International Journal of Technology 14(6) 1177-1184 (2023)

International Journal of Technology

http://ijtech.eng.ui.ac.id

Resolving Engineering, Industrial and Healthcare Challenges through AI-Driven Applications

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The recent technological advances have proven to be successful in facilitating various strenuous activities and improving daily life performance. Furthermore, the public has been amazed by the presence of Artificial Intelligence. Artificial Intelligence, often known as AI, is a type of technology in the field of computer science that has special abilities to solve problems. With its intelligence, which is said to be able to compete with human cognitive abilities, AI technology is, in fact, able to help a variety of human jobs, from easy to complex ones.

The first work which is now recognized as AI was done by Warren McCulloch and Walter Pitts in 1943 as they proposed a model of artificial neurons. Later from that day, research in machine learning were florished. Therefore, Alan Turing who was an english mathematician proposed a test to asses the machine's ability to exhibit intelligent behavior equivalent to human intelligence. The word artificial intelligence was first adopted by American computer scientist, John McCarthy at the Dartmouth Conference for the first time. The finding of several computer language such as Fortran, LISP or COBOL marked the enthusiasm for AI at that time.

The era of AI had several idle development along the way which called as AI winter in 1974 to 1980 and 1987-1993. This era refers to the time period where computer scientists dealt with a severe shortage of funding from government or companies. Until the year 1997, the IBM Deep Blue became the first computer to beat a world chess champion, the emergence of AI never went under. Companies like Facebook, Twitter and Netflix also started using AI deep learning, big data and artificial general intelligence since the 2006.

The applications of AI are vast, including in industrial automation, healthcare, transportation, finance, entertainment, and more. AI continues to develop along with advances in technology and research, with the ultimate goal of creating systems that have levels of intelligence and capabilities that increasingly approach human capabilities.

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10.14716/ijtech.v14i6.6767

Artificial intelligence also faces numerous debates regarding potential impacts on individuals. Although it could be risky, it's also offering a fantastic opportunity. It is estimated that the global Artificial Intelligence market will reach 267 billion dollars by 2027.

AI in Engineering and Industrial Role

Optimization plays an important role in manufacturing systems and engineering problems design. The goal is to provide effective solutions to manufacturing system problems while efficiently utilizing resources, which is always a top priority. AI is a technology that has been widely adopted in the era of Industry 4.0. This AI is capable of connecting every device, enabling individuals to automate all devices without needing to be on-site. Currently, there are numerous machines that can utilize Artificial Intelligence to interpret specific conditions or events. AI involves various processes such as learning, reasoning, and self-correction. The implementation of AI in human workmanship is to obtain optimal performance results with fast processing times and good results.

AI is to be expected to find its place in manufacturing sector. The manufacturing industry is undergoing a tremendous transformation supported by today's digital needs. AI in manufacturing market size was USD 1.82 billion in 2019. According to International Data Corporation (IDC) prediction, by 2021 at least one fifth of the largest manufacturers will rely on embedded intelligence system based on cognitive data applications and IOT. It is creating a need for artificial intelligence and machine learning to result in automation of large-scale processes, speeding up the execution time by nearly 25 percent.

For data analysis and predictions, AI can be used to analyze large and complex business data, identifying patterns, trends, and insights that can help in decision-making. Examples are sales predictions based on previous sales history, credit risk analysis in the financial industry, and supply-demand analysis.

AI can be used to create automated customer service chatbots, which are capable of providing customer support at scale. They can answer frequently asked questions, address common problems, and provide guidance to customers quickly and efficiently. Many e-commerce and entertainment businesses use AI to provide personalized recommendations to customers based on their shopping behavior or preferences. This helps increase customer engagement and sales.

AI can be used to analyze sentiment from customer reviews, social media, and other feedback. It helps businesses understand how customers feel about their products or services and take action accordingly.

In the manufacturing and retail industries, AI can be used to automatically recognize defects in products, perform visual quality checks, or recognize items based on images. The data collected from the machines are used to create a set of performance indicators. This enables data-driven root cause analysis of scrap and downtime.. This improves productivity and reduces downtime. The creation of a predictive model that monitors machine performance and downtime can then be used to predict the type of field improvement, the impact of external changes, scrap, production and quality.

In process automation, AI can be used to automate routine and repetitive tasks in business processes, such as invoice processing, inventory management, and production planning. AI algorithms can be used to analyse data and make decisions in real time enabling the automation of tasks that previously required human intervention. AI can be used to predict when equipment is likely to fail allowing maintenance to be scheduled in advance rather than waiting for a problem to occur.

