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Proposing an AI Helmet to Enhance Vocational Learning Experience: a Theoretical Overview

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PROPOSING AN AI HELMET TO ENHANCE VOCATIONAL LEARNING EXPERIENCE: A THEORETICAL OVERVIEW

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ABSTRACT

Students' engagement became the main concern to assess the quality of a learning lesson. Students are considered the main stakeholder in the educational process, their engagement represents the success of the educational institution and learning journey. In such an educational context, it is very important for any school to teach students to use innovative and up-to-date technologies in the marketplace, this will help them later to work and deal with those skills and tools in real workplace environments. Listing the objectives of the Kingdom of Bahrain's Vision 2030, it is required to embed the most innovative teaching approaches in line with learning processes to enhance students' learning experience, make the lesson interactive, and reach high-quality teaching standards. As vocational education is quite different, it is mandatory nowadays that engineering and vocational graduates be aware of advanced engineering solutions that are technically aligned with the most developed IT technologies. Currently, assessment techniques used to evaluate students' work are somehow outdated and not meet the criteria of 21st-century required skills. AI Helmet is a purely engineering and technological tool consisting of many advanced solutions including artificial intelligence, cloud computing, and IoT that can help the facilitator to track students' performance in workshops and align hand work skills with using technology. Recommendations directed to the use of AI Helmet to evaluate vocational students' learning and to expand it by proposing this tool to be used in industrial organizations.

KEYWORDS

Educational innovation, Vocational, Teaching, AI, Robotics, Kingdom of Bahrain

1. INTRODUCTION

Innovation is an essential means by which organizations survive and thrive (Colombo, 2017) Particularly, in the education field innovation and creativity has become important objective and goal that every country is looking for, especially in the Kingdom of Bahrain, one of the 2030 visions for achieving sustainable development goals in Education is to provide quality education for all students that meet the international standards by seeking a high level of proficiency in functioning literacy and numeracy skills (Fuad and et. al, 2020). Artificial intelligence, the Internet of Things, cloud computing, big data, cyber security, and more are the hottest topics in the information technology field. AI and robotics amplify and augment human potential, increase productivity, and move institutions forward with human-like cognitive abilities. To have a full picture of AI's impact, it is important to draw lessons from past successes and failures, as well as to anticipate its future directions and potential legal, ethical, and socio-economic implications. The robotics field has clearly shown the development in most of the tools and technologies used, where it is indicating the update in all aspects of development in programming languages, security, cloud, IoT, and AI (Akhbar-Alkhaleej Newspaper, 2016).

Using robots in the engineering field and specifically in factories and building sites has been considered a dream in the past. Currently, many sites and factories around the world are using

robots in their internal operations, either as support for human-being or as replaceable for workers. This great achievement became the rapid advancement in technology that drove this industrial wave when they decided to use servos, digital logic, solid-state electronics, and more. In the construction phase of robots' design, AI has been one of the main strategies. Some real examples of successful robot implementation in different fields show the fantasy of how magical impact is there.

SRI has paid recognized efforts in the robotics field through many contributions in machine vision, computer graphics, AI engineering tools, computer languages, autonomous robots, and more, where SRI focused on advancing the robotics sector by designing factory applications robots, and arm robots. Furthermore, there are some unstructured robots that have been developed in both military and commercial applications that supplement human capabilities such these are debris in natural disasters, pipeline robots, and more (ISO, 2017). Simple and critical operations are rapidly studied to embed AI technologies in embedding AI in the most critical and important operations became a challenge of any organization.

2. Problem Statement and Research Contribution

Currently, every engineering site should follow international safety standards in ensuring engineers' and workers' physical safety. Wearing safety shoes, helmets, safety gloves, eyeglasses, and more are mandatory tools that should be worn inside factories and workshops (Government of Kingdom of Bahrain, 2010). Similarly, vocational schools are also kind of small engineering sites where workshops contain varieties of engineering tools and machines that required students to be aware of using each one of them. Students could face complications in knowing the methods of using each machine, and as well as workshop instructors could face some difficulties to keep an eye on 25 students inside workshops, which creates kind of concerns about students' physical safety. Applying global safety standards is a concern for any industrial company to reduce accidents and risks to zero.

