8 °C to 53.0 °C with IQR 28.2 °C to 41.1 °C and median/average values 31.1/34.5 °C.

Top roof internal temperature ranged from 30.1 °C to 40.4 °C with IQR 34.1 °C to 36.8 °C and median/average values 35.3/35.5 °C.





Fig. 6(b) Five wall Orientation Temperature

As shown in Fig. 6c, the second measuring parameters relative humidity of *East wall* TB-*external* RH% in September ranged from 10% to 92% with IQR 26% to 67% and median/average value 43/46%. *East wall* B4-*internal* RH% ranged from 10% to 76% with IQR 31% to 60% and median/average value 44/46%. *West wall* TB-external RH% ranged from 10% to 89% with IQR 24% to 67% and median/average value 42/46%. West wall TB-internal RH% ranged from 11% to 76% with IQR 33% to 60% and median/average value 45/48%. South wall TB-external RH% ranged from 10% to 92% with IQR 23% to 65% and median/average value 42/45%.

According to the second method in the analysis we observe that for each wall, the maximum outdoor time is different depending on the movement of the sun until sunset. Maximum heat is in the western, southern direction. Especially after 12:00. The temperature rise is offset by a decrease in relative humidity and vice versa. Measuring unit location model external representation almost covers all units' location of the exterior walls. The internal model measurement unit location represents almost an average of all units' location of the interior walls.

External temperature of wall notes from September review:

The highest temperature-Out is 1-Southern wall (50.1 °C) than 2-Top Roof (48.7 °C) and 3-Eastern wall (48.1 °C) after 4-Western wall (47.6 °C) the lowest-Out temperature 5-Northern wall (41.8 °C). The wall that gets as hot first-Out 1-Southern wall at 10:32 AM after that 2-Eastern wall at 10:35 AM (about 3 minutes difference only) then Top roof at 10:52 AM (about 20 minutes difference) then after that Northern wall at 11:26 AM (about 54 minutes difference) and lastly Western wall at 2:44 PM (about 4h and 12 minutes difference) from time of southern wall maximum time.






From the september inner temperature study of the wall notes:

The highest temperature-IN is 1-Top Roof (39.3 °C) then 2-Southern wall (38.5 °C) then 3-Eastern wall (38.4 °C) after that 4-Western wall (38.1 °C) and the lowest-IN temperature 5-Northern wall (37.7 °C). The wall that gets as hot first-IN Southern wall at 12:15 PM then North wall at 12:22 PM (about 7 minutes difference) than East and West wall at 12:38 PM (about 13 minutes difference) and lastly Top Roof at 1:55 PM (about 100 minutes difference) from southern wall maximum time.

IV. CONCLUSION AND OBSERVATION

- 1. TB model internal temperature and humidity, both the farright and far-left points, are not identical and slightly higher in the middle point of the roof. The point to the east of the roof is higher than the point to the west.
- The measurement duration indicates that the east wall and west wall TB models are closer in internal temperature and internal humidity. The internal temperature of the eastern wall is significantly higher than that of the western

wall.

- 3. The measurement period, on overall TB model, shows that the internal temperature and humidity do not match the north and south walls. The internal temperature of the south wall is significantly higher than that of the north wall.
- 4. Comprehensive TB model assessment is in line with the transition in weather, temperature decreases steadily from September to November by around 10% indoor and outdoor additional humidity (mid-day).
- 5. In general, the measurement duration indicates that the internal temperature and humidity are higher in the roof within 2 degrees and lower in the orientation of the north wall.
- 6. The maximum outdoor time for each wall is different depending on the movement of the sun before sunset. The maximum heat, especially after 12:00, is in the western, southern orientation. The increase in temperature is compensated by a decline in relative humidity and vice versa. The external representation points of the measurement unit location model almost cover the

location of the external walls of all units. The location of the internal model measuring unit reflects almost the average location of the interior walls of all unit

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MHAGCN - Multi-Head Attention Graph Convolutional Network for Web Services Classification

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Abstract-Web classification can promote the quality of service discovery and management in the service repository. It is widely used to locate developers desired services. Although traditional classification methods based on supervised learning models can achieve classification tasks, developers need to manually mark web services and the quality of these tags may not be enough to establish an accurate classifier for service classification. With the doubling of the number of web services, the manual tagging method has become unrealistic. In recent years, the attention mechanism has made remarkable progress in the field of deep learning and its huge potential has been fully demonstrated in various fields. This paper designs a multi-head attention graph convolutional network (MHAGCN) service classification method, which can assign different weights to the neighborhood nodes without complicated matrix operations or relying on understanding the entire graph structure. The framework combines the advantages of attention mechanism and graph convolutional neural network. It can classify web services through automatic feature extraction. The comprehensive experimental results on a real dataset not only show the superior performance of the proposed model over the existing models but also demonstrate its potentially good interpretability for graph analysis.

Keywords-attention mechanism, graph convolutional network, interpretability, service classification, service discovery.

I. INTRODUCTION

WITH the introduction of the concept of web 3.0, web technology is developing rapidly and the demand for service-oriented applications is increasing. More and more software vendors publish their applications as web services on the Internet. As of now, ProgrammableWeb, the world's largest online web service repository, has recorded more than 30,000 open web APIs. These web services greatly accelerate the machine-to-machine interaction, which greatly promotes the development of service-oriented applications, while greatly increasing the burden on people to effectively use and manage the service repository. For inexperienced developers, choosing the right and interesting service from a large scale of services is very time-consuming. Web service classification has been proven to be an effective technique to alleviate this challenge, and it can promote service discovery[1, 2] and service recommendation[3]. Therefore, service classification is getting more and more attention.

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Web services are mostly described in natural language, and these text descriptions are classified by manual annotation or automatic tagging. At present, text classification methods are mainly divided into three categories:

- Rule-based methods.
- Traditional machine learning-based methods.
- Deep learning-based methods.

Rule-based methods require the user to directly determine the classification rules for each category to generate a category template. The rule classifier counts the rule entries and the number of occurrences of the rules in the test sample according to the category template and uses the position information of the rules in the test text structure to measure the category to which the test sample belongs. When the rules are changed or updated, users need to re-summary the rules and the maintenance cost is high. When there are many rules, there may be conflicts between the rules and other rules, which is difficult to maintain.

The traditional machine learning classification method splits the entire text classification problem into two parts: feature engineering and classifier. Feature engineering is divided into three parts: text preprocessing, feature extraction, and text representation. The ultimate target is to convert the text into a computer-understandable format and encapsulate enough information for classification, which has a strong ability to express features. After expressing the text as vector data that can be processed by the model, the classifier can be used to process the data. Common classifier models include Naive Bayes, KNN, Decision Tree, Support Vector Machine, GB-DT/XGBOOST, etc. The main problem of traditional machine learning is that the text representation is a high latitude and high sparse, the feature expression ability is very weak, and the neural network is not good at processing such data. In addition, it requires manual feature engineering, which is very costly.

In recent years, deep learning has been widely used in various tasks of computer vision and NLP and has shined in these areas[4–7]. Deep learning models such as CNN/RNN can automatically obtain the feature expression capabilities of the text, remove the complicated artificial feature engineering, and achieve end-to-end problem-solving. Deep learning not only can discover hidden patterns in data, but it can also be transferred from one application to another. Deep learning models have become the mainstream framework for various text classification tasks.

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In recent years, people have become more and more interested in the expansion of deep learning methods on graphs. Driven by the multiple factors, the researchers have drawn on the ideas of convolutional networks, recurrent networks, and deep autoencoders to define and design a neural network structure for processing graph data, thus a new research hotspot-"Graph Convolutional Networks (GCN)" came into being. As a powerful deep learning method for graph data, GCN has shown excellent performance in network analysis, which has aroused great research interest. One of the latest research trends in deep learning is the attention mechanism, which handles variable-size data and encourages models to focus on the most significant parts of the data. Its effectiveness in the framework of deep neural networks has been proven and is widely used in text analysis[8], knowledge graph[9] and image processing[10], and other fields. Graph Attention Network (GAT)[11], a new type of convolutional graph neural network, can only handle isomorphic graphs of one type of node or connection, and only pay attention to the attention between adjacent nodes. The features extracted between nodes are limited.

In this paper, we design a multi-head attention graph convolutional network (MHAGCN) service classification method. Compared with GAT, it allows the model to learn more relevant information between more nodes and have better robustness. Specifically, it first builds a heterogeneous graph based on document nodes and word nodes in the corpus. Then, using the multi-head attention mechanism learn the importance of nodes and neighborhood nodes, assign different weights to all neighborhood nodes, and update node information at the same time. Finally, use the learned graph to classify web services. Compared with other classification models on the real dataset, the results of the state of the art were obtained, which verified the effectiveness of the proposed method.

The contributions of our work are summarized as follows:

- The multi-head attention mechanism added to the graph convolution network can fully consider the importance of the neighborhood nodes of the heterogeneous graph, distinguish between the nodes that should be deleted and the nodes that should be retained, and improve the feature extraction between the nodes.
- The analysis of the multi-head attention mechanism shows that it is potentially good interpretable for the analysis of heterogeneous graphs.
- On the experimental dataset, compared with other classification algorithms, the results of the state of the art are obtained.

The rest of this article is organized as follows: The second part introduces some related knowledge of graph network. The third part introduces detailed information about MHAGCN. The fourth part evaluates MHAGCN through experiments. The fifth part summarizes the paper and discusses future work.

II. PRELIMINARY KNOWLEDGE

Because GCN has advanced performance in text classification tasks, it has attracted much attention. The research on GCN focuses on extending the convolution operation to heterogeneous graphs so that it can handle graph networks containing different types of nodes and edges.

A. Heterogeneous Graph

Heterogeneous graph is a special information network, which contains many types of objects or connections. A heterogeneous graph can be expressed as $G = (V, E, O_V, R_E)$, V and E are a collection of various types of nodes and edges, O_V is a collection of types of nodes, R_E is a collection of edges. In addition, each node also contains heterogeneous content (such as attributes, text, or images). In a heterogeneous graph, two vertex objects may be connected through different paths. For example, the link between two authors may go through the path of "author-newspaper-author", or the path of "author-newspaper-publishing occasionnewspaper-author". Different meta-path represents different semantics. The meta-path is a path defined on the network model $T_G = (A, R)$ of the graph. It's representation structure is $A_1 \xrightarrow{R_1} A_2 \xrightarrow{R_2} \cdots \xrightarrow{R_l} A_{l+1}$ (abbreviated as $A_1 A_2 \cdots A_{l+1}$), which describes a composite relation $R = R_1 \circ R_2 \circ \cdots \circ R_{l+1}$ between objects A_1 and A_{l+1} , where \circ denotes the compound operation of the relationship. Given a meta-path, each node has a set of neighbors based on meta path, which can display different structural information and rich semantics in a heterogeneous graph. Therefore, how to effectively capture information between neighboring nodes is particularly important.

B. Graph convolutional network (GCN)

GCN extends convolution operations from traditional data (such as images) to graph data. The core idea is to learn a mapping function f(.), through which node v_i in the map graph can aggregate its own feature x_i and its neighbor feature $x_i (j \in N(v_i))$ to generate a new representation of node v_i . There are currently two types of graph convolution operations, one is spatial domain graph convolution[12] and the other is spectral domain graph convolution[13]. The spectral domain method introduces a filter from the perspective of graph signal processing to define graph convolution, where the graph convolution operation is interpreted as removing noise from the graph signal. The spatial domain method represents graph convolution as aggregate feature information from neighborhoods. When the algorithm of graph convolutional networks runs at the node level, the graph pooling module can interleave graph convolution layers and read the graph as a high-level substructure. As shown in Figure 1, this architectural design can be used to extract all levels of graph representation and perform graph classification tasks.



Fig. 1. Graph Convolution Networks with Pooling Modules for Graph Classification.

C. Attention mechanism

In the past two years, attention mechanisms have been widely used in various types of deep learning tasks, such as natural language processing[8], image recognition[14, 15], and speech recognition[4]. It can handle the problem of input of any size, and the attention mechanism allows the model to focus more on important features and pay less attention to unimportant features. It has become one of the core technologies in deep learning technology that deserves attention and in-depth understanding. Graph attention network[11] uses attention mechanism to learn the importance between nodes and their neighbors, and merge neighbors to classify nodes. However, it utilizes the attention mechanism of homogeneous graphs that contain only one type of node or link.

III. THE METHODOLOGY

In this section, we will introduce the proposed method in detail, and directly outline its theoretical and practical benefits and limitations compared to prior work in the domain of neural graph processing. The overall framework of the proposed method is shown in Figure 2. It will be introduced in the following subsections.



Fig. 2. The overall framework of the proposed MHAGCN. (a) The input of MHAGCN is a sentence describing the web service; (b) The input sentence is used to construct a graph. Nodes starting with "D" are document nodes, and nodes starting with "W" are word nodes. Unused colors in document nodes represent different document categories. (c) Convolve the established graph, add a multi-head attention mechanism in the process of convolution, assign different weights to different nodes, and use an activation function to map after each convolution; (d) Use the learned features for classification.

A. MHAGCN Architecture

The input layer of MHAGCN is a set of node elements composed of document nodes and word nodes in the corpus, $h = \{h_1, h_2, \dots, h_N\}, h_i \in \mathbb{R}^F$, where N is the number of nodes, and F is the number of features in each node. The layer produces a new set of node features (of potentially different cardinality F'), $h' = \{h_1', h_2', \dots, h_N'\}, h_i' \in \mathbb{R}^{F'}$ at its output.

In order to obtain sufficient expressive power to convert the input features into high-level features, the node elements are input into the multi-head attention convolution layer we designed. The schematic diagram of the structure is shown in Figure 3 below.

We randomly sample several nodes in the graph. The number of nodes is the batch_size in traditional tasks, and each node has different importance. Therefore, we introduced an attention mechanism to learn the importance of each node in the sampling node and aggregate the representation of these meaningful nodes to form node embedding.



Fig. 3. A visual illustration of the MHAGCN sample and aggregate approach.

Since the nature of each node is different, different types of nodes have unsuitable feature spaces. Therefore, for each sampling, we have designed a specific shared weight matrix $W \in \mathbb{R}^{F*F'}$, which is the relationship between the input Ffeatures and the output F' features. A shared parameter Wlinear mapping augments the features of the vertices, of course, this is a common feature augmentation method. The feature augmentation process is as follows:

$$h_i' = W \cdot h_i \tag{1}$$

Where h_i and h_i' are the original feature of node *i* and the feature after augments. After that, we use the multi-head attention mechanism to learn the weights between sampling nodes. This mechanism can perform *K* linear transformations on the same node. Each linear transformation is considered to be a header calculation, and parameter *W* between the header calculations is different. Each calculation process is as follows:

$$head_{ijk} = Attention(W_k h_i, W_k h_j) \tag{2}$$

Equation 2 represents the importance of node j to node iin the kth linear transformation. The results of K calculations are spliced, and a linear transformation is performed to obtain the value of multi-head attention. The calculation process is as follows:

$$MultiHead_{ij} = \prod_{k=1}^{K} (head_{ij1}, head_{ij2}, \dots, head_{ijK}) \quad (3)$$

Where \parallel is a splicing operation. At the same time, the formula also shows that the attention of the importance of the node pair (i, j) depends on their own characteristics. Please note that $MultiHead_{ij}$ is asymmetric, the importance of node i to node j and the importance of node j to node i can be quite a difference.

After obtaining the importance between the node pairs, we normalize them through the *softmax* function to obtain the weight coefficient α_{ij}^{ϕ} :

$$\alpha_{ij}^{\varphi} = softmax(MultiHead_{ij})$$
$$= \frac{\exp(\sigma(a_{\phi}^{T} \cdot [MultiHead_{ij}]))}{\sum_{k \in N^{\phi}} \exp(\sigma(a_{\phi}^{T} \cdot [MultiHead_{ik}]))}$$
(4)

Where σ represents the activation function, a_{ϕ} is a singlelayer feedforward neural network, parametrized by the weight vector: $a_{\phi} \in \mathbb{R}^{2F'}$, node j is $j \in N_i^{\phi}$, N_i^{ϕ} is the neighborhood node of node (the neighborhood here is not necessarily a firstorder neighborhood, it may also be a second-order neighborhood). It can be seen from equation (4) that the weight coefficients of (i, j) depending on their characteristics. Also note that the weight coefficient α_{ij}^{ϕ} is asymmetric, which means that they contribute differently to each other. The multihead attention model is shown in Figure 4, where different colors represent different heads.



Fig. 4. Left: Single-head attention mechanism. Right: Schematic diagram of multi-head attention (K = 3 heads) near node X_1 . Different arrow styles and colors indicate independent attention calculations.

Aggregate the neighborhood node information through the aggregate function to get the embedded representation of node i, as shown below:

$$h_i^K = \sigma(W^{K-1} \cdot aggregate(h_i^{K-1}, \{h_u^{K-1}, \forall u \in N(v)\}))$$
(5)

Among them, h_i^K means that after the characteristics of the neighborhood node and its own characteristics are aggregated, the new characteristics formed are passed to the downstream task for use, h_i^{K-1} represents the characteristics of node *i* itself, h_u^{K-1} represents the characteristics of aggregation neighborhood nodes, *aggregate* is a function that can handle variable-length data.

When sampling in the graph, we use the fixed-length sampling method and use the resampling method with replacement to adopt a fixed batch size neighborhood node. The advantage of this is that the attention value can be calculated in parallel between the nodes.

In our experiments, we used the method of average aggregation. The method of average aggregation is to take the average value of the eigenvalues of the neighboring nodes as follows:

$$h_i^K = \sigma(W^{K-1} \cdot AVERAGE(\{h_i^{K-1}\} \cup \{h_u^{K-1}, \forall u \in N(v)\}))$$
(6)

The entire algorithm design of MHAGCN is as follows.

