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Artificial Intelligence: Current Applications and Future Frontiers

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Abstract:
In the future, intelligent machines are expected to replace or enhance human capabilities across multiple domains. Artificial Intelligence (AI), defined as the intelligence demonstrated by machines or software, is a specialized subfield of computer science. Over the past two decades, AI has become one of the most prominent areas of research, owing to its ability to improve human life and transform various sectors. Significant progress has been observed in manufacturing, services, and particularly in the field of education. Research in AI has led to the development of expert systems, a rapidly advancing technology designed to solve complex problems in specific domains. Today, expert systems are widely employed in areas such as education, engineering, business, medicine, and weather forecasting. Their application has resulted in notable improvements in both quality and efficiency. This paper provides an overview of AI and its diverse applications, with a particular focus on its role in education. It discusses the meaning of AI, the underlying search techniques, key inventions, and future prospects of this transformative technology.

Keywords: Machine Learning, Deep Learning, Neural Networks, Natural Language Processing And Knowledge Base System.

INTRODUCTION

Artificial Intelligence (AI) is increasingly recognized for its role in advancing research in educational technology, management sciences, and operational research. Intelligence, in a general sense, refers to the ability to acquire knowledge and apply it to solve complex problems. In the near future, intelligent machines are expected to enhance or even replace human capabilities in a variety of domains. AI, as a discipline, is concerned with the development of intelligent machines and software capable of reasoning, learning, acquiring knowledge, communicating, perceiving objects, and performing tasks that typically require human intelligence.

The term "Artificial Intelligence" was introduced by John McCarthy in 1956, defining it as a branch of computer science focused on making computers behave in ways similar to humans. Broadly, AI can be described as the study of computational processes that enable perception, reasoning, and action. Unlike psychology, which emphasizes human cognition, AI emphasizes computational approaches. Similarly, it differs from traditional computer science through its focus on perception, reasoning, and decision-making processes.

AI technologies are built upon artificial neural networks and logical frameworks such as conditional statements and formal theorems. Over the years, these technologies have matured to the point of offering practical benefits across diverse applications. Major areas of AI research and application include expert systems, intelligent computer-aided instruction, natural language processing, speech recognition, robotics and sensory systems, computer vision, scene recognition, and neural computing. Among these, expert systems represent one of the most rapidly growing technologies, exerting a significant impact across multiple fields. Techniques commonly employed in AI include neural networks, fuzzy logic, evolutionary computing, computer-aided instruction, and hybrid AI systems.

AI is often described as both the science and engineering of building intelligent machines, particularly intelligent computer programs. While it draws inspiration from human intelligence, it is not restricted to biologically observable methods. Although no single definition of AI has gained universal acceptance, it is generally characterized as the study of computational models that enable perception, reasoning, and action. In the current era, the vast amount of data generated by both humans and machines exceeds human capacity to absorb, interpret, and make complex decisions. AI addresses this challenge by forming the foundation of machine learning and advanced decision-making.

This paper presents an overview of artificial intelligence, discussing its definitions, history, major areas of application, techniques, growth, and achievements, with particular attention to its expanding role in education and other critical sectors.

Evolution of AI definition

AI has a history much longer than is commonly understood, in fields from science and philosophy ranging all the way back to ancient Greece but its modern iteration owes much to Alan Turing and conference in Dartmouth College in 1956 where the term "Artificial Intelligence" was officially coined and defined by John McCarthy at the time as "the science and engineering of making intelligent machines". Russel and Norvig (2020) referred to it as the "the birth of artificial intelligence." One of the initial paradigms of AI was that it revolved around high-level cognition. Not the ability to recognise concepts, perceive objects, or execute complex motor skills shared by most animals, but the potential to engage in multi-step reasoning, to understand the meaning of natural language, to design innovative artefacts, to generate novel plans that achieve goals, and even to reason about their own reasoning. This general human like intelligence was referred to as strong AI For strong AI, the primary approach has centred on symbolic reasoning, that computers are not simply numeric calculators but rather general symbol manipulators. As noted by Newell and Simon (1976) in their physical symbol system hypothesis, intelligent behaviour appears to require the ability to interpret and manipulate symbolic structures. While this approach showed promise initially (Newell & Simon, 1963), many branches of AI have retreated from this approach due its difficulty and the lack of progress coming in to the 21st century. It remains yet uncertain on when and if strong AI will be made a reality.