A proposed prototype and design of an AI Helmet will be suggested for the vocational intuition students which they can wear during their engineering classes inside workshops. The helmet will be developed with AI technology to instruct students with immediate and direct instructions to use and deal with specific engineering machines and apply operations following general safety instructions.

3. Literature Review and Historical Overview

3.1 A Startup To AI World

Many scientists defined artificial intelligence as machines that do things in smart ways. The use of different programming languages and many computer programs to initialize the principles of intelligence in general and human thought, in particular, can be another definition of AI. AI definitions improved to satisfy how much the machine is intelligent to grasp the capacity of information processing to be designed to its environment while working with insufficient knowledge and resources. Another Author explained the field of AI as a path that aims to understand how computers can be made to exhibit smartness, in terms of thinking, behaving, perception, reasoning, and questioning (AlMubarak, 2022).

3.2 AI Birth

Artificial intelligence was first evolute in 1956 when Marvin Minsky arranged an international Dartmouth Conference to release officially artificial intelligence as a name for a new field. Minsky and other scientists mentioned that AI is a discovery for a new era that unrestrained conquests for new knowledge, using computer programs, different programming languages, logical thinking, algebraic problems, and demonstrating theories in geometry. The concept of AI took its first place as machine calculators, which have been developed from the mechanical calculator of Babbage. The world realized the importance of automata theory in the second world war. Many motors have been developed, including logical machines that were created to operate information and store them. Although many different neurological structures and stimuli were issued as theories, the first time they used this concept as a theory was known with neurons. In the USA, many scientists in the fields of computers and engineering implemented the concept of AI through many tools and equipment, in the field of military, army, research projects, and many others. In 1971, scientists started to develop AI features by setting up leading laboratories in the field of speech recognition. From 1980 to 1987, AI programs which are known as expert systems were adopted by the most known companies, such these are IBM, apple, google, etc. In later years, AI researchers stated that most known technologies and computers companies worked hard to increase the speed and power of their LISP machines, to be the best in the market. In 1990, the new concept of intelligent agent emerged; the agent is a system that evaluates the environment surrounding it and undertakes actions that maximize its chances of being successful. In the late 1990s, new features have been revealed; probabilistic, frequentist, and fuzzy logic approaches which were aligned with AI to deal with the uncertainty of decisions. Trains and metros were built and embedded by fuzzy logic, in addition to factories, valves, gas, and petrol tank surveillance, automatic gear transmission systems, and reactor control in power plants. Moreover, household appliances such as these are air conditioners, heating systems, cookers, and vacuum cleaners. Since 2000, the third renaissance of the connectionism paradigm has arrived in place using big data (AlMubarak, 2022).

3.3 Closer Look At AI Evolution

Researchers revealed that AI evolution goes through many cycles. The birth of AI in the period of 1952-1956 focused on how to develop AI concepts and focus on cybernetics and neural networks, which they have worked on both to attract the attention of the scientific world. Then, in the first spring that lies on 1956-1974, computers at that time could solve algebra and geometric problems as well as speak English. Later, Scientists worked more to solve many raised issues by developing expert systems to embed the concepts of neural networks and speech recognition. After that, with the success of the internet and web, the Big Data revolution started to take place in the technology world along with Deep Learning. With the passage of time, the AI concept is improving every second, with Machine Learning, Deep Learning, Big Data, and Robotics in different fields (AlMubarak, 2022).

3.4 Subfields And Technologies Aligned With AI

Diversified sectors stated the usage of AI in their unique functions and processes. Worldwide examples have shown extreme development in multi fields around different regions. Currently, AI is used in online advertisement, driving, aviation, medicine, personal assistance, and image recognition. Mercedes company showed an impressive improvement in its technologies in the past 10 years; they have empowered its luxury cars with a smart and automatic steering system, that provides drivers with direct decisions taken by the cars, in which the system can make intelligent decisions on real traffic road condition, variables, and estimating the objects around the vehicles. Alpha Go which is developed by Google is the most professional beat game to beat professional players. Other examples are applying machine learning in Facebook as social networking service to spot suicidal users and human-computer interaction by describing images for blind users. Also, there are many services and projects built by many companies from different fields that used AI

concepts, such these are Cortana, Alexa, Amazon AI platform, Siri, Deep Blue, DQN, Microsoft Azure, Watson, Evolutionary Algorithms, Testbeds for AI, etc. (AlMubarak, 2022; Andreu-Perez and et. al, 2017)