B. Analysis of the Proposed Model

The graph attention layer described in the previous section directly addresses several issues that were present in prior approaches to modeling graph-structured data with neural networks: Algorithm 1 The overall process of MHAGCN

```
Require: The heterogeneous graph G = (V, E)

The node feature \{h_i, \forall i \in V\}

The number of attention head K

The share weight matrices W^K, \forall k \in \{1, 2, ..., K\}

The differentiable aggregator functions

AGGREGATE_K, \forall k \in \{1, 2, ..., K\}

The neighborhood nodes \{\phi_1, \phi_2, ..., \phi_p\}

The residual structural block

Ensure: The final embedding: Z

for \phi_i \in \{\phi_1, \phi_2, ..., \phi_p, \} do

for k = 1, 2, ..., k, do

Type-specific transformation h_i' \leftarrow W \cdot h_i

Calculate the attention of the kth node

head_{ijk} \leftarrow Attention(W_k \cdot h_i, W_k \cdot h_j, )

end for
```

Concatenate the learned embeddings from all attention

 $MultiHead_{ij} \leftarrow \prod_{k=1}^{K} (head_{ij1}, head_{ij2}, \dots, head_{ijK})$ Regularized attention value

 $\alpha_{ij}^{\phi} \leftarrow softmax(MultiHead_{ij})$ end for

Aggregate multiple attention values

$$Z \leftarrow \sigma(W^{K-1} \cdot AVERAGE(\{h_i^{K-1}\} \cup \{h_u^{K-1}, \forall u \in N(v)\}))$$
return Z

- The proposed model can handle various types of nodes and relationships and integrate rich semantics in heterogeneous graphs. Information can be transferred from one node to another through multiple relationships. Thanks to this heterogeneous graph attention network, different types of node embedding can enhance mutual integration, mutual promotion, and mutual upgrade.
- 2) The algorithm is efficient and easy to parallelize. The calculation of attention can be calculated separately across all nodes and paths. In the case of a given neighborhood, the time complexity of attention between nodes is $O(V_{\phi}FF'K+E_{\phi}F'K)$, where K is the number of attention headers, V_{ϕ} is the number of nodes, E_{ϕ} is the number of connections between neighborhood nodes, and F is the number of input features, F' is the number of output features. The total complexity is linear for the number of connections between nodes and neighborhood nodes.
- 3) After introducing the multi-head attention mechanism, the attention of the entire heterogeneous graph is shared. Shared attention means that the number of parameters does not depend on the scale of the heterogeneous graph, is only related to the neighbor nodes, and does not need to obtain the entire graph information. It makes our technique directly applicable to inductive learningincluding tasks where the model is evaluated on graphs that are completely unseen during training.
- 4) This model has a good explanatory ability for the embedding of learning nodes, which has great advantages for heterogeneous graph analysis. By learning the importance between nodes in the field, the model can better focus on some meaningful nodes in a specific task

and describe the heterogeneous graph more comprehensively. Based on the attention value, we can check which nodes have made a higher (or lower) contribution to our task, which helps to analyze and interpret our results.

IV. EXPERIMENTS

A. Service Dataset

1) Service Collection: We grab real web services from ProgrammableWeb, the world's largest online web service repository, and save them in the WSDataset dataset. The original dataset contains 15344 statements describing the actual web service, and each statement contains 20 attributes about the Web service, such as Title, Description, APIEndpoint, PrimaryCategory, APIForumMessageBoards, etc.

2) Service Category Analysis: We remove the interference items in the web service attributes and only keep the Description and PrimaryCategory attributes. After counting and sorting the dataset according to PrimaryCategory, the dataset contains a total of 401 categories, of which only 41 categories contain more than 100 services. The 217 categories (more than half of the categories) contain fewer than 10 services. By eliminating the one-shot, small size categories and keep big size categories to make the dataset more balance, the service dataset contains 10957 services with 50 categories.

3) Service Description Analysis: In the dataset after preliminary processing, the length of the attribute Description meets the normal distribution with the expected μ of 67.3211 and the standard deviation σ of 25.9841. By deleting too long descriptions and too short descriptions, the confidence level of Web service descriptions is kept at 90%. After a series of processing, the final data set of the Web service contains a total of 10184 description sentences and 50 categories.

4) Training and Testing Data Selection: In the final web service data set, the number of description statements of web services included in different categories is different (for example the number of description statements of category Tools is 580 and the number of description statements of category Application Development is 89) and the data has an imbalance problem. Randomly selecting a certain percentage of the training set and test set from the data set will cause the dataset to fail to meet the same distribution on small-size categories. Therefore, we adopted a new classification method, randomly selecting the training set and the test set in the same proportion on each category.

5) *Final Service Dataset:* After randomly selecting web services according to category, the final dataset contains a total of 10184 description sentences, of which the training set contains 8121 description sentences, the test set contains 2063 description sentences, the entire dataset has a total of 6750 vocabularies, and the number of nodes formed is 16934, contains 50 web categories. We use the classified dataset to train and test the proposed model and other classification algorithms. The categories and quantities of the final dataset are shown in Figure 5 below.

B. Evaluation of Models

In order to ensure the fairness of the experiment, all classification models adopt the same early stopping criterion



Fig. 5. The distribution of the top 50 categories.

and hyper-parameter selection strategy.

C. Training Procedures

In our experiments, 10 percent of the training data was used for validation in the training session. We used the Adam optimizer, early stopping criterion, and hyperparameter selection strategy. If the verification loss is not reduced for 10 consecutive cycles, we stop training. The optimal hyperparameters are obtained by grid search. The ranges of grid search are summarized in Table I.

TABLE I The grid search space for the hyperparametey

Hyperparameter	Range
Learning rate	0.1,0.2,0.3,0.5,0.01,0.02,0.03,0.05
Hidden size	16,32,64,128,516
Weigh decay(L2 regularization)	0.1,0.01,0.001,0.0001
Convolution Layers	1,10,20,30,50

D. Baselines

We compare with multiple state-of-the-art text classification and embedding methods, to verify the effectiveness of the proposed MHAGCN.

- CNN[16]: Convolutional Neural Network. We explored CNN-rand which uses randomly initialized word embeddings and CNN-non-static which uses pre-trained word embeddings.
- AdaBoost[17]: AdaBoost is an iterative algorithm, also known as reinforcement learning or lifting method, which trains different classifiers (weak classifiers) for our training set, and then aggregates these weak classifiers to form a stronger final classifier Strong classifier).
- *LDA-Linear-SVM*[18]: A linear support vector machine (linear SVM) is used as a model for document classification, and a hyperplane is used to distinguish different samples in the sample space of the training set.
- *LDA-RBF-SVM*: Use Radial Basis Function (RBF) as the support vector machine (SVM) kernel function for document classification model. Transform our data into a linearly separable high-dimensional space and use the k-means algorithm to classify documents.

- *Naive-Bayes*[19]: Naive Bayes is a probabilistic algorithm that uses probability theory and Bayes' theorem to predict sample categories. They are probabilistic. By calculating the probability of each category of a given sample, then output the sample category with the highest probability.
- *LSTM*[20]: The LSTM model defined uses the last hidden state as the representation of the whole text. We experimented with the model with pre-trained word embeddings.
- *RF*[21]: We use Random Forest (RF) to sample multiple data sets to generate multiple different data sets and train a classification tree on each data set. Finally, the prediction results of each classification tree are combined as the prediction results of the random forest.
- *Recurrent-CNN*[22]: Improve the process of CNN feature extraction with a circular idea. Save information directly in the word representation by means of context and use the word window to extract the features of the text.
- **BI-LSTM**: It is a bi-directional LSTM, commonly used in text classification. We input pre-trained word embeddings to Bi-LSTM.
- *ServeNet*[23]: A stacked deep neural network to automatically abstract low-level representation of service description to high-level features without feature engineering and then predict service.
- *GCN*[24]: Graph Convolutional Networks (GCNs) is a powerful deep learning method for graph-structured data. Graph Convolutional Neural Networks evolved from CN-N, which is a linear transformation of each node's neighbors through a set of shared weight parameters, and then added a nonlinear activation function to obtain a feature representation of the graph node. And subsequent studies have shown that GCNs are valuable in the direction of social network analysis, recommendation systems, and so on.

E. Implementation Details

For the proposed MHAGCN, we randomly initialize the parameters and use the optimization model of Adam [27]. We set the learning rate to 0.005, the regularization parameter to 0.001, the attention head number K to 8, the random sampling node number to 256, and select ReLU as the activation function. And we used early stop with the patience of 10, that is, if the verification loss for 10 consecutive cycles is not reduced, we will stop training. In order to make the experiment repeatable, we have publicly provided the dataset and code on website 4. For all models of Web classification, we use the exact same training set, verification set, and test set to ensure fairness.

F. Summary of Results

We compared 11 classification models on the service dataset, including Naive Bayes, Random Forest (RF), SVM (LDA-Linear-SVM, and LDA-RBF-SVM), AdaBoost, CNN, Recursive CNN, LSTM, BI-LSTM, GCN, and ServeNet. In our experiments, we used Top-1 Accuracy and Top-5 Accuracy to evaluate the classification model. Top-1 Accuracy refers to the accuracy rate of the top-ranked category that matches the actual results, while Top-5 Accuracy refers to the accuracy rate of the top five categories that contain the actual results. All classification models are trained and tested on Dell servers with NVIDIA RTX 2080Ti. The experimental results are summarized in Table II.

 TABLE II

 QUANTITATIVE RESULTS ON THE WEB SERVICE CLASSIFICATION TASK

Model	Top-5 A	ccuracy	Top-1 Accuracy		
Widden	Training Set	Testing Set	Training Set	Testing Set	
CNN	96.50	58.46	81.62	27.60	
AdaBoost	98.67	64.92	66.96	34.93	
LDA-Linear-SVM	79.49	71.91	36.39	33.28	
LDA-RBF-SVM	82.62	73.84	43.72	39.79	
Naive-Bayes	85.28	78.94	54.50	47.74	
LSTM	90.25	80.10	63.41	51.18	
RF	95.43	80.25	83.31	54.29	
Recurrent-CNN	97.80	84.29	85.29	60.02	
BI-LSTM	97.68	86.70	81.11	60.45	
ServeNet	99.83	88.40	98.78	63.31	
GCN	98.76	90.31	89.30	65.55	
MHAGCN	98.54	95.21	87.62	71.23	

G. Analysis

A notable feature of MHAGCN is the combination of a multi-head attention mechanism, which takes into account the importance of the neighborhood node when learning representative embeddings. You can obtain greater predictive power by observing a larger field. As mentioned earlier, given a specific task, our model can understand the attention value between neighborhood nodes. Some important neighborhood nodes that are useful for specific tasks often have greater attention. Here we take a description sentence in the data set as an example. The category of the Web service to which the description sentence belongs is Images. We enumerate the neighborhood nodes of the node images in the statement, and their focus values are shown in Figure 6. From Figure (a), we can see that the nodes "images" are connected to node "ImageRecycle" and node "photos", which belong to the image category; connected to node "MongoDB" and node "NoSQL", they belong to the database category, connected to the node "Internet", it belongs to the Internet of Things category. As can be seen from Figure (b), the node "images" get the highest attention value from its own node, which means that the node itself plays the most important role in learning its representation. This is reasonable because all the information supported by other nodes in the field is usually regarded as a kind of supplementary information. In addition to itself, the node "ImageRecycle" and node "photos" also received the second and third largest attention values. This is because "ImageRecycle" and "photos" also belong to the image category, and they can make a significant contribution to identifying the category of images. Nodes in the remaining neighborhood receive less attention because they do not belong to the image category and cannot make important contributions to the recognition of the image category. Based on the above analysis, we can see that the multi-head attention mechanism can distinguish the differences between neighborhood nodes and assign higher weights to some meaningful neighborhood nodes, which helps to analyze and interpret our results.



Fig. 6. The neighborhood nodes based node images and corresponding attention values.

To examine the impact of multi-head attention, we explored the performance of MHAGCN with different numbers of attention heads. The results are shown in Figure 7. Note that when the number of attention heads is set to 1, multi-head attention will be eliminated. According to the results, we found that the more attention the number of heads will improve the performance of MHAGCN. However, with changes in attention, the performance of MHAGCN has only slightly improved. At the same time, we also found that long attention can make the training process more stable.



Fig. 7. Number of attention head K.

V. CONCLUSION

In this study, we design a graph convolutional neural network based on the multi-head attention mechanism. The multi-head attention mechanism can be used to assign different weights to all nodes in the graph and can be independent of the entire graph structure. When calculating the weight, it can be calculated in parallel between all nodes, and the calculation efficiency is high. The experimental results prove that the classification of MHAGCN is accurate. By analyzing the learned attention weights, the proposed MHAGCN has proven its potentially good interpretability. There are some potential improvements and extensions of the multi-head attention graph convolutional neural network, which can be solved in future work. Some particularly interesting research directions include the thorough analysis of the interpretability of models using attention mechanisms and the development of unsupervised text training frameworks for representation learning on large-scale unlabeled text data.

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Performance Analysis of Traffic Classification with Machine Learning

Htay Htay Yi, Zin May Aye

Abstract-Network security is role of the ICT environment because malicious users are continually growing that realm of education, business, and then related with ICT. The network security contravention is typically described and examined centrally based on a security event management system. The firewalls, Intrusion Detection System (IDS), and Intrusion Prevention System are becoming essential to monitor or prevent of potential violations, incidents attack, and imminent threats. In this system, the firewall rules are set only for where the system policies are needed. Dataset deployed in this system are derived from the testbed environment. The traffic as in DoS and PortScan traffics are applied in the testbed with firewall and IDS implementation. The network traffics are classified as normal or attacks in the existing testbed environment based on six machine learning classification methods applied in the system. It is required to be tested to get datasets and applied for DoS and PortScan. The dataset is based on CICIDS2017 and some features have been added. This system tested 26 features from the applied dataset. The system is to reduce false positive rates and to improve accuracy in the implemented testbed design. The system also proves good performance by selecting important features and comparing existing a dataset by machine learning classifiers.

Keywords—False negative rate, intrusion detection system, machine learning methods, performance.

I. INTRODUCTION

N OWDAYS, network security becomes very important role in data and network system. Because malicious users and attackers are more and more increasable, especially in business and education. If the traditional hardware-based firewalls implement, these can vendor lock and higher cost. The system applies software-based open source firewall and it reduces complexity, time, often adaptive in configuration, and especially in cost [18]. When setting a rule on a firewall, the rule may be out of order, and the admin configuration error as typing may be a system vulnerability [2]. The protect system is main factors to be reliable, and robustness and also now focuses on IDS rather than firewall.

An IDS collects a variety of incoming data traffic and analyzes which data are what kind of attacks. The Intrusion Detection System has two main types. The first type is signature-based that can detect malicious attack with specific byte patterns to know attack. The second is anomaly-based that is a statistical monitor the network traffic instead of particular pattern. The system applies open source Snort-IDS to analysis protocols and detect for matching content. Intrusion detection is needed as an additional barrier for network protecting systems. Moreover, this Intrusion detection is

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applied to detect intrusions and also provided important data for countermeasures [19].

The main research areas of this paper are: 1) Creating the firewall rules on the software-based firewall interfaces as Outgoing traffic, IPCop Access, Internal Traffic, Port Forwarding and External IPCop Access based on services. 2) Providing IDS signature-based policy and proving with machine learning. 3) Proposed dataset implemented to improve the performance of the system.

The rest of the paper is composed of as follows. Section II summaries of the related works of the previous authors. Section III presents the research methodology. Section IV introduces the propose dataset and system setup. Section V approves the implementation and evaluation of the system with proposed dataset. Section VI is the conclusion and future work of this paper.

II. RELATED WORKS

The researchers are assisted to it to plan more effective NIDSs. In [8], that presented the detection procedures, attitudes and knowledge of IDSs. The authors acquaint with two prominent and open source tools for learning IDSs. The virtualization technology is used to study of IDS matters on Virtual Machine. In [1], the joint technique is used to Network Intrusion Detection Systems NIDS. They approached on determining the effectiveness and the performance of Snort IDS and the new one of Suricata IDS.

The researcher [9] proposed the types of network attacks. The paper described the firewall that is limited the access between networks in order of rules to prevent attack and impossible signal an attack from inside the network. The author is classified of IDS based on methodology as architecture, decision making, locality, reaction or response, decision methods.

Reference [5] described two Machine Learning approach neural network and Support Vector Machine (SVM) with a set of benchmark data from 1998 DARPA. The result compared the performance of neural network and SVM with intrusion detection. In this work, SVM is faster training time and running time. Tao et al. [7] also compared with other SVM-based Intrusion detection and the detection rate is so high. This paper proposed feature selection, weight, and parameter.

Reference [19] modified old Logistic Regression Algorithm to reduce training time. Hwang et al. [20] proposed a classification method using statistic signatures as direct sequence of packet size based on SVM (Support Vector Machine) for application traffic. In [22], the authors applied Kyoto2006+ to judge the performance, accuracy, false positive rate and detection rate with SVM.

III. RESEARCH METHODOLOGY

This section contains the Firewall, Intrusion Detection System (IDS) that are applied in this work. It will talk about using software-based firewall as IPCop and how to use the rules related to Snort-IDS.

A. Firewall

Today, firewalls are such a mainstream technology that are often considered a panacea for many security issues. In network security system, the design of firewall is to prevent malicious attack to or from a local network. Firewall is limited the damage that will spread from one subnetwork to another by divide a network into different subnetworks [2]. A firewall is enforced a firewall policy to access control between two more networks. The firewall policy is a compose of filtering fields as network fields and also includes protocol type, Source IP address, Source port, Destination IP address and Destination port that perform as action field.

When choosing the firewall to adjust with the system, there may be some considerations for the following facts: (i) the features that are given by firewall, (ii) the rate of wages to be adjusted for the users in the organization, and (iii) the budget to be spent when implementing the system. There are many types of firewall, some are hardware based and some are software-based. In this system software-based firewall IPCoP is deployed in the testbed environment. IPCop offers the outshines features and the free available for the users.

B. IPCop Firewall

The system can be implemented firewall as software-based or hardware-based or both. This paper applies software-based open source firewall. There have many software-based firewalls in firewall devices. Among them, some firewall gives free even commercial. A proposed system, firewall implements software firewall instead of a hardware firewall by using IPCop version 2.1.8, the last stable version, though it has a limited functionality, however, it is flexible enough to allow installation of various add-ons to enhance it to commercial grade firewalls.