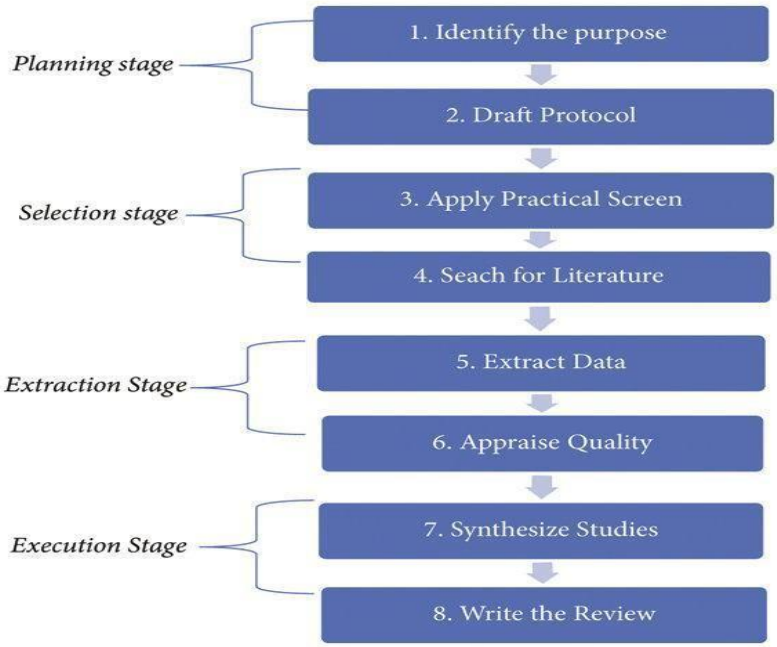
The distinction between weak AI and strong AI is also concerned with rule adherence, i.e., the way machines interact with rules distinguishes rule-based decision making in which machines strictly respect the rules set by developers from rule following decision making which machines follow rules that have not been strictly specified to them. Rule-based decision-making matches weak AI, while rule-following decision making is an attempt that tends towards strong AI. An example of rule-following decision making is neural networks (NN), which allow algorithms to learn from themselves. Strong AI would be machines making their own rules and then follow them, which is not possible at the stage of right now AI has gone through many peaks and troughs since its early inception in the 1950s, usually referred to as AI "summers and winters. Since 2010, however, AI can be said to have once again entered a summer period, mainly due to considerable improvements in the computing power of computers and the access to massive amounts of data .This resurgence in AI research is the result of three breakthroughs: (1) the introduction of a much more sophisticated class of algorithms; (2) the arrival on the market of low-cost graphics processors capable of performing large amounts of calculations in a few milliseconds; and (3) the availability of very large, correctly annotated databases allowing for more sophisticated learning of intelligent systems (Jain et al.,2004, Khashman, 2009, PWC, 2019). Despite the length of time the field has existed, there is still no commonly accepted definition (Allen, 1998, Bhatnagar et al., 2018, Brachman, 2006, Hearst and Hirsh, 2000, Nilsson, 2009). This is not considered a problem yet, as many scientific concepts only get true definitions after they have matured enough, rather than at their conception, and given the complexity and breadth of AI, it may not be feasible to expect AI to have a set definition yet. Still, this doesn't mean that the topic should be ignored, especially with the recent advancements and advancements relating to the field.However, without a clear definition of the term, "*it is*

difficult for policymakers to assess what AI systems will be able to do in the near future, and how the field may get there. There is no common framework to determine which kinds of AI systems are even desirable" (Bhatnagar et al., 2018). A similar concern has been echoed by Monett and Lewis (2018), that "*theories of intelligence and the goal of Artificial Intelligence (A.I.) have been the source of much confusion both within the field and among the general public*".