Other concepts evolved with AI to enhance its effectiveness. The neural networks concept came from how the human nervous system processes information, artificial neural networks allowed significant progress of AI to perform tasks related to perception. The deep Learning concept is part of machine learning, and it is usually linked to deep neural networks that consist of multiple levels of learning details or data representations; through different levels, data can be transferred from the low-level parameter to the high-level parameter, and this is corresponding to different levels of data abstraction. The fuzzy logic concept is focusing on information manipulation which is often imprecise; it provides a framework in which to operate with data assuming a level of imprecision over a set of observations as well as structural elements to enhance the interpretability of the learned model (AlMubarak, 2022).

Evolutionary computing focuses on the principle of natural selection or natural patterns of collective behaviour. Statistical Learning aims at AI employing a classical statistical perspective, an example of SL is Bayesian modelling. Ensemble learning and meta-algorithms aim to create models that combine several weak base learners to increase accuracy while reducing bias and variance. Logic-based artificial intelligence is used for task knowledge representation and inference, it can represent predicate descriptions, facts, and semantics (AlMubarak, 2022).

3.5 AI AND ROBOTICS

AI and Robotics emergence has clearly indicated the advances in mechatronics, electrical engineering, and computing fields. Embedding sensors in machines gave scientists the ability to adapt to the fast transformations available in the marketplace. Robotics are really used in industrial engineering fields around the world, and robotics are used in different production and operational activities. With no limitation to those fields, robotics is also used in army and police security operations. Scientists are trying to link AI and robotics by making those robots decision-makers and independent in terms of planning, moving, and collaborating. Intelligence can be built in by estimating how robots can predicate the future, plan for specific tasks, or even respond to exact actions. Many countries produced different varieties of robots that performed different tasks, examples of those were: driving vehicles, natural and industrial robots, carrying boxes and materials in different environments, swimming, picking items or objects, placing them in different locations, medical robots, etc... Since 1939, the first robot was presented at the world fair, as a first automated machine. With the passage of time, the idea and concept of robotics have been expanded among different fields. Nowadays, the importance of AI applications is allowing robots to sense the environment using integrated sensors and computational operations. Scientists and developers promised that these discoveries and improvements in AI and robotics will continue to reshape people's mindsets about robotics intelligence in many new domains (AlMubarak, 2022).

3.6 ARTIFICIAL INTELLIGENCE AND THE BIG BRAIN

The development of AI and robotics is attached to human brain pursuit. Computational neuroscience, decision-making, and human thinking are long-term goals that scientists are looking to develop by breaking down the precious internal functions in human and animal behaviour characteristics. The human brain is very complex, it contained millions of nerves and billions of connections. The earliest trials to model AI using the complexity of the human brain were for modelling neuronal complexity based on conductance-based biophysical models of synaptic interaction and spike generation such as the Hodgkin-Huxley model. They have used different software platforms to develop modelling approaches of realistic brain networks, such these were: GENESIS, NEURON, and exploit COBA models. Blue Brain project was a leading research project on creating computational neuroscience, started in 2005, and was the first to emulate the rat neocortical columns of around 10,000 neurons and 108 synapses. Currently, there is a vision to create neuromorphic hardware circuits to connect real-time large-scale simulations of neural networks (AlMubarak, 2022).

3.7 EDUCATIONAL INNOVATION

Universities and high schools around the world showed their successful projects in the field of AI. Where the students have developed many projects to solve real issues in different sectors. An example is prediction algorithms, recommender systems developed with machine learning, data scientists are using prediction algorithms to guess what people want and need and then generate recommendations. Another example is socially intelligent humanoid robots, in which students developed robots that can mimic human movement, speech patterns, facial expressions, and thought processes. The third example is smart farming technology based on AI and machine learning, where they have built robots to make farming more sustainable, which contains spray technology that identifies weeds and can target them specifically.