IPCop is an open source Linux Firewall Distribution and supports a secure and stable. IPCop firewall amidst those firewalls can get free and firewall policy rules can be set their service depended on their respective network. Moreover, add-on packages can be added easily if it is needed. It composed of four types of network interfaces as Green, Red, Blue, and Orange. A good design of IPCop firewall provides a web interface that can manage the firewall. The firewall filtering rules create in four interfaces such as outgoing traffic, IPCop access, internal traffic, external IPCop access and port forwarding. These four interfaces can assign the firewall filtering rules to manage the desire system. The examples of filter rules that applied in IPCop interface in internal traffic as shown in Table I.

 TABLE I

 Example of Internate Traffic In IPCop

R-	ul ₽ r-oto	Src-IP	Src-l	Politest-IP	Dest	-PArtt-ior
rl	UDP	192.168.235.50	any	192.168.137.100	53	allow
r2	TCP	192.168.235.*	any	192.168.137.*	443	deny
r3	UDP	192.168.235.*	any	192.168.137.100	22	deny
r4	UDP	192.168.235.50	any	192.168.137.100	443	allow
r5	UDP	* * * *	any	192.168.137.*	22	deny
r6	ICMP	192.168.235.*	any	192.168.137.*	Ping	deny
r7	ICMP	192.168.235.50	any	192.168.*.*	Ping	allow
r8	UDP	* * * *	any	* * * *	53	deny

C. Snort Intrusion Detection System

intrusion detection system (IDS) monitors An communication pursuant to certain rules. If the rule on the network connection is complied with, the system evaluates whether it is intrusion and reports it to the relevant administrator or user [2], [6]. There are three modes in snort: sniffer mode, packet recording mode and intrusion detection system. In sniffer mode, the program will read network packets and display them on the console. In packet logger mode, the program will log packets to the disk. This system uses intrusion detection mode to monitor network traffic and analyze it against a rule set defined by the user. Some of the powerful features of Snort depends on the signature-based rule through the plug-in and also preprocessors. Snort is depended on feasible of content analysis and a pattern matching. The Snort rule has two portions: the rule header and rule option. The example of a snort rule is

Rule Header -> alert udp any any -> 192.168.235.0/24 53 Rule Options -> (msg: "Domain access", sid=1000005;) The general form of a Snort rule:

action proto src_ip src_port direction dst_ip dst_port (option) **Actions:**Snort supports several assemble actions. A rule is matched with the directly log the packet, used the log actions. The alert action creates an alert by using the method defined in the file as configuration or on the command line, to logging the packet.

Protocols: The next field is operated to define the protocol in the rule applies. The values of this field are IP, ICMP, TCP, and UDP.

IP addresses: This field is specified the source IP addresses, destination IP addresses and ports in a rule.

Ports: The port filed will accept single ports as ranges with IP address. A range is defined to separate from upper to lower bound with a colon character.

Options: A snort plug-in used in each option field that consists of two potions as a keyword and an argument. This field scans incoming packets as opposed to snort plug-in.

Snort is a very useful reporting mechanism and that allows alerts to be recognized as a log, as well as by sending alerts to log servers such as syslog or a database. The Snort intrusion detection system is included in IPCop Firewall and can be detected attacks on internal servers. The added benefit of an IDS is that we can see what is passing through our network and attempt to isolate any traffic that appears malicious.



Fig. 1 Network System Design

IV. PROPOSED DATASET AND SYSTEM SETUP

The proposed dataset creates a testbed that takes from the traffic of firewall, IDS, web server, and public attacks.

A. Proposed Network Testbed

The proposed testbed network design uses software-based firewall IPCop. The firewall is configured for External Network, Local Area Network (LAN) and De-Militarized Zone (DMZ) for public and local users access in Fig. 1. De-Militarized Zone (DMZ) is also added as an additional security layer for the LAN network. Web server and file server are accessed from local and public users in DMZ. The Firewall defines the rules for the three main zones. For public user access, the forwarding rules are required for web server access within the DMZ network. To make the LAN secure, rules are set to prevent malicious attacks from invading the public and the DMZ network. The firewall rule creates only what is needed and focuses not only on security but also on performance. In the system implementation, the IDS is deployed with two NIC cards, one for external and the other for LAN card. The predefined rules related to firewalls are also applied in this IDS infrastructure.

The system testbed contains two ubuntu 20.04 machines as attacker1 and attacker2 for public network. The web server and ftp server are operated with OpenSuSE 15.1 in the system implementation. Admin and User PCs are setup with OpenSuSE 13.2 in the LAN. The number of services such as DNS, HTTP, and SSH servers are deployed and implemented in the Web Server.

B. Network Traffic in Testbed

DoS traffic are created by using hping3 tool for the network traffic between the public network and Web server. The public network to web server for DoS attack traffic using **hping3** tool. For normal traffic, traffic is captured by accessing Google, Facebook, and Amazon sites. Attack or normal traffic is captured by **tcpDump** tool on IDS VM to create a pcap file.

The pcap file is loaded to Wireshark that selected filter out traffic of TCP. The comma specified file format (.csv) is created by manually aggregating the values of features depending on the destination host of the package range. DoS attack traffic is captured at 3s, 5s, 10s, and 15s time and is generated according to different DoS instances weight and package range for csv file. Traffic analysis of performance obtained based on DoS time and Machine Learning Classifiers.

C. Applied Machine Learning Classifier in System

The system used six classifiers as Support Vector Machine (SVM), Logistic Regression (Logistic), J48, JRip, Random Tree, and Multiclass Classifier. Category of Classification: Classification belongs to the category of supervised learning where the targets also provided with the input data. SVM is an efficient tool widely used in the multiclass classification [15]. The first sequential minimal optimization algorithm for SVM is implemented by John for training a support vector classifier. Le Cessie and Van Houwelingen (1992) [4] illustrated Logistic Regression. Some are modified compare to [4] because Logistic Regression not divided with instance weight [16].

J48 is developed by Weka project team. C4.5 is an extension of ID3 (Iterative Dichotomiser 3) algorithm. It is applied to improve accuracy and performance in anomaly detection [21].

J48 and Random Tree are the decision tree algorithms that widely used in machine learning [23]. Random Tree is allowed to estimate of class probabilities and constructed a tree that considers k randomly chosen attributes at each node. The Machine Learning tasks applied Multiclass classifier that use to get valid output code and to improve accuracy. JRip is one of the data mining algorithms and is developed by Chohen to classify accuracy. The limitation of JRip has memory consumption (from Weka).

Most models of machine learning have over-fitting problems, which are conducted to prevent this from happening in k-fold cross validation. The dataset is randomly partitioned into k mutually exclusive subsets those are approximately equal size in each and one is kept for testing while others are used for training. This process is iterated throughout the whole k folds. The system is k = 10.

D. Overview of Existing Dataset

In intrusion detection field, KDD Cup 99 dataset [10], [11] has been used for a long time as evaluation data of intrusions. It contains 41 features labeled as normal or attack. However, there is a fatal problem in that the KDD Cup 99 dataset cannot reflect current network situations and the latest attack trends [3]. It was developed over a virtual network environment. Four types of attacks as Dos, R2L, U2R, Probe are used in KDD Cup 99.

Kyoto 2006+ has a total of 24 features, 14 of which are selected by KDD Cup 99 dataset and 10 features are further included in the analysis of NIDSs [3]. Kyoto 2006+ datasets on real network traffic and ignores the inclusion of redundant

TABLE II Dataset Features Applied in System

No.	Feature	Description
1	Dst_port	Destination port
2	Dst_ÎP	Target IP address
3	Total_Inpkt	Total Inbound packages to
	-	destination host
4	Total_Outpkt	Total Outbound packages from
	, î	destination host
5	Inpkt_bytes	Inbound packages bytes to
	· ·	Destination
6	Outpkt_bytes	Outbound packages bytes from
	· ·	destination
7	Total_InOut_pkt	Total packages to/from destination
	_	host
8	Inpkt_bits/s	Inbound packet bits/s
9	Outpkt_bit/s	Outbound packet bits/s
10	Protocol	Protocol as TCP or UDP
11	Service	Service types as http, ftp
12	Min_pktlen	Minimum packet length in the
	-	packet range
13	Max_pktlen	Maximum packet length in the
	_	packet range
14	Avg_pktlen	Average length of packet that fall
		in the range
15	Inout_count	Number of packets count with
		source and destination IP in this
		range
16	Class	Describe normal or attack

features. It composed two types of traffics such as normal and attack [14], [17].

NSL-KDD (2009) dataset features extract selected from KDD Cap 99 to improve the accuracy of IDS [3], [12]. It has 41 features that not included redundant duplicate record for training and testing data and not perfect for representing for existing real network. NSL-KDD Cup 99 dataset are composed of five main classes [13], [17]. There are Normal, Denial of Service (DoS), Remote to User (R2L), User to Root (U2R), and Probing (Probe).

The CICIDS-2017 dataset obtains a huge of traffic and a large number of 78 features to be observed for anomalies detection [13]. It composed of two traffics normal (Benign) and attack that is complexed type and improved performance of IDS on this dataset [12]. CICIDS-2017 included 7 attack types as Brute force, PortScan, Botnet, Dos, DDoS, Web, Infiltration [14].

E. Dataset with Extract Feature

The proposed dataset now included 16 keys features in Table 2. The dataset derived by extracting some features as destination port, minimum packet length and maximum packet length [12], [14] from CICIDS-2017 and added other features to reduce false positive rate. These features are considered depending on the destination according to the packet range, such as destination ports, destination inbound/outbound packets and, etc. Features are not specifically designed for the flag feature. Adding six TCP flag feature does not significantly improve the performance. Therefore, instead of applying those features, synchronous(syn), syn_ack, retransmission, reset(rst) are categorized into package ranges and are considered with respective features in normal and attack traffic.

V. IMPLEMENTATION AND EVALUATION

For huge network traffic, it is normally difficult to analyze the data. The developed system applied the WEKA (Waikato Environment for Knowledge Analysis) data mining tool to prove the performance of the system. The proposed dataset applied 10-folds cross validation of the training and testing to classify better performance.

TABLE III Performance with Classifiers in PortScan Attack

Detection Classifier	PortScan					
Detection Classifier	TP	FP	PRC	REC		
Logistic	0.989	0.001	0.99	0.989		
SVM	1.00	0.00	1.00	1.00		
J48	0.996	0.179	0.965	0.966		
JRiP	1.00	0.09	1.00	1.00		
Random Tree	0.977	0.09	0.977	0.977		
Multiclass Classifier	0.989	0.001	0.990	0.989		

The proposed system implement performance with IDS by machine learning classifier as Logistic Regression (Logistic), Support Vector Machine (SVM), J48, JRip, Random Tree, and Multiclass Classifier in Tables III and IV. The True Positive (TP), False Positive (FP), Precision (PRC), Recall (REC) proved performance with each classifier. Due to the high false positive rate, it is possible that the actual attack could not be detected and the important attacks were not recognized. So, the proposed system can reduce the false positive rate in all classifiers except J48 and Random Tree, when calculating the false positive rate to detect normal and PortScan attack.

 TABLE IV

 Performance with Classifiers in DoS Attack

Detection Classifier	DoS						
Detection Classifier	TP	FP	PRC	REC			
Logistic	0.993	0.004	0.993	0.993			
SVM	0.990	0.008	0.990	0.989			
J48	0.993	0.009	0.993	0.993			
JRiP	0.994	0.004	0.994	0.994			
Random Tree	0.993	0.002	0.994	0.993			
Multiclass Classifier	0.992	0.005	0.992	0.992			

In Table IV, the higher false positive rate is only 9% in J48 and SVM, and significantly lower in the other classifiers. Table V uses the following equation to calculate the accuracy of DoS and PortScan attack.

$$Accuracy = \frac{TruePositive}{TruePositive + FalsePositive}$$
(1)

In the DoS attack, the Random Tree has the highest accuracy of 99.8%, followed by Logistic and JRiP at 99.6% in Table V. The proposed system can see that the J48 and Random Tree classifier has the lowest accuracy 84.8% and the rest of the classifier has good accuracy in PostScan attack.

A. Comparison of Proposed Dataset and Existing Dataset

The proposed dataset is based on the CICIDS2017 dataset. Some features are taken from CICIDS2017 and some features

 TABLE V

 Accuracy of Detection on DoS and PortScan Attack

Detection Classifier	Accuracy %			
Detection Classifier	DoS	PortScan		
Logistic	99.598	99.89		
SVM	99.198	100		
J48	99.1	84.766		
JRiP	99.599	100		
Random Tree	99.799	91.57		
Multiclass Classifier	99.499	99.899		

have been added. This paper tested 26 features of CICIDS2017 with two classifiers to know performance. The 26 features shows in Table VI.

TABLE VI EXTRACTED 26 FEATURES FROM CICIDS2017

No.	Feature Name Extracted from CICIDS2017
1	Destination Port
2	Flow Duration
3	Total Fwd Packets
4	Total Backward Packets
5	Total Length of Fwd Packets
6	Total Length of Bwd Packets
7	Fwd Packet Length Max
8	Fwd Packet Length Min
9	Fwd Packet Length Mean
10	Fwd Packet Length Std
11	Bwd Packet Length Max
12	Bwd Packet Length Min
13	Bwd Packet Length Mean
14	Bwd Packet Length Std
15	Bwd Header Length
16	Fwd Packetss
17	Bwd Packetss
18	Min Packet Length
19	Max Packet Length
20	Packet Length Mean
21	Packet Length Std
22	Packet Length Variance
23	Average Packet Size
24	Avg Fwd Segment Size
25	Avg Bwd Segment Size
26	Fwd Header Length

The data with a high number of features require a lot of time, as well as resource consumption and computational complexity for data analytics [12]. Table VII proved the performance of FP, FN, PRC, and REL with two classifiers. Based on the 26 features of the CICIDS2017 dataset, the Logistic accuracy for the PortScan attack is 98.6%, and SVM is 94.3%. In this paper, when we compare Table VIII with Table III, we can see that the false positive rate is significantly higher.

 TABLE VII

 Performance of Two Classifiers with CICIDS2017

Detection Classifier	PortScan					
Detection Classifier	TP	FP	PRC	REC		
Logistic	0.988	0.014	0.988	0.988		
SVM	0.953	0.058	0.957	0.953		

In summary, when calculating performance using six classifiers in the proposed dataset, only one J48 classifier has

low accuracy and the other classifiers Logistic, SVM, JRiP, Random Tree and Multiclass Classifier have more than 99%, respectively. And also, the true positive rate is good with all classifiers.

VI. CONCLUSIONS

The proposed system implemented the dataset with a network testbed to prove performance. The system testbed included especially devices as firewall and IDS. This paper focuses on reducing false positive rates and improving accuracy, as false positives may not be known to the real attack. The system analyzes detection performance using six machine learning classifiers as Logistic Regression, Support Vector Machine, J48, JRiP, Multiclass Classification and, Random Tree. The system analyzes the performance of 16 features with six classifiers. The later work will focus on choosing some machine learning classifiers, adding other attacks, and using the python language to improve performance.

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Bio-inspired opto-responsive nociceptor based on memristor device built on two-dimensional hetero-structured oxides

S. Zhuiykov, M. Karbalaei Akbari

Abstract—Opto-responsive nociceptor based on memristor device is developed and tested for controllable imitation of human eye nociceptor. Memristor is built on conformal defect-free twodimensional (2D) TiO_2 –Ga₂O₃ hetero-structured oxides, where the thermally annealed Ga₂O₃ films play the role of charge transfer controlling component. It is discovered that the phase transformation in Ga₂O₃ is accompanied by substantial jump in conductivity, induced by thermally-assisted internal redox reaction of Ga₂O₃ nanostructure during annealing. It is also experimentally confirmed that the charge transfer in hetero-structured oxides can be tuned and controlled by the hetero-interfaces manipulation. Results demonstrate that the engineering of hetero-interfaces of 2D films enables the fabrication of either high-sensitive TiO₂-Ga₂O₃ (Ar) or high threshold TiO₂-Ga₂O₃ (N₂) nociceptors.

Keywords — 2D semiconductors, nociceptor, hetero-interfaces, Ga_2O_3 , TiO_2 .

I. INTRODUCTION

Emulation of the brain functionalities is facilitated by the moto-neourons incorporated into developed biosensors network, and neural signal processors and bio-motor enable the sustainable performance of nociceptors. Thus, the neuromuscular junction is a biological chemical synapse that transmits presynaptic action potentials to the muscle fiber by releasing the biological neuro-transmitters in neuro-muscular junctions. In the human brain, the obtained information is processed and then orders are delivered to the corresponding autonomic and somatic nervous systems [1]. The visual processing is one of the fundamental and prominent functionalities of the human brain. Visual processing is fulfilled by outstanding features of the human's eye [2], as natural visual detector and processor Fig. 1(a) consists of a large number of receptors Fig. 1(b) and nociceptors Fig. 1 (c). In fact, nociceptor is a key sensory receptor that recognizes noxious stimuli, which in turn generates and delivers the warning signals to the central nervous system. The brain and nervous system then generate commands to trigger the motor responses and then to minimize the potential sensitization. Visual cognition is established after the processing of directly captured and detected optical stimuli by the eye's cone and rod receptors in retina [3]. Then, the generated bio-chemical voltaic signals are transferred by retinal ganglion cells to the optical nerve and finally are transmitted into the visual cortex of the brain for further processing [3].

Looking at the nervous system, the biological synapse is the fundamental base of sensorimotor system facilitating various functionalities including the pain signal transfer in the neural system Fig. 1(d). The analogous artificial nociceptive device with similar synaptic functionalities is developed in this study and represents the semiconductor ultra-thin film sandwiched between two conductive layers as shown in Fig. 1 (e).



Fig.1. Scheme of the human eye nociceptor system.