In the years immediately preceding and after the 1956 Dartmouth conference where the term was coined, when the concept for AI was first brewing in academic consciousness, many researchers (would later become famous for their contributions to AI) formulated many theories and proposals that focused on the common features of mind and (McCulloch and Pitts, 1943, Turing, 1950, von Neumann, 1958, Wiener, 1948). While these thought leaders were influential, the field of AI as we know it owes more to McCarthy, Minsky, Newell, and Simon. While this is partly due to their own attendance of the famous 1951 Dartmouth conference, it is likely more since they went on to establish three leading research centres which shaped the stream of though regarding AI for years. Their own opinion on AI was as follows;*"By 'general intelligent action' we wish to indicate the same scope of intelligence as we see in human action: that in any real situation behaviour appropriate to the ends of the system and adaptive to the demands of the environment can occur, within some limits of speed and complexity" (Newell & Simon, Computer science as empirical enquiry: Symbols and search, 1976).*
Intelligence usually means "*the ability to solve hard problems*" (Minsky, 1958).

"AI is concerned with methods of achieving goals in situations in which the information available has a certain complex character. The methods that have to be used are related to the problem presented by the situation and are similar whether the problem solver is human, a Martian, or a computer program" (McCarthy, 1988). With the variety of separate opinions on what AI is, lacking agreement on a standard evaluation (i.e., criteria, benchmark tests, milestones) makes it extremely challenging for the field to maintain healthy growth (Hern´andez-Orallo, 2017).

A systematic guide to literature review development
Okoli (2015) propose a systematic review process that consists of 8 steps, namely planning (2 steps), selection (2 steps), extraction (2 steps) and execution (2 steps) that are completed across 4 phases (see Fig. 1.). Each of these four phases and eight steps are discussed in detail in the remainder of the section.



Discussion

This section summarises the findings of the SLR and highlights some areas that research to date has focused and the key findings from these studies. It is then followed by a discussion on the theoretical contributions and implications for practice. The overall goal is to uncover themes that are relevant for research and practice and identify areas which warrant further research. This section will discuss relevant insights we found from the literature, starting with the lack of cohesion around the definition of AI, the resurgence of AI interest and research in recent years, the specific contribution types of AI literature, and the disproportionate focus on machine learning and process automation.

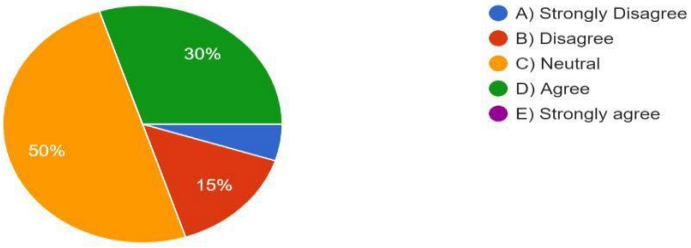
In this study we conducted a SLR that provides a comprehensive overview on AI in IS related studies. By using a systematic literature review, we identified, classified, and analysed 1877 studies on AI and ML in IS that were published between 2005 and 2020. Of these, 98 were identified as primary studies, after a rigorous filtering process. To understand the fundamentals of AI in IS we examined and studied the articles based on studies by year, publication channel, research methods used, and their contribution to IS contributions research. Prior to commencing this task however, we had to consider the problem that the definitions of artificial intelligence were largely varied and ambiguous.

Following are the sample Questions?