AI can be used in supply chain optimization to improve efficiency, reduce cost and increase customer satisfaction. It can be used to analyze data from various sources to forecast demand, identified rent, optimize production and also develop and execute optimal plans for sourcing production and distribution. Taking constraint into account such as capacity need times and transportation cost. AI plays a vital role in optimizing inventory levels based on demand forecast and lead times, reducing excess inventory and associated cost. AI helps optimizing Transportation routing and scheduling.

AI can be applied for voice recognition and natural language processing (NLP), such as virtual assistants and voice commands rely on voice recognition and natural language processing technology to interact with users naturally Additionally, AI plays a significant role in facial recognition and security. AI-based security systems can identify faces and detect suspicious behavior, making them valuable in security surveillance, physical access control, and presence management.

For product development and design, AI can help in product development and design by analyzing market data, design trends, and customer preferences. In the case of risk and financial management, AI is used in analyzing market trends, financial risk prediction, and investment portfolio management.

AI in Health Care Role

There are numerous potential applications of artificial intelligence in the disciplines of medicine and health care. The developments in analytical, computing techniques and the explosion of data in healthcare organizations put the AI in the role of healtcare. The following is an example of the application of AI in the world of medicin and health care.

AI has helped in achieving great success in robotic surgery. For example, the da Vinci robot is used for prostate surgery, hysterectomy, and heart surgery. The robots can now do delicate surgeries with the advancements in electronic technology. The robot is still operated by the surgeon but it can perform micro dissections and access tiny areas that a human hand would find impossible. Robotic arms are capable of performing intricate procedures on the brain and heart with absolute accuracy. This has been demonstrated the lessen complications and the danger of blood loss.

AI Solutions used in medical imaging support labor-intensive image scanning such as Analyze X-rays, CT scans, MRIs, and other medical images. By surfacing valid insights that can help radiologists identify critical cases first. The AI make more accurate diagnosis and possibly avoid errors while utilizing the complexity of electronic health records. Large data sets with hundreds of photos can be produced by a conventional clinical trial creating huge volumes of data that need to be reviewed. As studies from the entire health care sector can be examined for patterns using AI algorithms, it speeds up the process of finding important information for imaging specialists. Detecting or diagnosing of lung cancer, heart disease, liver disease should be more accurate with the maturation of AI.

AI can help doctors and other medical professionals make critical therapeutic decisions more quickly and effectively by using real-time data monitoring. Producing more quick and realistic results can reduce patient waiting times, improve preventative actions and reduce costs. Real-time analytics can support stronger physician-patient relationships if important health information is made available via mobile devices. IoT devices, including sensors and cameras, are used to monitor patient vital signs, activities, and their environment. This technology enables nurses to remotely monitor patient conditions from hospitals or healthcare centers, proving particularly beneficial for elderly patients, those with chronic diseases, and post-operative patients.

In the pharmaceutical industry, AI can be used to predict potential molecular structures for new drugs, speeding up the drug discovery process. The conventional methods of producing medications can frequently be unreasonably expensive and time consuming. AI uses patient genetic data and health condition monitoring to determine appropriate drug dosage. Drug doses can be adjusted automatically based on changes in the patient's health condition. This can reduce the side effects of the drug and increase its effectiveness.

Analyzing public health monitoring data to identify early spikes in infectious disease cases, such as flu outbreaks, measles, dengue fever, and other contagious diseases, allows for the prompt implementation of disease prevention and control measures. The time and resources required to assess and diagnose patients can be decreased by using artificial intelligence in some health care units. This allows medical professionals to respond more quickly and save more lives. The algorithms that use machine learning can identify danger much more accurately and quickly than traditional procedures.

The AI helps to monitor vital signs of pregnant women and fetuses using health monitoring devices installed on pregnant women. It can detect pregnancy complications such as preeclampsia or fetal growth disorders early. The technology allows medical intervention to improve maternal and infant health.

AI ables to analyze data related to activity, diet, and other health factors to offer personalized recommendations for a healthy lifestyle. This includes suggesting exercise types, calorie intake, and dietary choices tailored for weight management or cholesterol control, all based on an individual's health profile and genetic makeup. We need reliable data on time to identify the problem and solve it as soon as possible and using the most effective way.