Educational innovation is those practices, products, services, processes, and strategies that improve the learning and educational status within an institution. Other researchers defined educational innovation as those applications of significant changes to the educational processes beyond their abnormality which are applied within the educational context (O'Connor-Córdova and et. al, 2021). Examples of educational innovation practices that can be applied in the educational institution: competency-based learning, which means that students can learn the same thing at different times and from different places, can lead him/her to master the subject, this may lead to innovation at the institution; second, video streaming, flipped classroom, eLearning trends, which are different teaching strategies. The usage of social media, webinars, Zoom, Skype, and other technological solutions to run the classes can be considered as innovation; third, open curriculum, assessment, feedback loops, and certifications issuance are perfectly considered as an open curriculum; fourth, digital textbooks, whenever educational institution is turning all teaching and learning materials into digital format, this is kind of innovative practice; fifth, virtual and augmented reality, there are visions and missions for some institutions to switch their educational and learning journal to be virtual; sixth, smarter learning management system, comprehensive LMS that allow all stakeholders to interact with each other is a form of innovation; seventh, AI, which is similar to virtual reality, the most higher educational institution is looking for to apply in their campus to be fully into virtual and consist of automated processes. There are future visions to have a virtual educational city in some countries (Colombo and et. al, 2017; Dodgson and et. al, 2014; Fuad and et. al, 2021).

With the emergence of different generative artificial intelligence tools, the AI aspect became a mandatory part that can't be eliminated. The ability of computer machines to generate data both numbers, texts, voice, images, three dimensions shapes, through knowing the data distribution and how to simulate it. This process will lead to the creation of new data that will help to reshape new concepts or discover important relationships between data. Several applications examples can be used: ChatGPT,Bard AI, Midjourney, Jasper, etc..

3.8 VOCATIONAL EDUCATION IN THE KINGDOM OF BAHRAIN

The establishment of vocational education in the Kingdom of Bahrain goes back to the academic year 1937/36 AD when special classes were opened to teach carpentry and mechanics at Al-Hidaya Al-Khalifia School in Muharraq and Al-Gharbia School in Manama for boys. In the academic year 1938/1939, the first vocational school was inaugurated, and the duration of the study was two years. In the academic year 1947/46 AD, a fixed system for vocational education was kept in place, by updating the curricula and specifying study hours. Despite allocating incentive salaries for students who enroll in the vocational school at first, the turnout for it was weak, as there were only (20) students in the carpentry department, and (50) students in mechanics during the academic year 1953/1954 AD. In the sixties, vocational education witnessed a development, since there was an increasing demand for it, and it became its own curricula, and admission to the vocational school was limited to primary certificates holders as a minimum, and its students during the academic year 1964/63 AD reached to (266) students. Starting from the academic year 1970/69 AD, enrolment in vocational schools became restricted to students who obtained high school only. As a result of the implementation of the branching system in secondary education in the academic year 1980/1981 AD, and the ensuing system of improving its programs and diversifying its specializations, students' demand for vocational education increased significantly (Akhbar-Alkhaleej Newspaper, 2016).

In the year 1986 AD, an agreement was signed between the Ministry and UNESCO aimed at developing vocational education in the Kingdom of Bahrain according to the system of qualifying circles, and by adopting the system of credit hours in industrial secondary schools. Starting from the first semester of the academic year 1988/1989 AD, the system of qualifying circles was applied in an experimental manner at Al Jabriya Industrial Secondary School for Boys. The Ministry sought to expand this system in the academic year 1989/1990 AD, so it applied the first qualifying episode of this system in Sheikh Abdullah bin Issa Secondary School (vocational section), and with the advent of the academic year 1993/94 AD, this system was expanded to include all industrial secondary schools in the country (Akhbar-Alkhaleej Newspaper, 2016).

After conducting a comprehensive study and evaluation of vocational secondary education, according to the system of qualifying circles, it became clear to the Ministry that there are bottlenecks and problems resulting from the application of this system, so it tended to reconsider industrial secondary education programs and make them more responsive to the labour market (Akhbar-Alkhaleej Newspaper, 2016).