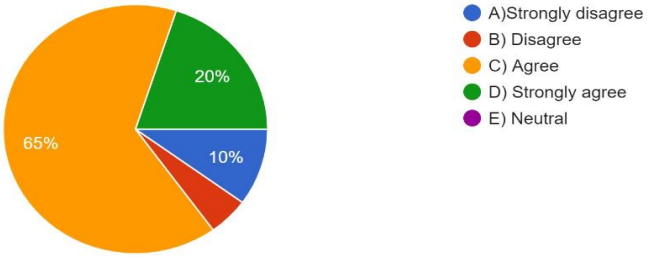
1) Are you aware of Artificial intelligence?
2) Should AI be allowed to replace human workers in certain job?
3) Do you agree that artificial intelligence has useful applications in the medical field and education sector?
4) How will the advancements of artificial intelligence and robotics impact your decision of being involved in a specialty?
5) Do you believe that artificial intelligence will significantly impact the future of technology and society?"
6) Artificial intelligence has the potential to revolutionize healthcare and improve patient outcomes?
7) Ethical considerations aside, I am comfortable with the use of AI-powered virtual assistants in my daily life?
8) I believe that governments should establish clear regulations for the ethical use of AI technology?
9) I believe that AI should be used to address global challenges such as climate change, poverty, and healthcare disparities?
10) AI has the potential to enhance efficiency and productivity in various industries?

DATA ANALYSIS

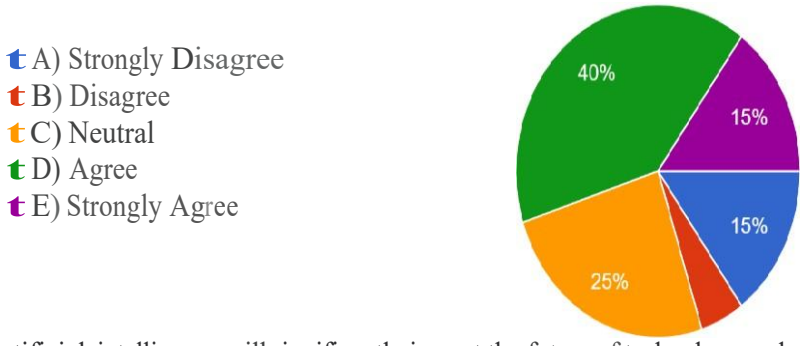
2) Should AI be allowed to replace human workers in certain jobs ?
20 responses



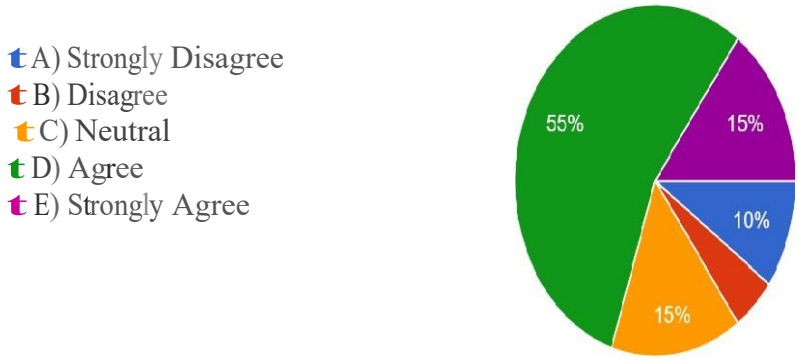
3) Do you agree that artificial intelligence has useful applications in the medical field and education sector?
20 responses



4) How will the advancements of artificial intelligence and robotics impact your decision of being involved in a specialty?
20 responses

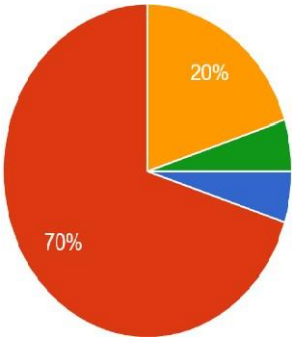


5) Do you believe that artificial intelligence will significantly impact the future of technology and society?"
20 responses