AI enables researchers to gather enormous amounts of data from numerous sources. The capacity to use a big and expanding data collection allows for more precise analysis of fatal diseases. this research can profit from the abundance of data that is currently available. Technologies that will aid medical practitioners in managing enormous data sets are also being developed by groups engaged in medical research.

AI is a potent administrative worker. We can use it for prior authorization in clinical recording, medical record management, schedule optimization, billing and claim processing. AI can identify a patient's health plan, medical benefits and the services that go with those benefits and require authorization. AI can also assist with the gathering of paperwork such as patient histories data and medical approvals. AI can reduce the stress of data collecting and free up the time of doctors and employees to focus on other activities.

In this special edition, IJTech's editors-in-charge in the respective fields of study have selected 20 Papers from Difcon 2023 Malaysia 26-28 July 2023, "Advancing Sustainability Development for Resilient Future".

The first paper, authored by M.K.M. Naeim, G.C. Chung, I.E. Lee, J.J. Jiat, and S.F. Tan, focuses on integrating Internet of Things (IoT) technology to enhance health monitoring systems for elderly citizens. This paper presents a low-cost wearable prototype device designed to measure heart pulses, detect falls, and provide indoor positioning information for seniors. The IoT platform connects these devices to deliver real-time health data, emergency alerts, and remote control of home appliances. This research paper makes a valuable contribution to the field of IoT-based health monitoring, with a clear focus on improving the well-being of elderly citizens and simplifying the daily routines of caregivers. The study offers a comprehensive system architecture, detailed hardware and software descriptions, and flowcharts for the prototype devices.

The next paper, co-authored by Y. Wang, P.C. Woods, and A.C. Koo, delves into various aspects of traditional Chinese architecture and its development across different historical

periods. It explores the role of Jiehua paintings in documenting architectural forms, the methodology employed in the study, the historical evolution of architectural forms in these paintings, and the underlying historical factors driving this evolution. Additionally, the paper discusses the key elements influencing traditional Chinese architectural forms, including geographical environment, cultural traditions, and economic development.

The third paper, authored by M. Barakat, G.C. Chung, I.E. Lee, W.L. Pang, and K.Y. Chan, concentrates on the application of deep learning techniques for detecting and sizing durian fruits in images, with an emphasis on zero-shot learning, which reduces the need for specific training data. This research paper introduces two state-of-the-art models, Grounding DINO and Segment Anything (SAM), and evaluates their effectiveness in detecting and segmenting durian fruits. The study offers valuable insights into the application of deep learning in agriculture and provides a comprehensive evaluation of the proposed models, establishing it as a significant contribution to the field.

The fourth paper, authored by F. Mustakim, A.A. Aziz, A. Mahmud, S. Jamian, N.A.A. Hamzah, and N.H.B.A. Aziz, primarily focuses on analyzing traffic behavior at unsignalized intersections, with a particular emphasis on the behavior of right-turn motorists (RTM). The authors employ both Logistic Regression Method (LRM) and Structural Equation Modeling (SEM) as statistical tools to investigate and gain insights into this subject matter. The study encompasses five unsignalized intersections (UI) and delves into the dynamics of three primary types of turning volume: right-turn volume (RTV) from a minor road to a major road, left-turn volume (LTV) from a minor road to a major road, and right-turn volume (RTV) from a major road to a minor road.

The fifth paper, authored by M.S.N.B. Abdullah, H. Abdul Karim, and N. Al Dahoul, focuses on an essential aspect of machine learning and computer vision: violence detection in videos. The authors emphasize the significance of violence detection in preventing exposure to violent content, particularly among younger audiences, and enhancing a safer viewing environment. Their research aims to overcome limitations in existing violence detection models, such as memory inefficiency and slow inference, making them unsuitable for implementation on resource-constrained embedded systems.

The next paper, authored by T.S. Teoh , P.P. Em, and N.A.B. Ab Aziz, presents a novel vehicle localization algorithm that utilizes a combination of Inertial Measurement Unit (IMU), Global Navigation Satellite System (GNSS), and Onboard Diagnostics (OBD2) sensors. This algorithm aims to improve driver drowsiness detection systems by providing a more reliable and accurate method for tracking the vehicle's lateral position, especially in situations where traditional lane lines may be unreliable. The paper also includes the development and testing of this algorithm, providing an in-depth explanation of the Kinematic Bicycle Model (KBM) and the Extended Kalman Filter (EKF) used in the vehicle localization process. The authors conducted experiments to evaluate the algorithm's performance in different real-world scenarios and compared the results with existing techniques.