During the academic year 1997/1998 AD, the Ministry of Education adopted a new structure for the developed system in industrial secondary education. It was implemented in vocational secondary schools at the beginning of the academic year 1997/1998 AD. This structure divides vocational education into two main tracks: the technical track and the applied education track. The

new structure for this education consists of three levels, which were circulated to all vocational secondary schools by the academic year 2000/99. During the academic year 2000/2001 AD, vocational secondary schools in the country were considered accredited centers for granting professional qualifications granted by the Scottish Qualifications Authority (SGA) (Akhbar-Alkhaleej Newspaper, 2016).

The quality of knowledge and education in vocational programs became a concern for all stakeholders. The vocational institutions along with the Ministry of Education are looking to enrich the subjects, improve the teaching, and assessing practices, use advanced and developed machines, and embed technology and technological concepts with vocational materials and subjects.

4. RESEARCH MODEL

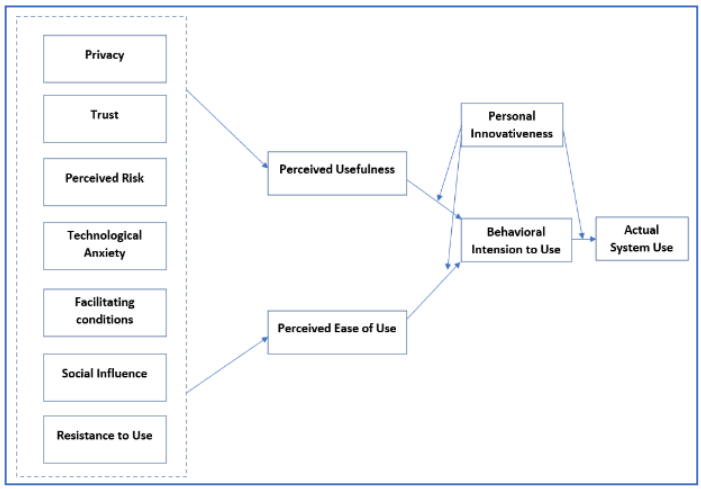

Figure 1: Research Conceptual Framework

Toward achieving the research objectives, reviewing many journals papers, articles have been published globally, it was shown that the extended TAM (technology acceptance model) which was taken from: Personal innovativeness, social influences, and adoption of wireless internet services via mobile technology, published September 2005, by June Lu, James Yao and Chun-Sheng Yu is the most suitable model to assess the acceptance of using AI Helmet in the vocational institution; in which they mentioned innovation as external stimuli that affect the perceived usefulness and ease of use. And another paper that explains the TAM model and how it was developed to reach more external factors is: Is the Technology Acceptance Model: Past, Present, and Future by Younghwa Lee, Kenneth A. Kozar, and Kai R. Larsen in January 2003. The researcher designed a research model based on the above-mentioned studies.

The above framework is consisting of eleven main variables which are: privacy, trust, perceived risk, technological anxiety, facilitating conditions, social influence, resistance to use, perceived usefulness, perceived ease of use, behavioural intention to use, and actual system use. It contains one moderator which is personal innovativeness. All components were taken from the papers mentioned earlier. The research model will be used to test the acceptance and behavioural intention to use the AI Helmet from a student perspective in the vocational institution. All variables are having a direct relationship as clearly shown in the above model.

5. RESEARCH METHODOLOGY

5.1 PROPOSED AI HELMET: A TOOL TO IMPROVE THE VOCATIONAL JOURNEY

The idea of an AI Helmet was revealed when the researcher reviewed the traditional Helmet that students are using, it is recommended to increase safety and to reduce their concerns, since that students are less experienced in using machines and they need continuous support from their instructors in workshops. The researcher suggests designing and implementing an AI Helmet that consists of the most developed program to assist students with the instructions they need to be followed inside the workshop to ensure their safety from any unexpected incidents. The proposed model should consist of raspberry pi 4b, a complete headset (speaker, Mic), a Micro servo motor, high brightness LED, white colour, a four-channel relay controller for 12C, Transparent eyeglasses, an ultrasonic sensor with high distance recognition. Whenever a student is wearing the helmet, the virtual assistant will ask for the student ID Number to record his vocational experience in the historical records of that Helmet. All students' IDs are saved in a cloud database which is active only whenever there is an internet service within the institution. An AI Helmet consists of a Network Interface Card (NIC) that allows AI Helmet to be connected to a Wi-Fi network. The IP address of the Helmet will be recorded into that access point; thus, it will be easier to recognize the location of that device.