In this work, we report fabricated optical artificial nociceptors built upon ultra-thin amorphous all-oxide heterostructures with ionic transport, anisotropic electrical characteristics and ultimate transparency. Developed nociceptor represents the electronic memristor with both insulating and semi-metallic characteristics and controllable charge transfer. These capabilities in turn could facilitate the fabrication of electronic devices whose resistive functions are controlled by their nano-structural modification.

II. EXPERIMENTAL

All samples were deposited on the SiO₂/Si wafers by plasma-enhanced atomic layer deposition (PE-ALD) technique using the cross flow reactor of Savannah S100 (Ultratech/Cambridge Nanotech). Prior the deposition, in order to facilitate the subsequent investigation of the properties, Au films were deposited on the SiO₂/Si wafers using an Electron Beam Evaporator method [Nanochrome II (Intivac, USA)]] with the thickness of 150 nm, and a 200 µm-wide gap at the center of each unit was intentionally left at the same time for the characterization of the developed nano-films, due to the roughness of Au films. PE-ALD was employed to deposit 5.0 nm thick Ga₂O₃ films over Au electrodes. The tris (2,2,6,6tetramethyl-3,5-heptanedionato) gallium (III), [Ga(TMHD)₃] (Strem Chemicals, 99%) and O2 plasma were used in PE-ALD process. For RTA treatment, the Au-Ga₂O₃ electrodes were thermally annealed in controlled condition under Ar or N₂ atmosphere. The heating rate was 60°C/min. 20.0 nm thick

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amorphous TiO_2 films were then deposited by PE-ALD (tetrakis dimethylamino titanium and O_2 plasma) over the RTA Ga_2O_3 to develop all-oxide heterostructures. At the final stage, Pt or indium tin oxide (ITO) top electrodes were fabricated over all-oxide-heterostructured films.

Various characterization techniques were employed for investigation of the material properties, including Raman spectroscophy (λ =750 nm, HORIBA micro-Raman, Lab Ram ARAMIS), XPS studies for evaluation the chemical compositions, percentage of elements and vacancies in the RTA and heterostructured films as well as to determine the band alignment at semiconductor heterointerfaces (XPS, Thermo Scientific theta probe), UV-vic (Shimadzu, UV-vis 2600) to evaluate the bandgap of heterostructured films. The field emission scanning electron microscope (FESEM JEOL-7800F) was used for measurement of photoluminescence characteristics. Autolab Metrohm (PGSTAT204) instrument was used to evaluate the performance of memristors. Tunable LED laser driver (λ =360 nm) in combination with the Autolab signal analyzer (PGSTAT204) were employed to measure the photoresponsive and nociceptive responses of devices and to precisely design and pattern optical pulses.

III. RESULTS AND DISCUSSION

Fig. 2 (a) shows the results of conductivity measurements vs. the RTA processing temperature. All measurements were performed after rapid quenching to investigate the final structural phases of materials. It was observed that as-deposited Ga₂O₃ samples are in insulating mode whereas for the samples annealed at 450°C the conductivity is still low (~10⁻¹ Scm⁻¹) and transparency is as high as 84 % in the visible region. Noteworthy, measurements confirmed a profound increment of conductivity (RTA in Ar) is about six orders of magnitude higher than that of the as-deposited samples. The observed jump in conductivity value is incredible. However, further annealing at higher temperature is accompanied by the conductivity decline.



Fig. 2. Result of conductivity variation of Ga_2O_3 films after RTA in Ar and N_2 atmosphere.

A model has been introduced which relates the conductivity increment phenomenon to the nucleation of crystalline and stoichiometric Ga₂O₃ nucleus in amorphous gallium oxide, as presented in Fig 3 (a), (b) and (c), respectively.. It is suggested that further nucleation of stoichiometric Ga₂O₃ phases is accompanied by the increase of metallic content in ultra-thin films owing to the initial Ga excess in the sub-stoichiometric microstructure. It is expected that the Ga interstitials enhance the number of donors in amorphous Ga₂O₃. Therefore, the remained amorphous Ga₂O₃ in RTA sample is heavily donordoped semiconductor. It was suggested that Ga excess increases the possibility of formation of new electronic states above the valence state of amorphous Ga₂O₃. It is confirmed that the number of states in the optical bandgap of amorphous Ga₂O₃ increases by enhancement of Ga content in microstructure. It consequently results in the decrease of energy gap between the highest occupied states and the conduction band. Our observations have also confirmed the bandgap decrease and alteration of the valence band maximum (VBM) of the annealed samples in Ar atmosphere.



Fig. 3 (a-c). Phase transformation in Ga₂O₃ films during RTA treatment. The as-deposited films are amorphous until the crystallization temperature at which the nucleation of crystalline stoichiometric Ga₂O₃ nucleus sites takes place.

The control of the charge transfer phenomenon in the memristor devices is the fundamental bases of neuromorphicbased technology [1]. It is expected that the high bandgap heterostructured films can fulfill the requirement of neuromorphic units since the charge transfer can be tuned and controlled by the manipulation of the hetero-interfaces [4]. Furthermore, both transparency and electronegativity differences between the heterostructured components can facilitate the development of bio-inspired opto-responsive instrument. In doing so, 20.0 nm thick TiO₂ film was deposited by ALD on as-deposited and RTA Ga₂O₃ (5.0 nm) films to fabricate Pt/TiO2-Ga2O3/Au devices. The Raman studies demonstrate the vibration modes of Ga_2O_3 and TiO_2 in heterostructured films. To understand the charge transfer mechanisms, the current-voltage (I-V) measurements were performed under dark condition while the Pt/TiO2 was biased and Au/Ga₂O₃ was grounded. Typical bipolar switching curves were obtained during the sweeping from $0 \rightarrow 1 \rightarrow 0 \rightarrow -1 \rightarrow 0$ for Au/Ga₂O₃-TiO₂/Pt and Au/Ga₂O₃(Ar)-TiO₂/Pt, as shown in Fig.

4 (a). Fragile loop openings were observed in both devices. The driven current from the Au/Ga₂O₃(Ar-600°C)-TiO₂/Pt sample is tangibly higher than that of as-deposited TiO₂-Ga₂O₃ samples. The plausible explanation can be attributed to higher level of Ga excess in RTA (Ar-600°C) samples compared with that of as-deposited Ga₂O₃. It also can be related to the improved crystallinity of Ga₂O₃ film after RTA process. The phase transformed Ga₂O₃ with higher level of Ga excess performs as high-conductive layer between TiO₂ film and Au electrode. The migration of oxygen vacancies in thicker TiO₂ layer and charge trapping phenomenon at the heterostructured interface are the most plausible explanations for the resistive behavior of samples [4]. In fact, the thermal annealing of the heterostructured film in oxygen atmosphere has resulted in the deterioration of RS characteristics of them. It can be attributed to the decline of vacancy related charge trapping sites. However, still the memristive switching and performance of Ga₂O₃-TiO₂ and Ga₂O₃(Ar-600C)-TiO₂ devices are not considerable (Fig. 4 (a)). The hetero-interface engineering was employed to alter the charge transfer mechanism between two semiconductor components and to improve the memristive characteristics of heterostructured semiconductor devices. To this aim, ultra-thin Ga₂O₃ film was annealed in nitrogen atmosphere to manipulate the hetero-interfaces band alignment and also affect the charge trapping and transfer mechanisms at Ga₂O₃-TiO₂ hetero-interfaces.



Fig. 4. Electrical characterization of the fabricated memristor devices accompanied by the characterization of resistive behavior of them.

The cyclic I-V curves for Pt/TiO₂-Ga₂O₃ (N₂-450°C)/Au device showed considerable loop opening, as presented in Fig. 4 (b). During I-V sweeping the cell was set to the low resistance state (LRS) at the positive voltage and reset to the high resistance state (HRS) at the negative voltage. This process is well-known as the counter-eight-wise-switching mechanism. A considerable improvement of HRS/LRS ratio was observed after modification of TiO₂-Ga₂O₃ semiconductor heterointerfaces by incorporation of N2 atoms into Ga2O3 film. While the current and resistance values changed gradually for the forward biased, they both changed abruptly at the reverse biased voltage. The memristive behavior of Pt/TiO2-Ga2O3 (N₂)/Au device was tangibly different with the performance of TiO₂/Pt/ Ga₂O₃ (Ar)/Au samples. Strong rectification behavior (Fig. 4 (c)) was observed during the cyclic I-V test of TiO₂- Ga_2O_3 (N₂-600°C), which is the characteristic of the development of type-II heterojunctions. The loop opening, as characteristic of the charge trapping/de-trapping, is observed again. Comparing the first cyclic loop, it was found that the driven current for TiO₂-Ga₂O₃ (N₂) was tangibly lower than that for the TiO₂-Ga₂O₃ (Ar). It was also discovered that the driven current from Pt/TiO₂-Ga₂O₃ (N₂-600°C)/Au device (Fig 4 (c)) was tangibly lower than that of the same device annealed at 450°C (Fig. 4(5b)). Pt/TiO₂-Ga₂O₃ (N₂-600°C)/Au heterointerfaces also showed the rectification behavior. It can be understood by investigation of charge trapping mechanisms and also determination of energy band alignment at semiconductor hetero-interfaces. To realize the underlying dynamics of the charge transfer across the hetero-structure, double logarithmic scale I-V curves of Pt/TiO₂-Ga₂O₃ (N₂-600°C)/Au devices are plotted at the several cyclic loops (Fig. 4 (d)). The slope value close to one is the characteristic of the Ohmic-like conductance (I-V) at lower positive bias voltage, which is caused by the thermally generated free carriers. Trap-filled limited voltage (Vth) shifted from 0.39 V at the first cycle down to 0.26 V at the second cycle (Fig. 4 (d)). Thus, it is estimated that the trapfilled limited condition is the main mechanism of the charge trapping at higher voltage. It further confirms the occurrence of charge trapping phenomenon across the 2D hetero-interfaces between TiO₂ and Ga₂O₃ (N₂-600°C) films. The non-linear variation of the current at higher voltage is fitted by the Child's law (I V_2). The charge trapping phenomena in TiO₂ film and also at the TiO_2 -Ga₂O₃ (N₂) hetero-interfaces are expected to be the main mechanism for the resistive behavior at the middle range biased voltages. In the last stage of I-V curve, which is called the trap filled-limited region, an abrupt increase of current is observed when the voltage passes the threshold limit (VTFL). By imposing higher voltage (V > VTFL ~ 0.9 V) the device resistance changed from HRS to LRS. The abovementioned observations confirmed the importance of the trapcontrolled space-charge-limited current (SCLC) mechanism in the resistive switching of hetero-structured device. The graph of $\ln (1/V_2)$ versus the $\ln (1/V)$ has depicted the transition from the direct to the Fowler-Nordheim (F-N) tunneling by gradual increase of the biased voltage. Graph showed that the specific inflection point was shifted to higher values after the first and second cyclic test. While two individual transport regimes were observed in the positive biased voltage, the device only experienced one transport regime corresponding to the negative biased voltages.

The trapping/de-trapping characteristics of our all-oxideheterostructured nociceptor were accompanied by the internal electric field caused by the difference in electron affinity of TiO_2 and Ga_2O_3 films. These observations bring the idea of the development of optically modulated resistive neuromorphic device. In ITO/TiO₂-Ga₂O₃ (Ar-600°C)/Au device, the photoresponse appeared and increased suddenly when the magnitude of light intensity was higher than 15 mW/cm^2 (Fig. 5 (a)). This observation indicates that the tangible photo-induced charge transport happens when enough photo-induced carriers are generated by the pulsed light. This is the basis of the threshold nature of fabricated optical nociceptor device. The distinguished nociceptor photo-responsivity in on and off states confirms that the threshold phenomenon has quite significant impact on nociceptive performance of fabricated devices. As an incredible observation, it was found that the required light intensity to turn-on and then to get the saturation state in TiO₂- Ga_2O_3 (N₂-600°C) device is higher than that of TiO₂-Ga₂O₃ and TiO₂-Ga₂O₃ (Ar-600°C) devices (Fig. 5(a)). Furthermore, it was observed that the t_0 and (t_s) of TiO₂-Ga₂O₃ unit is higher than those of TiO₂-Ga₂O₃ (Ar-600°C) device. It is observed that the turn-on time and saturation time of TiO₂-Ga₂O₃ (N₂-600°C) device are the highest value among all nociceptors. TiO₂ is considered as the main charge generation and trapping component of all-oxide transparent heterostructure. Considering the similarity of TiO₂ thickness in all devices, the t₀ and t_s values are mostly attributed to the charge transfer phenomenon in hetero-interfaces. It was discovered that the ΔE_c of TiO₂-Ga₂O₃ (Ar-600°C) hetero-interfaces is the smallest among all instruments, while the ΔE_c of TiO₂-Ga₂O₃ (N₂-600°C) heterostructured film is the highest one. This higher barrier height in hetero-interfaces can explain why it takes longer time and needs higher energy for TiO_2 -Ga₂O₃ (N₂) device to turn-on and then to reach to the saturation state. These distinctions among our heterostructured devices enabled us to fabricate either high sensitive TiO2-Ga2O3 (Ar) or highthreshold TiO₂-Ga₂O₃ (N₂) nociceptors. It was found that after saturation, the device photocurrent does not change even by increasing the power density of the pulsed light (Fig. 5(b)). This behavior is similar to the no-adaptation characteristics of the natural human nociceptors, which protects the organs from the unnecessary and harmful external stimuli. The signal relaxation is another important characteristic of the fabricated nociceptors. It explicitly refers to the required time for the ultimate decay of the response current after the elimination of light stimuli. Fig. 5 (b) depicts that the current increased suddenly and stayed constant for the rest of stimulation at 13.3 s. Our observations confirmed that the relaxation time is dependent on the stimuli frequency where the increased light frequency has resulted in longer relaxation time (Fig. 5(c)). The device property is similar to the human nociceptors when a stronger pain is caused by intense and continues stimuli and the pain lasts longer until it completely disappears. Furthermore, at higher frequencies the response signals overlap, resulting in the nociceptor charge accumulation (Fig. 5(c)). In this state, the remained generated photo-carries of the previous spike facilitates the device conductance in the following stimulation stage. Similar behavior was observed in the synaptic units, which is called excitatory postsynaptic current (EPC). The EPC corresponds to the synaptic weight of a biological synapse which can be transferred from the short term plasticity (STP) to the long-term potentiation (LTP) mode. This characteristic is also similar to the human nociceptors when even a weak hazardous stimuli triggers a strong chronic pain.



Fig. 5. Photo-induced nociceptive behavior of devices.

Consequently, all-oxide-heterostructured optoresponsive nociceptor with controllable charge transfer is fabricated. Nociceptor utilized ultra-thin sub-stoichiometric amorphous TiO₂-Ga₂O₃ heterostructures. Ultra-thin Ga₂O₃ films were thermally annealed in Ar and N₂ atmospheres. The artificial nociceptor has clearly demonstrated the threshold, relaxation, allodynia and hyperalgesia states closely resembling the human bio-nociceptor behavior. It was experimentally confirmed that the charge transfer can be tuned and controlled by the interfaces manipulation in the ultra-thin heterostructures. The heterointerface manipulation ultimately enabled fabrication of either high-sensitive TiO₂-Ga₂O₃ (Ar) nociceptor or the highthreshold TiO₂-Ga₂O₃ (N₂) nociceptor. Moreover, due to its biorealistic capabilities and scalability advantage over the existing micro-structured counterparts, developed nociceptors are highly desirable to be utilized in micro- and nano-robotics at various environmental conditions.

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Microneedle Application of Vertically Aligned Carbon Nanotubes

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Abstract—The subcutaneous injection is a more preferred method in disease treatments since oral administration of drugs is not feasible because of poor drug absorption or enzymatic degradation in the gastrointestinal tract or liver. However, it is seen that this method is also inadequate in some aspects because of issues emerged in its practice and use of high dose medications to be effected. For these reasons, the subcutaneous injection carried out by hypodermic needles is about to yield next generation drug delivery methods. The transcutaneous delivery by microneedle (MN) injection is the foremost among these methods. MN types of various functionalities have been fabricated by many researchers using various materials and fabrication techniques so that MN mediated drug delivery, which has a great potential, is widely used. The simplicity in fabrication and the performance of MNs greatly determine the feasibility and the success of MN technology in drug delivery. Therefore, choosing a material which provides convenience in fabrication and structural flexibility to manufacturer has a great importance. The selection of building materials of MNs as a silicon or metals increases the number of processing steps in the fabrication and the production time and cost. In this regard, carbon nanotube (CNT) can be considered as an ideal building material in MN fabrication if the simplicity and flexibility on its synthesis are taken into account. The capability to form the entire geometry of the MN, including the lumen, with a single step of CNT synthesis considerably facilitates the fabrication. Here, we report the fabrication of an array of hollow MNs for transdermal drug delivery using vertically aligned CNTs reinforced with polyimide and to test their robustness and fluid flow rate. Vertically grown CNTs by chemical vapor deposition (CVD) method formed the scaffold of the hollow MNs. Fe nanoparticles which catalyze CNT synthesis will be patterned on SiO2 as hollow circles by using photolithography and electron beam evaporation technique, thus CNTs grew up from only these regions. As a result, vertically grown CNT bundles had the shape of hollow, cylindrical MNs. The vertically aligned CNT scaffold has a porous structure which has less strength against physical pressures. To overcome the issue and provide a mechanical strength, the porous scaffold was filled with polyimide by a spin coater. The mechanical strength and fluid flow rate of CNT MNs was tested in hydrogel and in cadaver rat skin (in vitro). Before and after the application, CNT MNs were viewed by SEM to prove its strength. The CNT MNs reinforced with polyimide reached the mechanical strength to penetrate both hydrogel and in cadaver rat skin.

Keywords—Carbon Nanotubes, Drug Delivery, Microneedles, Transdermal.