The seventh paper, authored by M.S.M. Nor, A.A. Khan, S. Mohamad, and P. Thirunavakkarasu, successfully addresses the need for an innovative, cost-effective, and efficient sensor for real-time water salinity detection. The authors have developed an optical fiber sensor with the capacity to accurately monitor changes in water salinity using absorption spectroscopy. By employing a broadband light source and a spectrometer, the authors have demonstrated the sensor's capability to detect variations in the optical spectrum in response to different concentrations of sodium chloride ions in water. The modification of a plastic optical fiber into a D-shaped sensor structure, combined with the strategic use of functionalized carbon nanotubes (CNT), significantly enhances the sensor's

sensitivity. The research highlights the promise of CNT-based coatings in enhancing the sensing capabilities of optical fiber sensors, paving the way for more cost-effective and reliable water salinity detection.

The eighth paper, authored by K.R. Alla and G. Thangarasu, addresses a pressing concern within the pharmaceutical industry: the management of drug product supply chains. It introduces an innovative approach that leverages the potential of blockchain technology and reinforcement learning to optimize drug supply chains and offer personalized drug therapy recommendations. The pharmaceutical industry has shown a growing interest in adopting blockchain technology to ensure secure and transparent pharmaceutical product distribution. This paper not only acknowledges this trend but also underscores the significance of establishing a secure technical platform for efficient supply chain operations. The integration of blockchain technology is central to this research, as it promises to enhance transparency, traceability, and authenticity in the pharmaceutical supply chain, thereby mitigating the risks associated with counterfeit drugs.

The next paper, authored by A.M. Ramly, A. Amphawan, T.J. Xuan, and N.T. Kian, responds to the growing demand for high-bandwidth communication in outdoor environments by exploring the synergy between Orbital Angular Momentum (OAM) multiplexing and Orthogonal Frequency Division Multiplexing (OFDM) modulation. The paper conducts a comprehensive analysis of the combined application of OAM modes and OFDM modulation in outdoor free-space optical communication. Through in-depth simulations encompassing various modulation schemes and code rates, the research sheds light on the performance of these systems under varying outdoor conditions. Notably, the study identifies the OAM+4 Mode as the most robust option, surpassing other OAM modes in terms of Bit Error Rate (BER) and Packet Error Rate (PER).

The tenth paper, authored by C.F.-Y Chen, T.J. Chan, and N.H. Hashim, delves into the ever-expanding landscape of fintech adoption in Malaysia, highlighting the significant proliferation of fintech services, especially through collaborations with major e-wallet providers like Touch'n Go, Boost, and Grab. While fintech has made substantial strides in delivering efficient financial services to users, it also introduces uncertainties and concerns related to perceived technology security, which can impact users' intentions to continue using fintech applications. The study employs the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) framework to explore the factors influencing users' intentions to continue using fintech applications.

The eleventh paper, authored by F. Aftab, S.U. Bazai, S. Marjan, L. Baloch, S. Aslam, A. Amphawan, and T.K. Neo, provides a comprehensive overview of the dynamic field of sentiment analysis, which is a critical branch of natural language processing (NLP). It delves into the methodologies, applications, and recent research trends, bridging the gap between academic exploration and real-world implementation. This survey serves as a guide for both scholars and practitioners interested in the field of sentiment analysis. It showcases the current state-of-the-art techniques, applications, and challenges, offering valuable insights into a dynamic area of study that holds immense potential in the era of big data and digital communication.

The next paper, authored by H.F. Al-Selwi, A.A. Aziz, F. Abas, A.A Kayani, N.M.M. Noor, and S.F.A. Razak, explore a crucial aspect of modern transportation systems: traffic prediction. It introduces an innovative approach that leverages deep learning and graph convolutional networks (GCNs) to address the challenges of modeling large, interconnected road networks. The authors have also incorporated a Kalman Filter to further enhance the accuracy of traffic predictions.

The thirteenth paper, authored by J.H. Chan and C.Y. Lau, presents a comprehensive study focused on enhancing the capabilities of the Hilti Jaibot, an innovative construction site drilling robot. By harnessing the power of Internet of Things (IoT) technology and predictive maintenance methodologies, the study addresses key concerns related to safety, monitoring, and productivity within the construction industry. The research not only addresses immediate concerns in the construction industry but also paves the way for broader applications of IoT and predictive maintenance in various domains. It demonstrates how emerging technologies can drive positive change and innovation in traditionally conservative sectors.