The AI Helmet will interact with the student, in which the student can ask about the machine's name and all the instructions will be given to him by having an AI voice service available, in addition, the ultrasonic sensor will recognize whether any object is close to the student and will give him a sign to be careful, this service is set up by embedding IoT technology into the AI Helmet, in which a sensor is used and actions are assigned to each distance, whenever a student is close to an object which is located a specific distance, the action will be retrieved from the cloud database. In addition, there is an object recognition feature which responsible for recognizing the object name which is also embedded in the eyeglass, and all possible choices are saved in the cloud database. For example, if the object that is in front of the student is a steel beam, the Helmet will instruct the student to be careful of this object and to turn either right or left or ask the instructor to move this beam. A speech recognition feature will be embedded in the AI Helmet, which will be used to translate all given instructions into texts using closed captions, texts will be saved in the cloud database. This action will be saved as historical records for each student, and it can be used to evaluate students' performance, experience, and whether they have completed the required tasks for each class.

6. RESEARCH DESIGN AND METHODS

Direct observation will be performed to measure students' acceptance and behavioural intention to use the AI Helmet. Videos will be taken as evidence for conducting direct observations of the students. In addition, a validated and reliable questionnaire will be distributed through online channels to measure students' acceptance. First, the section of the questionnaire is the descriptive background of the student including age, school specialization, and experience level in using the technology. The demographic background will be using multiple choice questions type, and one question will be a small text type. In addition, the next sections will be used to measure the acceptance by responding to the Likert scale type. The participants will submit their responses through the online form, the link will be sent to them through email, or other online channels like

the Microsoft Teams chat group. This procedure will be performed as part of the data collection stage.

7. Recommendations And Future Actions

It is recommended that future actions be implemented by adapting the recent AI, robotics, cloud, IoT, and other technological aspects, which are always considered the best academic practices. Assessing students' abilities in learning the required skills is a priority task and is always positioned at the top of the strategic plan list. Adapting more AI features in robotics projects is part of applied learning in which students can improve their learning in the areas of programming, AI, engineering, cloud solutions practices, etc. Examples of features that can be embedded to apply the learned concepts and to develop the existing equipment are speech recognition, language translator, natural language processing, intelligent robotics, machine learning, deep learning, quantum computing, ethical gene editing, intelligent disaster response system, and many more. Projects can be prepared after conducting research and the market needs to go across real issues to study the field requirements and to implement the projects based on those problems. With AI Helmet students can improve their vocational experience and enhance their engineering skills as well as technological knowledge and skills. AI Helmet idea can be expanded to reach the industry workplaces to achieve a suitable environment by embedding technology into organizations' main operations.

8. Conclusions

Rich knowledge of AI has been discussed by presenting a startup of AI and robotics, the history of AI, the evolution, fields, and technologies aligned with AI, the relationship between robotics and AI in detail, educational innovation, vocational education history in the Kingdom of Bahrain, research design and methods, proposed AI Helmet tools and requirements needed. The research conceptual framework has been discussed. Variables and items have been shown. Future directions and recommendations have been suggested and proposed for further consideration.

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Conflict of Interest Statement

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The author's name listed below certifies that none of her relatives or businesses with which she is associated has any personal or business interest in or potential for personal gain from any of the organizations or projects linked to any other journal. The author also confirms that the disclosed information is correct and that no other situation of real, potential, or apparent conflict of interest is known to the author. I undertake to inform the Board President of any conflict of which I become aware immediately following any announcement by the Board or the Administration which may concern the author. The author is confirming that she is going to undertake to inform the Board

President of any change in these circumstances that affect the relation with journal paper publication.

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