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Symmetric Notches Induce Notch Strengthening in Metallic Glasses

Yun Teng, Zhendong Sha

Abstract—For all engineering materials, the flaws are introduced inevitably from fabrication, mechanical damage, and corrosion. These stress raisers always induce catastrophic failures and it is therefore of great importance to understand the effect of flaws on the mechanical properties of engineering materials. The effect of flaws on metallic glasses (MGs) is a debatable topic because many relevant works have reported notch strengthening, notch weakening and notch insensitivity for brittle MGs. The significant notch strengthening of MGs was attributed to the transition of failure mechanism, from catastrophic shear banding to ductile fracture. Here we investigate systematically the influence of notch geometry on mechanical behaviors of symmetrically notched MGs by molecular dynamics, including the notch depth, notch height and notch sharpness. Our work observes notch strengthening obviously in brittle MGs with a brittle failure through shear banding. This noteworthy notch strengthening is a consequence of the constrained growth of the plastic zone. A transition from shear banding to homogeneous deformation within the un-notched ligament can be viewed by increasing the notch depth when the un-notched ligament width is under the threshold value, and also a stronger notch strengthening. Besides, the sharper notch enhances the fracture strength more apparently. Another important finding is the determined demand of notch configuration for observed notch strengthening. It is found that the notch strengthening behavior would be degraded by single-edge notch or asymmetric double-edge notches. Current results provide important insights into the deformation and failure modes of notched MGs, which may guide the design and engineers of MGs.

Keywords—Metallic glasses; symmetric notches; notch strengthening; molecular dynamics simulation.

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Extracting Business Methodology: Using Artificial Intelligence-Based TOR Method

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Abstract— In this current journey, the technical pathway's golden roads show the ultimate metaphor of artificial intelligence society. All the upbringings and algometry calculations are commonly based upon the tool of the unsupervised predictor. Meanwhile, the superposition shows us the business trigonometry to legit the TOR method we have proposed in our research. In the conscious form of learning, minds are the most quarreling term of artificial intelligence. Hence, we are moving towards the omnipotent form of artificial intelligence to sort our business society by shaking the hand of green business intelligence. The vital terms of business intelligence are gaining the accuracy-based AI and genetic algorithm-based prediction where the crossing over shows the leading figure of interest-based profit. The clinical stores, banks, NGO's, insurance, some government officers have integrated the circuit between artificial intelligence and business intelligence. As we have mentioned earlier about the superposition of business trigonometry intersects the whole over the formula of enclosed integration occurred by deep learning. Our proposed methodology represents the business profit wavelength's uttermost amplification, which may have been in longitudinal form. The research occupied the responsibility of green profit-based businesses to establish the stabilizers of the green economy. The green economy is always looking for the silverfish of mind computation, which has been supervised by last in first out predictivity. But the golden fish is the management of the green economy. This research's future scope shows its X dimension towards the management. Y dimension denotes the notary of sustainable business technology, and the Z dimension compiles the code of soft electronic business covering Ecommerce, E-payment, E-relief, etc. The super vector machine builds the monography of soft Intelligence to create vision computing. Therefore, our research aims to clarify the span between business intelligence and Artificial Intelligence concerning soft computing. By using the proposed methodology prepared by our study, must give the filament of transient business profit. One of the most unlocked doors is the third-party entry into the management server. However, we have used neural networking to safeguard critical data. It is next to impossible to decrypt the neural data's blueprint because there is an infinite number of outputs for a single input. The Tor-based business modules show four terms: AI-based business advantages, Green economy-based business profit, Sustainable establishment of business interest, Rapid growth of business benefits. To fill the space of blue water, the research is mixing the distilled integration of structured data. Covering the research's monopoles, we used the TOR technique, which denotes a tabular or recreating grid of central resonance management, which is the antidote against the business's giant asteroids called risk management. The research reconnects the past data wot the record of present data and compares the existing development of business management to establish the TOR method's theme, which will be the business intelligence town-based artificial intelligence buzzword.

Keywords— acute profit, algometry, deep learning, hypothesis, integrated AI.

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Hybrid Extraction of Detecting Breast Cancer with Fuzzy

Sritha Zith Dey Babu

Abstract — Breast Cancer early detection using terminologies of image processing is suffered from the less accuracy performance in different automated medical tools. To improve the accuracy, still there are many research studies going on different phases such as segmentation, feature extraction, detection, and classification. The proposed framework is consisting of four main steps such as image preprocessing, image segmentation, feature extraction and finally classification. This paper presenting the hybrid and automated image processing based framework for breast cancer detection. For image preprocessing, both Laplacian and average filtering approach is used for smoothing and noise reduction if any. These operations are performed on 256 x 256 sized gray scale image. Output of preprocessing phase is used at efficient segmentation phase. Algorithm is separately designed for preprocessing step with goal of improving the accuracy. Segmentation method contributed for segmentation is nothing but the improved version of region growing technique. Thus breast image segmentation is done by using proposed modified region growing technique. The modified region growing technique overcoming the limitations of orientation as well as intensity. The next step we proposed is feature extraction, for this framework we have proposed to use combination of different types of features such as texture features, gradient features, 2D-DWT features with higher order statistics (HOS). Such hybrid feature set helps to improve the detection accuracy. For last phase, we proposed to use efficient feed forward neural network (FFNN). The comparative study between existing 2D-DWT feature extraction and proposed HOS-2D-DWT based feature extraction methods is proposed.

Keywords-Breast Cancer, Removing, Processing, Filtering.

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Indoor Airborne Microplastics Quantification in Sydney-Australia and Its Potential Health Impacts

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Abstract— In recent years, much attention has been given to microplastics in aquatic environments as an emerging contaminant. While quite less consideration has been given to its ubiquitous presence in the atmospheric environment. Specifically, indoor environments where people spend about 90% of their lives.

This study is the first study of indoor airborne microplastics in Australia. Thirty-two samples were collected across the city of Sydney from private houses. The prevalent shape of the settled particles ~99% was fibers and the highest proportion of fibers had a length ranging between 200 and 400 μ m. Regarding fiber type, 39% of analyzed fibers were identified as petrochemical fibers. While 42% and 18% of fibers were natural and transformed natural based fibers, respectively. The deposition rate of MP fibers was estimated between 22 and 6169 (fibers/m2/day) among the houses. The potential exposure to MPs via inhalation and ingestion in different age ranges was investigated with younger age groups likely to be more susceptibility to MPs through both pathways.

Keywords-Microplastics, dust, Indoor fallouts, Deposition rate.

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Irrigation Water Quality Evaluation Based on Multivariate Statistical Analysis: A Case Study of Jiaokou Irrigation District

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Abstract—Groundwater is main source of water supply in the Guanzhong Basin, China. To investigate the quality of groundwater for agricultural purposes in Jiaokou Irrigation District located in the east of the Guanzhong Basin, 141 groundwater samples were collected for analysis of major ions (K⁺, Na⁺, Mg²⁺, Ca²⁺, SO4²⁻, Cl⁻, HCO3⁻, and CO3²⁻), pH, and total dissolved solids (TDS). Sodium percentage (Na%), residual sodium carbonate (RSC), magnesium hazard (MH), and potential salinity (PS) were applied for irrigation water quality assessment. In addition, multivariate statistical techniques were used to identify the underlying hydrogeochemical processes. Results show that the content of TDS mainly depends on Cl⁻, Na⁺, Mg²⁺, and SO4²⁻, and the HCO₃⁻ content is generally high except for the eastern sand area. These are responsible for complex hydrogeochemical processes, such as dissolution of carbonate minerals (dolomite and calcite), gypsum, halite, and silicate minerals, the cation exchange, as well as evaporation and concentration. The average evaluation levels of Na%, RSC, MH, and PS for irrigation water quality are doubtful, good, unsuitable, and injurious to unsatisfactory, respectively. Therefore, it is necessary for decision makers to comprehensively consider the indicators and thus reasonably evaluate the irrigation water quality.

Keywords—Irrigation water quality, multivariate statistical analysis, groundwater, hydrogeochemical process.

I. INTRODUCTION

GROUNDWATER is the most precious resource for various purposes in support of domestic, agricultural, and industrial development all over the globe [1], [2]. The Guanzhong Basin has fertile soil with a long history of irrigation, so the quality demand for irrigation water is high. However, it is located in a semi-arid area lacking surface water resources, so the security of agricultural irrigation water strongly depends on groundwater resources [2]. For proper operation of groundwater for agricultural irrigation, it is necessary to recognize the quality of available groundwater for ensuring a reliable supply [3], [4].

In order to evaluate irrigation water quality, many indices have been put forward and widely used in groundwater, such as Na, sodium adsorption ratio (SAR), RSC, MH, permeability index (PI), Kelley's ratio (KR), and PS [2]-[5]. Multivariate statistical techniques, such as Pearson's correlation analysis, cluster analysis (CA), and principal components analysis (PCA) are effective tools for assessing groundwater quality, and interpreting the hydrogeochemical processes [6]-[9]. Jiaokou Irrigation District is a typical irrigation area in Guanzhong Basin; therefore, to assess the water quality for irrigation purpose and to disclose the underlying hydrogeochemical processes, this study investigated the groundwater of Jiaokou Irrigation District using the multivariate statistical methods. The findings of this study can provide reasonable guidance for the groundwater irrigation in this area.

II. STUDY AREA

The Jiaokou Irrigation District (34°30'7"–34°52'37"N, 109°12'40"–110°10'1"E), surrounded by Shichuan River in the west, Luo River in the east, and Wei River in the south, is located in the east of the Guanzhong Basin, Shaanxi province, China. The topography of Jiaokou Irrigation District is divided into floodplain, first terrace, and second terrace of the Wei River, loess plateau, and sand belt (Fig. 1). The climate is classified as warm temperate and semi-arid monsoon. Mean annual temperature and precipitation are 13.4 °C and 548.5 mm, respectively [10]. The groundwater flows from northwest to southeast in this area. The land use throughout majority of this area is for agricultural purpose [10], [11].

III. MATERIALS AND METHODS

A. Sampling and Analysis

Totally, 141 groundwater samples were collected in the Jiaokou Irrigation District. The sampling sites are presented in Fig. 1. The pH and TDS of groundwater samples were measured using portable devices in the field. The SO_4^{2-} and Cl^- were tested by ion chromatography, and HCO_3^- was tested by alkalinity titration. Ca^{2+} and Mg^{2+} were analysed by the EDTA titrimetric method. The concentrations of K⁺ and Na⁺ were determined by flame atomic absorption spectrophotometry. To ensure accuracy in the analysis, the charge balance error (CBE) for the water samples should be controlled within the acceptable range of \pm 5% [2], [4], [10], [12], [13].

$$CBE = \frac{\sum \text{cations} - \sum \text{anions}}{\sum \text{cations} + \sum \text{anions}} \times 100\%$$
(1)

where, all cations and anions were expressed in meq/L.

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Fig. 1 Map showing the location of the study area and the distribution of sampling sites

B. Indicators for Irrigation Water Quality

Four indicators, Na, RSC, MH, and PS were selected to evaluate the groundwater for irrigation purposes. They were calculated using (2)-(5) [2].

$$Na\% = \frac{\left(Na^{+} + K^{+}\right) \times 100}{Ca^{2+} + Mg^{2+} + Na^{+} + K^{+}}$$
(2)

RSC =
$$\left(CO_{3}^{2-} + HCO_{3}^{-}\right) - \left(Ca^{2+} + Mg^{2+}\right)$$
 (3)

$$MH = \frac{Mg^{2+}}{Ca^{2+} + Mg^{2+}} \times 100$$
 (4)

$$PS = CI^{-} + \frac{1}{2}SO_{4}^{2-}$$
(5)

where, all ionic concentrations are expressed in meq/L.

C. Multivariate Statistical Analysis

In this study, the Pearson's correlation analysis was used to find potential relationships among the irrigation quality indices and hydrochemical parameters of groundwater samples. Coefficient values of 0.7 and 0.3 are the threshold for strong, medium, and weak correlation [10], [14]. The hierarchical cluster analysis (HCA) was conducted by using a metric of Euclidean distance to classify the irrigation quality indices and hydrochemical parameters and to identify their pattern of associations. These analyses were performed using the Statistical Package for Social Sciences software (SPSS. 20).

IV. RESULTS AND DISCUSSION

A. Groundwater Hydrochemical Parameters

The geographical spatial distribution of all the groundwater parameters was obtained using a geographic information system (GIS) interpolation technique, and shown in Fig. 2. The distribution of TDS is similar to that of Cl⁻, Na⁺, Mg²⁺, and SO_4^{2-} , indicating that these ions mainly determine the TDS. The contents of these components are high in the center of this area, with the low groundwater level, suggesting that the evaporation concentration plays an important role [10]. In addition, probably due to the good permeability and strong water circulation of sand, the TDS content of the groundwater in the sand belt is low (Fig. 2). The other ions also have low contents in the sandy areas. Except for the sand area in the east, the HCO₃⁻ content is generally high in the whole region, which may be related to widespread carbonate minerals such as calcite and dolomite.



Fig. 2 Maps of the spatial distribution of hydrochemical parameters in the study area

B. Irrigation Water Quality

Too high Na% will destroy soil structure and reduce irrigation effect [2]. From Table I, Na% ranges from 13.04% to 88.09%, with a mean of 60.63%, indicating that the average level of irrigation water quality is doubtful. The water with high RSC easily leads to the deposition of sodium carbonate and

makes the soil barren [15]. Table I shows that RSC has a range between -33.47 meq/L and 20.23 meq/L (mean of -1.62 meq/L), indicating that the average level of irrigation water quality is good. More Mg^{2+} in water would result in the alkaline soil, which can reduce the permeability of soil and thus adversely affect crop yields [16]. MH has a range of 31.01-91.34%, with a mean of 74.45%. This indicates overall irrigation water quality level is unsuitable. In addition, PS ranges between 0.19 and 93.63 meq/L (mean = 17.20 meq/L), suggesting that the average irrigation level of groundwater is injurious to unsatisfactory.

TABLE I THE CLASSIFICATIONS OF GROUNDWATER QUALITY FOR IRRIGATION IN JIAOKOU IRRIGATION DISTRICT

		JIAUKU	U IRRIGATION I	JISTRICI		
Indicator	Unit	Range	Water quality	Maximum	Minimum	Mean
		<20	Excellent			
		20-40	Good			(0.(2
Na%	%	40-60	Permissible	88.09	13.04	00.03
		60-80	Doubtful			
		>80	Unsuitable			
		<1.25	Good			
RSC	meq/L	1.25-2.50	Doubtful	20.23	-33.47	-1.62
		>2.50	Unsuitable			
MH	%	<50	Suitable	01.24	21.01	74.45
		>50	Unsuitable	91.54	31.01	
		<3.0	Excellent to			
PS			good	93.63	0.19	17.20
	meq/L	3.0-5.0	Good to			
			injurious			

>5.0 Injurious to unsatisfactory

C. Multivariate Statistical Analyses

From Table II, it is seen that Na% has a moderate relationship with HCO₃⁻ (R = 0.61) and Na⁺ (R = 0.54). RSC has a strong negative relationship with Ca^{2+} (R = -0.74) and Mg^{2+} (R = -0.81). These results can be explained by exchange and adsorption which consumes the Ca²⁺ and Mg²⁺ provided by the carbonate dissolution, thus producing HCO3⁻ and Na⁺. MH has a medium positive correlation with HCO_3^- (R = 0.60) and Na^+ (R = 0.50), which also indicates the existence of cation exchange, especially the substitution of Ca²⁺ for Na⁺. PS has a strong positive relationship with Cl⁻ (R = 0.99), and SO₄²⁻ (R =0.96) also has a strong correlation with TDS (R = 0.95), Na⁺ (R= 0.93), and Mg²⁺ (R = 0.78), indicating that TDS mainly depends on Na⁺, Mg²⁺, Cl⁻, and SO₄²⁻ (Table II). These also reflect that the main hydrogeochemical processes may be dissolution of silicate minerals (K-, Na-, and Ca-feldspar), carbonate minerals (dolomite and calcite), gypsum, and halite, the cation exchange, as well as evaporation and concentration.

TABLE II

PEARSON	'S CORRELA	TION COEFF	ICIENTS OF	IRRIGATION	QUALITY I	NDICES AND	HYDROCH	EMICAL PAR	AMETERS IN	N JIAOKOU II	RRIGATION I	DISTRICT
R	Na%	RSC	MH	PS	\mathbf{K}^+	Na ⁺	Ca ²⁺	Mg^{2+}	CO3 ²⁻	HCO ₃ -	Cl	SO_4^{2-}
Na%	1											
RSC	0.42^{**}	1										
MH	0.64**	0.09	1									
PS	0.30**	-0.62**	0.35**	1								
\mathbf{K}^+	-0.04	-0.31**	-0.14	0.22**	1							
Na^+	0.54^{**}	-0.33**	0.50^{**}	0.93**	0.12	1						
Ca ²⁺	-0.42**	-0.74**	-0.44**	0.38**	0.57^{**}	0.14	1					
Mg^{2+}	-0.02	-0.81**	0.41^{**}	0.78^{**}	0.22^{**}	0.64^{**}	0.49^{**}	1				
CO32-	0.43**	0.25**	0.37**	0.13	0.11	0.29**	-0.07	0.13	1			
HCO3 ⁻	0.61**	0.31**	0.60^{**}	0.21^{*}	0.07	0.45**	-0.15	0.26**	0.59**	1		
Cl	0.27**	-0.63**	0.35**	0.99**	0.25**	0.89**	0.40^{**}	0.79**	0.13	0.22**	1	
SO_4^{2-}	0.30**	-0.57**	0.33**	0.96**	0.16	0.92**	0.33**	-0.72**	0.13	0.18*	0.90**	1

Notes: R is the Pearson's correlation coefficient; ** Significant at the 0.01 level (2-tailed); * Significant at the 0.05 level (2-tailed).