The fourteenth paper, authored by L. Baloch, S.U. Bazai, S. Marjan, F. Aftab, S. Aslam, and A. Amphawan, presents a comprehensive systematic literature review that explores the use of Big Data (BD) in healthcare. With the increasing complexity and volume of healthcare data, this review addresses the potential opportunities and challenges related to harnessing BD in the healthcare sector. It highlights the significance of data-driven approaches in enhancing patient care, public health, and medical research. The paper also recognizes the pivotal role of emerging technologies such as AI, IoT, ML, deep learning, and wearable sensors in amplifying the application of BD analytics in healthcare. The document points to future research directions, including the development of digital platforms and applications based on BD analytics, as well as specialized applications dedicated to managing diagnostic images.

The next paper, authored by W.-L., Tey, H.-N. Goh, A.H.-L., Lim, and C.-K. Phang, explores the detection of depressive symptoms in social media users, with a particular focus on Twitter data. The study introduces several novel contributions, including the use of the Patient Health Questionnaire-9 (PHQ-9) survey, a BERT-based model, and the differentiation of users into pre-depressive and post-depressive classes. These contributions are significant for advancing the field of mental health prediction through machine learning and text analysis. The study highlights the increasing relevance of mental health in the context of the COVID-19 pandemic and the importance of early detection for effective intervention. By incorporating the PHQ-9 survey, the paper enriches the data collection process and provides more reliable insights into users' depressive symptoms. The proposal of a BERT-based model, along with emoji decoding and PHQ-9-based lexicon features, demonstrates the authors' dedication to leveraging state-of-the-art natural language processing techniques for improved predictive modeling.

The sixteenth paper, authored by J. Jupir, K.A. Aziz, and H. Hassan. This study aims to explore possible determinants for collaborative project management success and validate the framework in the context of the Malaysian construction industry. It tested project management maturity and some other variables. The study adopted a quantitative research approach and used a close-ended questionnaire as the data collection instrument. The findings can be applied to manage construction projects or any other collaborative project and also contribute to the project management body of knowledge and elaboration of Coordination Theory application in home construction projects.

The next paper, authored by Y. Ning, H.B. Ismail, and L.K. Piew, explores the potential benefits of CSR initiatives for businesses. However, the impact of these initiatives on customer satisfaction has remained a mystery. This study sets out to explore how petroleum companies can harness the full potential of CSR to communicate, integrate, and organize their projects effectively through CSR implementation to uncover how it can significantly boost customer satisfaction in Malaysian petroleum companies. Drawing on the latest insights from the Theory of CSR, Stakeholder Theory, and Social Influence Theory,

this study takes a quantitative approach to fill crucial gaps in the CSR literature and provide valuable insights into the links between CSR activities and consumer behavior.

The eighteenth paper was authored by S.A. Bakar and M. Dorasamy**.** The study utilized qualitative research methods such as focus group interviews and thematic analysis to unravel the many facets of Agile adoption, from its initial stages of comprehension and implementation to the long-term sustainability of its practices. The research reveals that Agile methodologies triggered significant organizational changes, including shifts in team dynamics, leadership paradigms, and cultural ethos. The study provides practical insights that can aid in adopting and scaling Agile practices within organizations, emphasizing the need for a robust and flexible organizational culture to support such transformations.

The nineteenth paper was authored by A. Anwar, S.B. Goyal, and T. Jan. Current blockchain-based clinical trial platforms lack scalability, interoperability, and integrity. A meta-model paradigm for blockchain-based clinical trial security and transparency addresses these constraints. The suggested meta-model framework and algorithm can improve blockchain-based clinical trial security and transparency, making data management more trustworthy and efficient.

The last paper, authored by K.L. Aravindan, M.A. Izzat, T. Ramayah, T.S. Chen, Y.V. Choong, S. Annamalah, N. Ilhavenil, and A.B. Ahmad. This study is poised to examine the determinants of consumers' purchase intention on electricity, underpinned by The Extended Theory of Planned Behaviour. This quantitative research is set on purposive sampling while PLS-SEM is utilized for data analysis. Findings from 362 respondents reveal that technology readiness, perceived cost, perceived symbol, and knowledge lead to electric car purchase intention.

I hope this special edition of IJTech conveys new insights in the Development of Applications based on Artificial Intelligence (AI) as a Solution to Solve Problems in The Fields of Engineering, Industry, and Health.

With warmest regards from Jakarta,

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