Based on the cut-off at the smallest distance (12.5) [17], the irrigation quality indices and hydrochemical parameters of groundwater samples can be divided into two main clusters in the dendrogram (Fig. 3). In cluster 1, it can be found that PS, Na⁺, Mg²⁺, Cl⁻, and SO₄²⁻ are first grouped together, which verifies the conclusion of the correlation analysis, namely, the TDS is greatly influenced by the dissolution of gypsum and halite, as well as evaporation and concentration. Meanwhile, the RSC, Ca²⁺, and K⁺ are also first grouped together, suggesting the dissolution of carbonate and cation exchange. In cluster 2, it includes HCO3⁻, CO3²⁻, Na%, and MH, which also indicates the occurrence of carbonate dissolution and exchange and adsorption. The carbonate dissolution provides the HCO₃, CO_3^{2-} , Ca^{2+} , and Mg^{2+} , while Ca^{2+} and Mg^{2+} are consumed by cation exchange along with producing K⁺ and Na⁺, as well as promoting the dissolution of carbonate minerals such as calcite and dolomite.



Fig. 3 Dendrogram of the clusters for irrigation quality indices and hydrochemical parameters of groundwater samples

V.CONCLUSIONS

To reveal the water quality status for irrigation purpose, to explore the relationship between irrigation indicators and hydrogeochemical parameters of groundwater and to disclose the underlying hydrogeochemical processes, this study provides an investigation of groundwater of Jiaokou Irrigation District, using the multivariate statistical analysis methods. The geographical spatial distribution of TDS is similar to that Cl-, Na⁺, Mg²⁺, and SO₄²⁻, indicating the content of TDS mainly depends on these ions. The HCO₃⁻ content is generally high except for the eastern sand area, which may be related to widespread carbonate minerals. Based on the Na%, RSC, MH, and PS, the average irrigation level is doubtful, good, unsuitable, and injurious to unsatisfactory, respectively. The evaluation results are not completely consistent, mainly due to the influence of complex hydrogeochemical processes, including the dissolution of carbonate minerals (dolomite and calcite), gypsum, halite, and silicate minerals, the cation exchange, as well as evaporation and concentration. Therefore, it is necessary to consider the indexes comprehensively to evaluate the irrigation water quality reasonably.

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Irrigation Water Quality Evaluation in Jiaokou Irrigation District, Guanzhong Basin

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Abstract-Groundwater is an important water resource in the world, especially in arid and semi-arid regions. In the present study, 141 groundwater samples were collected and analyzed for various physicochemical parameters to assess the irrigation water quality using six indicators (sodium percentage (Na%), sodium adsorption ratio (SAR), magnesium hazard (MH), residual sodium carbonate (RSC), permeability index (PI), and potential salinity (PS)). The results show that the patterns for the average cation and anion concentrations were in decreasing orders of $Na^+ > Mg^{2^+} >$ $Ca^{2^+} > K^+ and SO_4^{2^-} > HCO_3^- > Cl^- > NO_3^- > CO_3^{2^-} > F^-$, respectively. The values of Na%, MH, and PS show that most of the groundwater samples are not suitable for irrigation. The same conclusion is drawn from the USSL and Wilcox diagrams. PS values indicate that Cl⁻and SO4² have a great influence on irrigation water in Jiaokou Irrigation District. Residual sodium carbonate (RSC) and permeability index (PI) values indicate that more than half of groundwater samples are suitable for irrigation. The finding is beneficial for the policymakers for future water management schemes to achieve a sustainable development goal.

Keywords—Irrigation water quality evaluation, groundwater chemistry, Jiaokou Irrigation District, Guanzhong Basin

I. INTRODUCTION

GROUNDWATER plays an important role for domestic drinking, industrial production, and agricultural irrigation all over the world, especially in arid and semi-arid regions where surface water and precipitation are usually scarce [1], [2]. The quality of groundwater has been regarded as a decisive factor for a country's sustainable development [3]. Agricultural irrigation requires much higher water quality than industrial water and even household water [2].

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Especially for irrigated areas, the variation in groundwater chemistry has a strong effect on plants and soil, potentially damaging plants and reducing crop yields [4], [5]. Specifically, the physical effect of ions is to decrease the osmotic pressure in the structural cells of a plant, preventing water from reaching the branches and leaves [5]. Especially for irrigated areas located in arid and semi-arid areas, groundwater salinization is a common problem [6], [7], where the level of human activities may have significantly increased or disturbed the extent of these processes. This in turn results in crop reduction and subsequent negative impact on the economy and human society. This research has important reference value for regions and countries with food security issues caused by irrigation water quality [8]-[10]. Therefore, it is a prerequisite to understand groundwater quality for irrigation purposes.

The aim of this study is to evaluate the groundwater suitability for irrigation purposes using different indices (sodium percentage (Na%), sodium adsorption ratio (SAR), residual sodium carbonate (RSC), magnesium hazard (MH), permeability index (PI), and potential salinity (PS)) and to provide information for policymakers to achieve sustainable development.

II. STUDY AREA

The Jiaokou Irrigation District (34°30'7"–34°52'37"N, 109°12'40"–110°10'1"E), with 60 years of irrigation history, is one of the artificial irrigation areas within the Guanzhong Basin [11]. It is surrounded by water on three sides, with the Shichuan River in the west, Luo River in the east, and Wei River in the south and is located in the east of the Guanzhong Basin (Fig. 1). The climate is classified as warm temperate and semi-arid monsoon with a mean annual temperature of 13.4 °C, a precipitation of 548.5 mm, and annual evaporation of 1003.1 mm. The irrigation water comes from the Wei River with the Canal Head Station of the irrigation area located on the north bank of the river 2.5 km east of Jiaokou Town, Lintong District, Xi'an City (Fig.

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1), and the volume of water taken from the river per year is 3.07×10^8 m³. The canal system is mainly distributed throughout the central and western parts of the irrigation area, which is dominated by cultivated land. However, the

dry land is mainly developed in the sandbelt area in the east of the irrigation area. In addition, orchards and residential areas are scattered throughout the study area.



Fig. 1 Map showing the location and land use of study area as well as the distribution of sampling points

III. MATERIALS AND METHODS

A. Sample collection and laboratory analysis

A total of 141 phreatic groundwater samples were collected in 2014 from the borewells/hand pumps in the Jiaokou Irrigation District (Fig. 1). The pH and TDS of groundwater samples were measured using a portable device in the field. Ca²⁺, Mg²⁺, CO₃²⁻, and HCO₃⁻ were measured by titration with a detection limit of 1.0 mg/L, whereas K⁺ and Na⁺ were measured using flame atomic absorption spectrometry. Cl⁻ and SO₄²⁻ were determined by ion chromatography. To ensure the appropriate accuracies in the analyses, the ionic-balance-error for the ions in the water samples was within the acceptable limit of $\pm 5\%$ [1], [2], [11].

B. Evaluation method

Six indicators, sodium percentage (Na%), sodium adsorption ratio (SAR), residual sodium carbonate (RSC), magnesium hazard (MH), permeability index (PI), and potential salinity (PS), were calculated to evaluate the status of the groundwater for irrigation purposes [2], [5], [12], [13]. All the parameters used in the following equations were expressed in the milli-equivalent unit.

$$Na\% = \frac{Na^{+} + K^{+}}{Na^{+} + K^{+} + Ca^{2+} + Mg^{2+}} \times 100$$
(1)
SAR
Na^{+}

$$\sqrt{(Ca^{2+} + Mg^{2+})/2}$$

=

$$RSC = (C0_{3}^{2-} + HCO_{3}^{-}) - (Ca^{2+} + Mg^{2+})$$
(3)
MH

$$= \frac{Mg^{2+}}{(Ca^{2+} + Mg^{2+})} \times 100$$
(4)
$$PI = \frac{Na^{+} + \sqrt{HCO_{3}^{-}}}{Na^{+} + K^{+} + Ca^{2+} + Mg^{2+}} \times 100$$
(5)

PS

$$+\frac{1}{2}$$

× SO_4^{2-}

 $= C1^{-}$

IV. RESULTS AND DISCUSSION

A. Groundwater parameters and groundwater chemistry

The chemical characteristics of groundwater in this study region are presented in Table 1. Seven out of 141 groundwater samples, located west of the study area, have a pH outside the recommended range of 6.5 to 8.5. TDS represents the total dissolved salts in water, and ranged from 237 to 7667 mg/L, with an average value of 2215 mg/L. The patterns for the average cation and anion concentrations were in decreasing orders of Na+ > Mg2 + > Ca2)+ > K+and SO42- > HCO3- > C1- > NO3- > CO32- > F-, respectively (Table). Specifically, the Na + content ranged from 23 to 2822 mg/L (mean=557.43 mg/L) in all groundwater samples, with 83.69% of samples exceeding the allowable limits of 200 mg/L, while the K+ concentration ranged from 0.37 to 96.46 mg/L, with an average value of 4.90 mg/L. Ca2+ and Mg2 + as important indicators of water hardness, showed values from 9.3 to 452.5 mg/L and 20.5 to 435.8 mg/L, respectively. The SO42-concentrations ranged from 9.4 to 4367 mg/L, with an average value of 625.27 mg/L. Over 70% of samples exceeded the threshold of 250 mg/L for SO42-. HCO3-concentrations varied between 199

and 1249 mg/L, with a mean of 611.19 mg/L, while CO32 – values ranged between 11.6 and 120 mg/L, with an average value of 43.48 mg/L. In this study region, 85.82% of the groundwater samples exceeded the recommended levels of 300 mg/L for HCO3-. The Cl- concentrations varied between 3.16 and 1909 mg/L, with a mean of 379.37mg/L, with 54.61% of the samples exceeding the threshold of 250 mg/L. NO3- concentrations ranged from 0.1 to 1087 mg/L, with a mean of 156.5 mg/L, while F- concentrations were between 0.2 and 8.92 mg/L, with a mean value of 2.06 mg/L.

Indices	Min.	Max.	Mean	SPL (WHO)	Number of Samples Exceeding the SPL
pН	6.48	9.9	7.68	6.5-8.5	7
TDS	237	7667	2215.01	1000	117
K^+	0.37	96.46	4.90	10	12
Na ⁺	23	2822	557.43	200	118
Ca ²⁺	9.3	452.5	62.10	200	3
Mg^{2+}	20.5	435.8	119.78	200	22
CO32-	11.6	120	43.48	-	-
HCO3 ⁻	199	1249	611.19	300	121
Cl	3.16	1901	379.37	250	77
SO4 ²⁻	9.4	4367	625.27	250	104
NO ₃ -	0.1	1087	156.50	50	99
F-	0.2	8.92	2.06	0.5-1.5	93
$\operatorname{COD}_{\operatorname{Mn}}$	0.24	4.35	0.81	3	1

TABLE I STATISTICAL SUMMARY OF CHEMICAL COMPOSITION OF GROUNDWATER IN THE STUDY REGION

Notes: SPL is standard permissible limit value.

B. Groundwater quality for irrigation purposes

The ion concentration in water will affect the osmotic pressure of water entering the plant cells, which will affect the transportation of water in the plant and finally disrupt plant metabolism [5], [14]. Thus water quality assessment plays an important role in irrigation. In this study, various irrigation water quality indices, Na%, SAR, RSC, MH, PI, and PS were calculated, and the results are summarized in Table . The spatial distribution maps of these indices are plotted in Fig. 2.

TABLE II IRRIGATION QUALITY PARAMETERS OF JIAOKOU IRRIGATION DISTRICT

IL	WQ	Ν	Р	IL	WQ	Ν	Р
Na%				SAR			
<20	excellent	10	7.09%	<10	excellent	69	48.94%
20-40	good	13	9.22%	10-18	good	59	41.84%
40-60	permissible	28	19.86%	18-26	doubtable	12	8.51%
60-80	doubtable	72	51.06%	>26	unsuitable	1	0.71%
>80	unsuitable	18	12.77%				
RSC				MH			
<1.25	good	80	56.74%	<50	suitable	13	9.22%
1.25-2.5	doubtable	9	6.38%	>50	unsuitable	128	90.78%

Conference Proceedings, Melbourne Australia Feb 01-02, 2021, Part I

>2.5	unsuitable	52	36.88%				
PI				PS			
<25%	unsuitable	0	0	<3	excellent to good	18	12.77%
25-75	moderate	67	47.52%	3-5	good to injurious	9	6.38%
>75%	suitable	74	52.48%	>5	injurious to unsatisfactory	114	80.85%

Notes: IL is indices levels; WQ is water quality; N is the number of groundwater samples; P is the percentage.

Na%, as an evaluation index of irrigation water quality, represents the sodium hazard. High Na% will damage the soil structure, reduce the permeability, and finally result in poor internal drainage in irrigation [12]. Na% is classified into five classes (Table \Box). The majority of the samples for irrigation are in the doubtable category (51.06%), followed by permissible (19.86%), unsuitable (12.77%), good (9.22%), and excellent category (7.09%). Only 23

groundwater samples meet the regular irrigation. However, 72 and 18 samples have 60% to 80% and > 80% sodium, indicating that these samples are harmful for crops because of their effects on soil permeability and texture. As shown in Fig. 2(a), except for a small part of the eastern part of the study area, the Na% of the rest of the groundwater has permissible to unsuitable for irrigation.



Fig. 2 The spatial distribution maps showing different irrigation indices

SAR is used to assess the alkali/sodium level due to the excess sodium or limited calcium and magnesium [15]. Based on the SAR values, irrigation waters are classified into four categories (Table \Box). A total of 128 out of 141 groundwater samples are good for general irrigation because of limited calcium and magnesium. In addition, increasing the Ca²⁺ and Mg²⁺ concentration in water will improve soil permeability, and this is beneficial for groundwater samples that are not suitable for irrigation (less

than 10%). From Fig. 2(b), only a small part of the central and northern areas of the study area, the SAR values exceeded the specified value (> 18%).

The US Salinity Laboratory (USSL) diagram [16]; (Fig. 3(a)) and Wilcox diagram [17]; (Fig. 3(b)), combining both salinity hazard and alkalinity, were used further to analyze the suitability of water for irrigation. Based on these data, most of the water samples fall into zone C3 and C4, indicating a high salinity hazard. Moreover, the SAR values

increase with the increase of EC values (Fig. 3(a)). In addition, as shown in the Wilcox diagram (Fig. 3(b)), most of groundwater samples belong to the categories "permissible to doubtful" and "doubtful to unsuitable". Moreover, the groundwater samples fall into the zone of "permissible to doubtful" are mainly poor water. The fair groundwater is generally distributed in the category of "excellent to good", indicating that fair groundwater for drinking purposes is a good source for irrigation. Ten samples belong to the category "unsuitable" with EC more than 3000 μ S/cm. For groundwater samples with TDS less than 1000, they are mainly distributed in the category of "excellent to good". It can be seen from Fig. 3(a) and Fig. 3(b), the larger the TDS of the water, the less suitable it is for irrigation.



Fig. 3 USSL and Wilcox diagrams demonstrating irrigation water quality: (a) USSL diagram and (b) Wilcox diagram

RSC is defined as the difference of the sum of carbonate and bicarbonate and the sum of calcium and magnesium [2], [18]. In this study, the RSC values of 80 groundwater samples are less than 1.25, i.e., 56.74% of groundwater samples are good for irrigation purpose (Table \Box). However, 9 and 52 water samples belong to the doubtable and unsuitable category, respectively. Irrigation water with high RSC value may make the soil infertile due to the presence of sodium carbonate [19],[20]. Furthermore, the high-value area of RSC is small and scattered (Fig. 2(c)). High bicarbonate concentration in irrigation water will raise the RSC values and increase water hardness due to the precipitation of calcium bicarbonate and magnesium bicarbonate [21].

Calcium and magnesium in groundwater generally maintain an equilibrium state. However, when more Mg^{2+} is present in groundwater, the crop yields will decrease due to the alkaline soil [14], [15]. Moreover, high level of magnesium in water can deteriorate soil structure because

of exchangeable Na in irrigated soils. MH reflects the damage of magnesium to soil structure. The boundary value of MH for irrigation is 50 [22]. In the Jiaokou Irrigation District, 128 (90.78%) groundwater samples are unsuitable for irrigation based on the MH value (Table \Box) and these unsuitable samples are basically distributed throughout the study area (Fig. 2(d)), confirming high magnesium content in the study area.

Long-term irrigation of the soil with mineral-rich (Ca²⁺, Mg²⁺, Na⁺, and HCO₃⁻) water will reduce soil permeability and eventually make soil to retard the emergence of seedlings [2], [4], [13], [15]. PI, as an indicator to reflect soil permeability, was proposed by Doneen [6] and classified into three categories, unsuitable (<25%), moderate (25-75%), and suitable (>75%). Some 47.52% of the groundwater samples belong to the moderate category and 52.48% belong to the suitable category (Table \Box). It can be seen that the impact of irrigation water in the study area is slight on soil permeability. The spatial distribution of PI is shown in Fig. 2(e).

PS, as an indicator of the impact of Cl⁻and SO₄²⁻on irrigation water, is defined as the Cl⁻concentrations plus half of the SO₄²⁻concentration [2], [5]. The groundwater samples are classified into three categories, excellent to good, good to injurious, and injurious to unsatisfactory, based on the PS values. The results show that 114 and 9 of

V.CONCLUSIONS

Various physicochemical parameters of 141 groundwater samples were analyzed to assess the irrigation water quality using six indicators (Na%, SAR, RSC, MH, PI, and PS). The major conclusions of the study are as follows:

The patterns for the average cation and anion concentrations were in decreasing orders of $Na^+ > Mg^2$ $^{+}$ > Ca²⁺ > K⁺and SO₄²⁻ > HCO₃⁻ > Cl⁻ > NO₃⁻ > $CO_3^{2^-} > F^-$, respectively. The majority of the samples for irrigation based on Na% are in the doubtable category (51.06%), followed by permissible (19.86%), unsuitable (12.77%), good (9.22%), and excellent category (7.09%). The USSL and Wilcox diagrams show that most of groundwater samples are not suitable for irrigation. RSC values indicate 56.74% of groundwater samples are good for irrigation purpose, and 128 (90.78%) groundwater samples are unsuitable for irrigation based on the MH value and basically distributed throughout the study area. Based on the PI values, 47.52% of the groundwater samples belong to the moderate category and 52.48% are belong to the suitable category, and 114 and 9 of groundwater samples are belong to categories "injurious to unsatisfactory" and "good to injurious" based on the PS, indicating that Cl⁻and SO₄²⁻have a great influence on irrigation water. These findings would provide guidance for spatial management decisions of irrigation groundwater in Jiaokou Irrigation District.

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groundwater samples belong to categories "injurious to unsatisfactory" and "good to injurious", respectively (Table). However, only 18 of the samples belong to "excellent to good". This indicates that Cl^- and $SO_4{}^2^-$ have a great influence on irrigation water. As shown in Fig. 2(d) and Fig. 2(f), the spatial distribution of PS is basically consistent with MH.

acknowledged.

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Management Practices, Performance and Constraints of Camel Production in Kebri Dahar District, Somali Region, Ethiopia

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Abstract — The study was conducted in Kebri Dahar District of Somali Region Ethiopia, with objectives to assess traditional management practices and determine reproductive performance of camel. Four Kebeles were selected purposively out of twenty-one kebeles, based on the accessibility and potential for camel production. Thirty camel herders were selected from each Kebele randomly, making total sample size of 120. Primary and secondary data were relied on this study. Camels are kept for multi-purposes. The main purpose of consumed milk and meat were (53.3%) followed by social prestige (23.3%), income source (12.3%), and transportation (9.1%). The major feeds available in study area were Cordiaovalis (Maayo), Ziziphus Mauritian (Gob), Acaciabusie (Galool), Bosciaminimifolia (Maygaag), and Cordeauxia edulis (Yu'ub). The major water sources were water well (48.3%) and pumped water well (41.3%). The frequency of watering camel differed in seasons. During the wet season, 80.8% of camel herders water their camels after one month, while 19.2 % water their camel once in month. However, in the dry season, camels drink once in a week (1.7%), once in two weeks (85.5%) and once in month (12.5%), respectively. The average daily milk off-take per camel in wet and dry season was 6.84 and 3.4 liters, respectively. The average lactation length was reported to be 13.76 months. The average camel milk produced, consumed, and sold in the wet season were 22.8, 21.2, and 8.2 liters, respectively, while in the dry season, 12.3, 10.8, and 7.4 liters, respectively. The average prices of camel milk in wet and dry seasons were 26 and 32 ETB, respectively. The mean average prices of young female and male camels were 9091.7 and 8580 ETB, respectively. The mean average prices of matured male and female camels were 13,462.5 and 12,966.7 ETB, respectively. The average prices of the old male and female camels were 18,841.7 and 11,383.3 ETB, respectively. Average age at sexual maturity, average age at first calving, calving interval, and gestation length of female camel were 4.4 years, 5.9 years, 24.3 months, and 12.3 months, respectively. The average age at sexual maturity, at first service and reproductive life span of the male camel, were 5.3, 6.3, and 20.5 years, respectively. The camel herders responded that feed shortage was the major problem (55%), followed by disease problem (29.2%). The most prevalent disease was lymphadenitis. Generally, it can be concluded that the performance of camels in the study area is low due to traditional husbandry practices. Strength efforts to make the pastoral production system efficient and improve the life of pastoral society by introducing modern husbandry practices such as: conserving feed resource and improving the health extension service, and developing and strengthening watering points are recommended to improve the production of camel in the study area.

Keywords— camel herders, constraints, production, reproductive performance.

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Biotransformation of Monoterpenes by Whole Cells of Eleven *Praxelis clematidea*-Derived Endophytic Fungi

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Abstract—Monoterpenoids are mainly found in plant essential oils and they are ideal substrates for biotransformation into oxygen-containing derivatives with important commercial value due to their low price and simple structure. In this paper, eleven strains of endophytic fungi from Praxelis clematidea were used as test strains to conduct the whole cell biotransformation of the monoterpenoids: (+)-limonene, (-)-limonene and myrcene. The fungi were inoculated in 50 ml Sabouraud medium and incubated at 30 \square with the agitation of 150 r/min for 6 d, and then 0.5% (v/v) substrates were added into the medium and biotransformed for further 3 d. Afterwards the cultures were filtered, and extracted using equal volume of ethyl acetate. The metabolites were analyzed by GC-MS technique with NIST database. The Total Ion Chromatogram of the extractions from the eleven strains showed that the main product of (+)- and (-)-limonene biotransformation was limonene-1,2-diol, while it is limonene and linalool oxide for biotransformation of myrcene. This work will help screen the microorganisms to biotransform the monoterpenes.

Keywords—Endophytic fungi, (+)–limonene, (-)–limonene, myrcene.

I. INTRODUCTION

THE basic structure of terpenoids is made up of different I numbers of isoprene connected end to end. According to the rules of isoprene, two isoprenes are called monoterpenes. Monoterpenes are classified into acyclic monoterpenes, monocyclic monoterpenes, bicyclic monoterpenes, and irregular monoterpenes. According to their structure, monoterpenes mainly exist in essential oils, most of which have aroma, antibacterial, and flavor-correcting effects, and are widely used in the pharmaceutical industry, perfume industry, insect pheromone and insect repellent, etc. [1]. Among the monoterpenoids, the two monoterpenes, limonene and pinene, derived from lemon essential oil and turpentine oil, have always been ideal biotransformation substrates due to their simple structure and low price. In the reported literature, limonene [2], α - and β -pinene [3] can all be biotransformed with bacteria, fungi, yeasts and plant cells. Among the reported microbial catalysts, bacteria accounted for 41% and fungi accounted for 33% [4].

Among the bacteria used for biotransformation of terpenoids, Pseudomonas sp. has been reported the most. This genus of bacteria was first isolated from the soil in 1966, and it was discovered that the bacteria can use limonene as the only carbon source for biotransformation [5], [6]. It was subsequently discovered that P. aeruginosa can convert tyrosol into hydroxytyrosol [7]-[9], convert myrcene into dihydrolinalool for 1.5 days biotransformation, and 2,6dimethyloctane for 3 days biotransformation, respectively [10]. *P. rhodesiae* PF1 can generate isonovalal from α -pinene oxide [11], P. putida converts limonene into perillic acid [12], [13]. In 2013, Molina et al. [14] summarized the study on the biotransformation of terpenoids by Pseudomonas sp. In fungi, Fusarium oxysporum 152b [15]-[17] was reported to convert R-(+)-limonene and S-(-)-limonene into R-(+)- α -terpineol and limonene-1,2-diol, respectively. Penicillium digitatum and Yarrowia lipolytica can convert (+)-limonene to α -terpineol [18]-[22] and perillic acid [23], [24]. Another important mold is Aspergillus niger, which has been reported to employ (S)-(+)-Linalool [25], [26], α- and β-pinene [27], [28], (R)-(+)- and (S)-(-)-citronellol [29] as substrates. In 2014, Parshikov et al. [30] summarized the application of A. niger for biotransformation of terpenes.

In recent years, the role of plant endophytic fungi in the field of biocatalyst has begun to receive attention. Plant endophytic fungi need to co-evolve with host plants to adapt to changes in the environment, showing that they may produce abundant enzymes to adapt to the host [31]. Based on the above assumptions, the plant endophytic fungi should be applied to biotransformation, and some reports confirm this hypothesis. For example, the endophytic fungus Botryosphaeria sp., isolated from the seaweed Bostrychia radicans, can convert camphor into 6-endo-hydroxy racemic camphor, 6-exo-hydroxy camphor 5-exo-hydroxy camphor, 5-endo-hydroxy camphor, 3-exo-hydroxy camphor and 8-hydroxy camphor^[32]. Phomopsis sp., isolated from Pinus *taeda*, can biotransform limonene into carvone (0.536 g L^{-1}) and limonene-1,2-diol (2.08 g L^{-1}). More interestingly, the only main product, limonene-1,2-diol, is produced at 2.10 g L⁻¹ if citrus peel extract is used as the substrate [33]. Therefore, it is feasible to use plant endophytic fungi to biotransform monoterpenoids.

In this experiment, myrcene, which is an acyclic monoterpene, (+)- and (-)-limonene, which is monocyclic monoterpene, were selected as the substrate for biotransformation. Eleven endophytic fungi, isolated from

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Praxelis clematidea, were used as test strains. The products of the extraction of culture broth were analyzed by GC-MS. Through this experiment, our goal is to screen some strains suitable for biotransformation of monoterpenes to produce compounds with important commercial value.

II. MATERIALS AND METHODS

A. Materials and Apparatus

(+)-Limonene, (-)-Limonene, Myrcene, AR grade, were purchased from Tokyo Chemical Industry Co., Ltd., Japan; absolute Ethanol, Ethyl Acetate, Petroleum Ether, AR grade, were purchased from Sinopharm Reagent Co., Ltd., Shanghai, China. Thin layer chromatography silica gel plate (GF₂₅₄), which size is 50 mm×200 mm×(0.20~0.25) mm, was purchased from Qingdao Ocean Chemical Plant Branch, Shangdong, China.

The apparatus used in this experiment was listed as followings: Shaking incubator(Shanghai Zhichu Instrument Co., Ltd., Shanghai, China), XH-C Vortex Mixer (intan Baita Xinbao Instrument Factory, Zhejiang, China), Clean Bench SW-CJ-1FD (Suzhou Antai Air Technology Co., Ltd., Zhejiang, China), Medical Centrifuge Machine H1650 (Hunan Xiangyi Laboratory Instrument Development Co., Ltd., Hunan, China).

B. Separation and Identification of Plants Endophytic Fungi

Fresh and healthy specimens of *Praxelis clematidea* were collected from the Xiamen Campus of Huaqiao University and identified by Dr. Qizhi Wang from the College of Chemical Engineering, Huaqiao University. The plant specimen certificate code is 431127 and stored in the specimen room of Huaqiao University.

The endophytic fungi were separated from the leaves of *Praxelis clematidea*. The separation protocol was recorded in [34]. All the strains were stored in the Natural Products Laboratory, College of Chemical Engineering, Huaqiao University.

The endophytic fungi were identified by molecular biology identification. First, The fungal ITS sequence was amplified with the primer: ITS1 (5'-TTCGTAGGTGAACCTGCGG-3') and ITS4 (5'-TCCTCCGCTTATTGATATGC-3'), then the sequences were assembled and uploaded to National Center for Biotechnology Information (NCBI) searching for BLAST sequence similarity.

C. Whole-Cell Biotransformation of Monoterpenoids

The experiment was done according to [27] with some modifications: a loopful of each strain was inoculated in 250 mL Erlenmeyer flasks containing 50 mL of sterile Sabouraud medium (g L⁻¹: peptone 10, glucose 40, 1000 mL distilled water, pH 4.0-6.0) and incubated aerobically in orbital shaker at 30 °C and 200 rpm for 6 days. After the microorganisms' growth, 0.5 mL of substrate solution (substrate: absolute ethanol = 1:1, v/v, the final concentration of substrates is 0.5%) was added and biotransformed for 3 days under the same conditions. The experiments were carried out in parallel with controls, in the same conditions without the presence of microorganism.

At the end of the experiment, the cultures were filtered, and

the product recovery was performed by liquid–liquid extraction with an equal volume of ethyl acetate. The final solution was dried over anhydrous sodium sulfate and stored at 4 °C for TLC and GC/MS analysis. In the TLC analysis, the developer is 5% vanillin sulfuric acid developer (5 g vanillin is dissolved in 100 mL of 10% sulfuric acid ethanol solution).

The reaction products were identified by GC/MS (Angilent 8860 GC System-5977B GC/MS with G4513A autosampler) using a capillary column HP-5ms (30 m×0.25 mm×0.25 μ m). The column temperature was programmed to 60 °C for 1 min, increased at 20 °C/min at 300 °C for 13 min. Helium was the carrier gas, and the injection and detector temperatures were 250 °C. 1 μ L of the solution was injected into the GC/MS system. The apparatus operated with a flow rate of 1.5 mL/min and in split mode (split ratio 1:5).

The identification of the compounds was accomplished by comparing the mass spectra with those from the National Institute of Standard and Technology (NIST) 11.0 database.

III. RESULTS AND DISCUSSION

A. Strain Identification

After comparison of ITS sequence similarity, it was found that these endophytic fungi belonged to *Alternaria Nees* in the *Ascomycota* (Berk.) *Caval.*-Sm., except *Diaporthe Nitschke* for strain PS19,The serial ITS accession number for PS02, PS03, PS08, PS09, PS14, PS17, PS19, PS20, PS21, PS23, PS24 is MK640567, MK640571, MK640575, MK640579, MK640582, MK640584(PS19), MK640585, MK640586, MK640588, MK640589, respectively. PS08 failed to find a comparison result for the low similarity, so its species is not yet determined.

B. Analysis of (+)-Limonene Bioconversion Products

The Total Ion Chromatography (TIC) of the extract is shown in Fig. 1.







Fig. 1 the result of TLC analysis for extraction. The developing system is chloroform: methanol = 10:1 with 5% vanillin sulfuric acid developer

In Fig. 1, it can be seen the purple spot ($R_f = 0.73$ and 0.66) and grey spot ($R_f = 0.54$) commonly appeared in most of samples. Compared to the strain PS08 and PS19 to other strains, one red spot (R_f = 0.39) appeared in both of two strains. Based on the TLC analysis results, each extract was subsequently subjected to GC-MS to analyze its specific chemical components.





Fig. 2 TIC of the extraction for (+)-limonene biotransformation. a.PS02, b.PS03, c.PS08, d.PS09, e.PS14, f.PS17, g.PS19, h.PS20, i.PS21, j.PS23, k.PS24, L.limonene control

It can be seen from Fig. 2 that limonene-1,2-diol ($t_R = 6.64$ min) is the main signal in the extraction except PS08. The report of biotransformation of (+)-limonene to limonene-1,2-diol by plant endophytic fungi is consistent with the literature reported by [33] and [35]. The authors used the endophytic fungus *Phomopsis* sp. and *Cladosporium* sp.to biotransform (+)-limonene, and its main product is also limonene-1,2-diol (2.08 g L⁻¹, 1.5 g L⁻¹, respectively).

It also can be seen in Fig. 2i (PS21) two main products, limonene epoxide ($t_R = 5.03 \text{ min}$) and limonene-1,2-diol. This metabolic pathway has been clearly studied, that is the C-1, 2 position of (+)-limonene is first epoxidized and then hydroxylated to form diol compound [36]-[38]. The question is limonene epoxide is not common in these test fungi. The reason MAY BE EXPLAINED LIMONENE EPOXIDE IS CONVERTED TO LIMONENE diol in different level in Fig. 1, which the peak (t_R =5.03 min) is weak or undetectable. The ratio of limonene diol to limonene epoxide is depended on the

epoxide hydrolase activity level.

In Fig.2c and Fig. 2g, it can be seen the signal of phenyl ethanol. Combined with Fig. 1, it is speculated that the red spot (R_f =0.39) is phenyl ethanol. Normally, 2-Phenethyl alcohol (2-PE) is produced by biotransformation of *L*-phenylalanine as substrate^[39,40], but few reports on biotransformation of limonene into 2-PE, so its bioconversion mechanism needs to be further clarified.

C. Analysis of (-)-limonene bioconversion products

The TIC of the extract after the biotransformation of (-)-limonene by endophytic fungi is shown in Fig. 3.



Fig. 3 the result of TLC analysis from the extraction of (-)-limonene and

myrcene biotransformation by endophytic fungi. the developing system is petroleum ether: ethyl acetate =14:6 with 5% vanillin sulfuric acid developer. a. substrate-(-)-limonene, b. substrate-myrcene. 1.PS02, 2.PS03, 3.PS08, 4.PS09, 5.PS14, 6.PS17, 7.PS19, 8.PS20, 9.PS21, 10.PS23, 11.PS24, 12. myrcene standard, 13.(-)-limonene standard.

In Fig.3a, it can be seen the main spot is the same except the column 4 (PS09) for (-)-limonene biotransformation, so it was sampling for GC-MS analysis from column 3 and 4. In Fig.3b, the main spot is the same to the nine column except column 1 (PS02) and 3 (PS08), so the column 4 was also sampling for myrcene biotransformation. The result of GC/MS was shown in Fig. 4.



Fig. 4 TIC of the extraction. a. PS08 for (-)-limonene, b. PS09 for (-)-limonene, c. PS09 for myrcene.

As can be seen from Fig. 4, the metabolites are complex and diverse. In Fig. 4a, the main signal is limonene-1,2-diol. Combing the data in Fig. 4a and Fig. 2, plant endophytic fungi can transform both (+)- and (-) limonene into limonene-1,2-diol, indicating that the corresponding oxidase has no stereospecific requirements for the substrate. The assumption does not apply to strain PS09. The products of PS09 are myrcene, linalool oxide, 2,4-tert-butylphenol and m-camphorene.

In Fig. 4c, the signal showed the signals are myrcene, limonene, and linalool oxide, This result is consistent with the report of Akbar Esmaeili et al^{[10}]. The authors reported *Pseudomonas aeruginosa* can biotransform myrcene into dihydrolinalool and 2,6-dimethyloctane for 1.5 days, the products are belonging to ring-opening compound, so the linalool oxide is explainable. In this paper, the bacteria can also biotransform myrcene into 2,6-dimethyloctane and α -terpineol for 3 days, the formation of the latter is aided by the intermediate product limonene, so the closed-loop monoterpenoids, limonene and limonene-1,2-diol, can be formed by myrcene biotransformation.

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Challenges in the Last Mile of the Global Guinea Worm Eradication Program: A Systematic Review

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Abstract- Objective: The objective of this study was to identify the existing challenges in the last mile of the global Guinea Worm Eradication Program (GWEP). Method: Systematic Literature Review (SLR) on articles published from January 1, 2000 until December 31, 2019. Papers listed in Cochrane Library, Google Scholar, ProQuest PubMed and Web of Science databases were searched and reviewed. Results: Twenty-five articles met inclusion criteria of the study and were selected for analysis. Hence, relevant data were extracted, grouped and descriptively analyzed. Results showed the main challenges complicating the last mile of global GWEP: 1. Unusual mode of transmission; 2. Rising animal Guinea Worm infection; 3. Suboptimal surveillance; 4. Insecurity; 5. Inaccessibility; 6. Inadequate safe water points; 7. Migration; 8. Poor case containment measures, 9. Ecological changes; and 10. New geographic foci of the disease. Conclusion: This systematic review identified that most of the current challenges in the GWEP have been present since the start of the campaign. However, the recent change in epidemiological patterns and nature of Guinea Worm Disease (GWD) in the last remaining endemic countries illustrates a new twist in the global GWEP. Considering the complex nature of the current challenges, there seems to be a need for a more coordinated and multidisciplinary approach of GWD prevention and control measures in the last mile of the campaign. These new strategies would help to make history by eradicating dracunculiasis as the first ever parasitic disease.

Keywords— dracunculiasis, guinea worm, eradication program, last mile.

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Factors Affecting the Investment Returns of Listed Financial Institutions: A Study Based on Colombo Stock Exchange

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Abstract— Stock market investors are expecting an optimum return from their investments through dividends and capital gain. However, there are factors affecting their stock return. The factors examined in this study include Dividend Payout Ratio, Earning per Share (EPS), Return on Assets (ROA), and Return on Equity (ROE) on stock returns of the bank, finance, and insurance companies listed in Colombo Stock Exchange (CSE). Annual reports of 60 financial sector companies for the period from 2014 to 2018 were analysed in the current study This study represents an attempt to investigate the main factors determining stock return in the CSE (Colombo Stock Exchange). According to the current study, there is a significant positive effect of earning per share and dividend payout. Simultaneously there is a positive relationship between return on asset and stock return. In contrast, return on equity has a negative effect on stock returns which are both statistically insignificant.

Keywords— Dividend payout, Return on Asset, Earning per share, Return on equity, Stock return.

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Challenges of Eradicating Neglected Tropical Diseases

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Abstract— Background: Each year tropical diseases affect large numbers of tropical or subtropical populations and give rise to irreparable financial and human damage. Among these diseases, some are known as Neglected Tropical Disease (NTD) that may cause unusual dangers; however, they have not been accounted for appropriately. Taking into account the priority of eradication of the disease, this study explored the causes of failure to eradicate neglected tropical diseases.

Method: This study was a systematized review that was conducted in January 2021 on the articles related to neglected tropical diseases on databases of Web of Science, PubMed, Scopus, Science Direct, Ovid, Pro Quest and Google Scholar. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines as well as Critical Appraisal Skills Program (CASP) for articles and AACODS (Authority, Accuracy, Coverage, Objectivity, Date, Significance) for grey literature (provides five criteria for judging the quality of grey information) were integrated.

Finding: The challenges in controlling and eradicating neglected tropical diseases in four general themes are as follows: shortcomings in disease management policies and programs, environmental challenges, executive challenges in policy disease and research field and 36 sub-themes.

Conclusion: To achieve the goals of eradicating forgotten tropical diseases, it seems indispensable to free up financial, human and research resources, proper management of health infrastructure, attention to migrants and refugee, clear targeting, prioritization appropriate to local conditions and special attention to political and social developments. Reducing the number of diseases should free up resources for the management of neglected tropical diseases prone to epidemics as dengue, chikungunya and leishmaniosis. For the purpose of global support, targeting should be accurate.

Keywords— neglected tropical disease, NTD, preventive, eradication.

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Buddhism and Origin of Untouchability

Anup Hiwrale

Abstract— Buddhism emerges as a philosophy and spiritual practice for the cultivation of Mind and Dhamma. Buddhism is moving across the world and helping people to make meaning and sense of the world. However, It has originated within Indian realities with respect to caste and untouchability in 2500 years ago. Historically, the Untouchables were the followers of Buddha and Buddhist philosophy. They had been subjected to all kinds of discrimination and subjugation within India due to caste and untouchability forced upon them which had destroyed their humanness and lead to the creation of caste-being. The birth of a person attached to the caste and millions of people were considered as impure and not worthy of human association. This paper tries to understand Buddhism from the perspective of Untouchables with the conversion to Buddhism to reclaim humanity.

Keywords— Buddhism, Caste, Dalit, Untouchability.

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Future of Electric Power Generation Technologies

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Abstract— The objective of this paper is to demonstrate and describe eight different types of power generation technologies, and to understand the history of, as well as the future trend for, each technology. In addition, a comparison analysis between these technologies will be presented with respect to their cost analysis and associated performance.

Keywords—Conventional Power Generation, Economic Analysis, Environmental Impact, Renewable Energy Power generation.

I. INTRODUCTION AND BACKGROUND

S INCE the invention of electric power system by Tomas Edison back in 1882, electricity has become one of the most essential forms of energy in our daily life. Since that time, there are many power generation technologies that were introduced to focus on converting different forms of energy into electricity. For example, one of the oldest generation technologies is burning coal which converting the thermal energy into electricity. In addition, hydroelectric power generation is an old technology that is converting the kinetic energy (from water flow) into electricity.

As per the IEA report [50], the total electricity generated worldwide by fossil fuels is 64% of the total electricity (38% coal, 3% oil and 23% gas) as shown in figure 1.



Figure 1 "Electricity energy generation resources distribution worldwide"

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II. CONVENTIONAL POWER GENERATION

A. Coal Power Generation

A.1 History and future trend

Coal is one of the oldest resources that humans have used for heat since ancient history. Since the 1880s, coal has been used to produce electricity that supplied many homes at that time [1]. As of today, the total power capacity of coal-based power plants in the world is more than 2,000 GW. and almost 50% of this capacity is in China [2].

Despite the fact that coal power generation produces CO2 emissions, there has been a slight increase in the total power generated by coal power plants around the world. By the end of 2018, there had been a 3% increase worldwide, according to IEA data, and this increase was mainly driven by Asian countries as detailed in figure 2 [26]. The EnerFuture forecast states that the world will reduce coal power plants share in electricity generation by 10% by 2040, as shown in figure 3 [27].



Figure 2 "Coal power generation increase in 2018 worldwide"



Figure 3 "EnerFuture forecast in Coal generation globally"

A.2 Technology Description

Coal power plant technology is based on using coal as a heat source (by burning) to boil water, and produce steam that can drive the steam turbine. The steam turbine drives the generator that produces electricity. These components are shown in figure 4 [3].



Figure 4 "Coal Power Plant Layout"

B. Natural Gas Power Generation

B.1 History and future trend

Natural gas was first used as an energy resource (approximately 500 B.C.) by the Chinese [4]. They used natural gas to boil sea water to make it drinkable. Starting in the 1990s, natural gas has become one of the most important resources for power plants around the world [5]. Today, natural gas power plants worldwide have a total capacity of 1,600 GW, and this is expected to exceed 3,000 GW by 2050 [6] as shown in figure 5.



Figure 5 "Natural Gas power plant installed capacity trend"

B.2 Technology Description

There are two main technologies in natural gas power plants; simple and combined cycles. The simple cycle produces electricity by burning natural gas, using a combustion gas turbine that can drive a generator. Because of their quick response during the startup, the main advantage of the simple cycle is that it can supply power during peak demand periods. About 67% of the heat is wasted in this process by the gas turbine. The combined cycle adds another process by utilizing the wasted heat from the gas turbine to produce steam from the water source, which can drive a steam turbine to run another generator. As a result, the combined cycle has a higher efficiency of around 60% compared to only 35% in a simple cycle. Figure 6 shows the process diagram for each technology [7] [8].



Figure 6 "Simple cycle vs. combined cycle process"

C. Nuclear Power Generation

C.1 History and future trend

In 1954, Russia built the first nuclear power plant in history for electricity production purposes, with a total capacity of 5 MW. After that, in 1956, a 50 MW nuclear power plant was built in England for commercial use [9]. As of today, the USA is leading the world's total installed nuclear power plant capacity by producing 100 GW of electricity from a total of 400 GW worldwide, as shown in figure 7 [10]. In addition, it is expected that the total installed nuclear power plants globally will increase to reach 536GW by 2030.





Figure 7 "Nuclear power plant future trend vs. courtiers share".

C.2 Technology Description

The current installed nuclear power plants around the world are mainly divided into two technologies; pressurized water (PWR) and boiling water (BWR) reactors. The pressurized water reactor is more commonly used which represents around 75% of the installed reactors. Figure 8 shows the main principle behind the PWR, which is putting the primary water under high pressure, to hold the water from boiling under high temperature that is caused by fuel elements (nuclear reaction). After that, the pressurized primary water is going to heat up the secondary water through a heat exchanger (sometimes called steam generator). This results in producing steam that can power the steam turbine. We can notice from this process that the steam is not mixed with radioactive elements because they are separated. Figure 8 also shows that BWR is boiling the water directly, using the nuclear reaction, which results in contaminating the produced steam with the radioactive material [11].





Figure 8 "Pressurized Water Reactor vs. Boiling Water Reactor Processes"

III. RENEWABLE ENERGY POWER GENERATION

A. Solar

A.1 History and Future Trend

It was documented that solar energy has been used since the 7th century B.C.E., when people were using sunlight to start fires, using glass. In 1873 it was discovered that solar energy can be converted into electricity using selenium [12]. After that, the solar PV industry started to grow up slowly in the 19th and 20th centuries. By the start of the 21st century, and due to the development of PV technology, the total installed capacity has reached around 500 GW globally by the end of 2018, as shown in figure 9. This figure also shows that the solar capacity will exceed 1 TW by 2023 in the low scenario [26].



A.2 Technology Description

There are two main technologies where solar energy can be harvested and converted into electricity; Solar Photovoltaics (PV), and concentrated solar power (CSP). Solar PV is the most common and advanced technology in solar energy industry. The concept behind this technology is to convert sunlight into electricity, using a semi-conductor material, such as silicon. Nowadays, solar PV is one of the fastest growing technologies in renewable energy. Concentrated solar power (CSP) uses solar energy as a heat source by concentrating sunlight using mirrors to generate hot steam that will power a steam turbine. Figure 10 shows the current growth trend in the installed capacity of both technologies globally, in which it can be noticed that the growth in solar PV is much higher, due to the maturity of the technology and its feasibility [14].



Figure 10 "Solar PV vs. Concentrated Solar Power growth"

B. Wind

B.1 History and Future Trend

Human have used wind energy for marine transportation since 5,000 BCE, when they utilized it on Nile River. In 200 BCE, it was documented that the Chinese started to use simple water pumps operated by wind energy resources [15]. At the beginning of the 20th century, people started to use wind to produce electricity using wind turbines on a small scale. In the last decades, wind turbine technology has been developed dramatically, due to the enhancement in efficiency, and the reduction in capital cost. As of 2018, the total installed capacity has reached around 560 GW globally, in which China has the highest contribution with a total of 185 GW [13]. Furthermore, it is expected that the wind power industry will become one of the main electricity resources around the world, and it is forecasted to exceed 9 TW of installed capacity by 2050, as shown in figure 11 [27].





B.2 Technology Description

A wind turbine captures wind energy using blades, and converts the kinetic energy into electricity, by rotating a generator. Wind turbines can be categorized as vertical or horizontal axis turbines, as shown in figure 12 [16].



Figure 12 "Horizontal vs. Vertical Axis Wind Turbines"

C. Biomass

C.1 History, technology overview and future trend

The use of biomass can go back in history to the cavemen who utilized wood as a raw material to light a fire for heating purposes [17]. Today, biomass is considered one of the renewable energy resources that can be used to produce electricity. There are different methods to produce electricity utilizing biomass. The most popular method is to burn biomass materials such as wood or agricultural waste to produce electricity [18]. Figure 13 shows the process in any biomass material, such as wood, and then burns it to heat up the water, to generate steam, which will drive a steam turbine to run a generator.



Figure 13 "Biomass power generation process"

In the last decade, there has been a steady increase in the total installed capacity of biomass power plants globally, and by the end of 2018, the total electricity generated has reached 592.2 TWh, and it is forecasted to exceed 764 TWh by 2023, as shown in figure 14 [28].



D.Geothermal

D.1 History and future trend

10,000 years ago, Indians in North America discovered geothermal energy by using hot springs, coming from underground, in their daily life activities, such as cooking and cleaning. Later in the 18th century, Italy became the first country that used geothermal energy in the industrial sector, by utilizing the hot underground steam for extracting boric acid. In 1904, the first geothermal power plant in history was commissioned by an Italian scientist called Piero Ginori Conti, who used the geothermal hot steam for electricity generation [20]. Over the years, geothermal power plant capacity has grown steadily, and the United States has a total installed capacity of 3.7 GW compared to 13.3 GW installed globally [13]. Furthermore, this trend is expected to continue and reach 17 GW by 2023 as shown in figure 15 [29].



Figure 15 "Geothermal installed capacity trend worldwide"

D.2 Technology Description:

Geothermal power plant technology mainly utilizes hydrothermal energy, which consists of water and heat, to generate electricity by running the steam turbine. Figure 16 illustrates the process of the main three types of geothermal power plants [22]:

• A Dry Steam Power Plant (DSPP) is the simplest design for a geothermal power plant. A DSPP takes the hot steam directly from underground to power a steam turbine.

• A Flash Steam Power Plant is the most common type and takes the hot steam mixed with water, and use a flash tank to fully convert the input into steam — before going to the steam turbine.

• A Binary Cycle Power plant extracts the geothermal hot water and runs it through a heat exchanger, to heat up a

separate water source and convert it into steam. This type of technology avoids the direct contact of the geothermal water, to ensure the cleanliness of the steam going through the turbine.



Figure16 "Different Types of Geothermal Power plants"

E. Hydropower

E.1 History and future trend:

Over 2,000 years ago, the Greeks used the energy generated by the moving water to rotate wheels to grind grain [23]. In 1882, hydropower was first used to generate electricity by commissioning the Fox River hydroelectric power plant in the United States [24]. This technology is considered one of the oldest technologies for generating electricity, and it has been growing over the last two centuries in which the overall installed capacity worldwide has reached to approximately 1,200 GW. Due to the maturity of this technology, the world will continue to install more hydropower generation plants, and it is forecasted to reach 1,325 GW by 2023, as illustrated in figure 17 [30].



E.2 Technology Description:

Hydropower plants generate electricity by converting the kinetic energy from the water flow into electricity, utilizing water turbines. There are three main types of hydropower plant technologies [25]:

• Run-of-River Hydropower plant: The main concept behind this type of plant is to divert part of the route of a river into a canal that captures the energy using turbines, as illustrated in figure 18. Since this type does not use dams or any storage facility, the output power depends on the flow of water, and hence it is considered as intermittent electricity generation.

• Storage Hydropower plant: This is the most common type in hydroelectric power plants, where it uses dams to store and control the flow of water that passes through the turbines. Therefore, it is considered a dispatchable generation source because of its ability to control the output electricity.

· Pump Storage Hydropower plant: This type is similar to

the storage hydropower plant, but it has a reversible water turbine that can pump the water back to the reservoir during the low demand period (when the electricity is cheaper) to increase the water head. Then, during the peak demand period (when electricity is more expensive), the water from the reservoir is released to generate electricity.



Figure 18 "Run of River vs. Pumped Storage Plant"

IV. COMPARATIVE ANALYSIS

In this chapter, different types of power generation technologies will be compared and analyzed based on two major aspects; technology performance, and economic analysis. Table 1 summarizes the comparative analysis done, with respect to the following:

• The technology performance in each generation type was evaluated based on the energy efficiency, as well as the average capacity factor of the power plants. The capacity factor is equal to the actual electrical energy generated, over the maximum electrical energy that can be generated, based on the installed capacity over a specific period.

• The cost aspect of different power generation technologies is compared based on two parameters; the installed cost (or capital cost) and the levelized cost of energy (LCOE). The LCOE is the best parameter to economically assess different types of power generation resources, because it considers the total lifetime cost — including installation, operation, and maintenance — over the total energy produced in the lifecycle (\$/KWh). Therefore, LCOE is used to determine the average cost of producing electricity per KWh.

• The environmental impacts is measured based on the quantity of CO2 emitted from the power generation over 100-year period taking into account the CO2 emissions resulted from the whole lifecycle of the plant [49].

Power Generation Type	Technology Performance		Economic Analysis		Environmental impact
	Efficiency	Capacity factor	Total installed cost (\$/KW)	Levelized cost of electricity (\$/KWh)	g-CO2/Kwh over 100 years [49]
Coal	33% [46]	54% to 85% [45]	4,600 to 5,200 [48]	0.088 to 0.16 [45]	282-1,011
Natural Gas CC	60% [8]	51% to 87% [45]	900 to 1,200 [48]	0.033 to 0.039 [45]	230-481
Natural Gas CT	35% [7]	7% to 30% [45]	1,100 to 1,600 [48]	0.066 to 0.155 [45]	230-481
Nuclear	33% [47]	92% [45]	5,700 to 6,500 [48]	0.07 [45]	78-178
Solar PV	15% to 22% [39]	18% [38]	1,210 [38]	0.09 [38]	7.85-26.9
Concentrated Solar Power (CSP)	up to 25% [40]	45% [38]	5,204 [38]	0.19 [38]	6.43-25.2
Onshore Wind	35% to 45% [41]	34% [38]	1,497 [38]	0.06 [38]	4.8-8.6
Offshore Wind	35% to 45% [41]	43% [38]	4,353 [38]	0.13 [38]	6.8-14.8
Hydropower	Up to 90% [42]	47% [38]	1,492 [38]	0.05 [38]	61-109
Geothermal	12% [43]	84% [38]	3,976 [38]	0.07 [38]	29-79
Biomass	20% to 40% [44]	78% [38]	2,105 [38]	0.06 [38]	86-1,788

Table 1 "Generations Resources Comparative Analysis Summary"

V.CONCLUSION

Based on the previous analysis, it can be shown that renewable resources technologies have become more feasible. Based on the current trend, the world could replace coal generation power plants with alternative sources of energy, since these new technologies are able to compete, as shown in the previous table. Many studies have been conducted that forecast renewable energy resources will comprise a major share pf the overall energy resources for electricity generation. For example, according to BP Energy Outlook report, it is forecasted that the renewables will overtake coal's share in electricity generation by 2040, as shown in figure 19 [52].

Fuel shares in power



Figure 19 "the electricity generation share future trend worldwide"

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