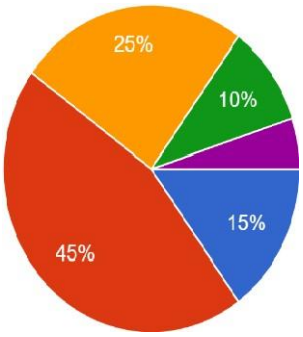
6) Artificial intelligence has the potential to revolutionize healthcare and improve patient outcomes
20 responses

A) Strongly Agree
B) Agree
C) Neutral
D) Disagree
E) Strongly Disagree



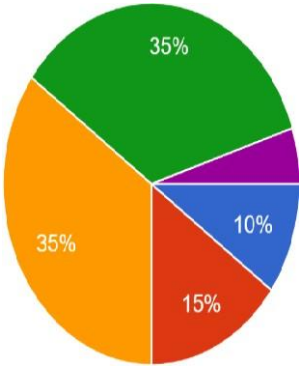
7) Ethical considerations aside, I am comfortable with the use of AI-powered virtual assistants in my daily life?
20 responses

A) Strongly Agree
B) Agree
C) Neutral
D) Disagree
E) Strongly Disagree



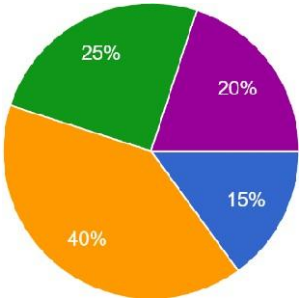
8) I believe that AI should be used to address global challenges such as climate change, poverty, and healthcare disparities?
20 responses

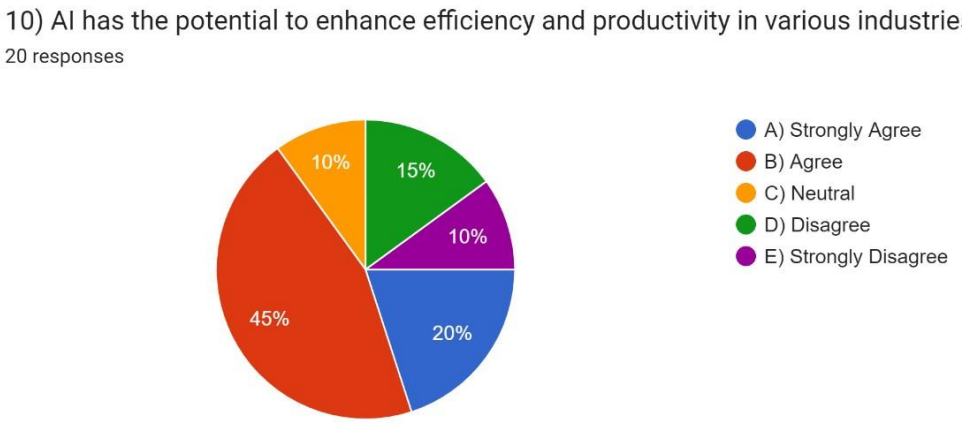
A) Strongly Disagree
B) Disagree
C) Neutral
D) Agree
E) Strongly Agree



9) I believe that governments should establish clear regulations for the ethical use of AI technology?
20 responses

A) Strongly Disagree
B) Disagree
C) Neutral
D) Agree
E) Strongly Agree





ARTIFICIAL INTELLIGENCE METHODS:

1. Machine Learning

It is one of the applications of AI where machines are not explicitly programmed to perform certain tasks; rather, they learn and improve from experience automatically. Deep Learning is a subset of machine learning based on artificial neural networks for predictive analysis. There are various machine learning algorithms, such as Unsupervised Learning, Supervised Learning, and Reinforcement Learning. In Unsupervised Learning, the algorithm does not use classified information to act on it without any guidance. In Supervised Learning, it deduces a function from the training data, which consists of a set of an input object and the desired output. Reinforcement learning is used by machines to take suitable actions to increase the reward to find the best possibility which should be taken in to account.

2. Natural Language Processing(NLP)

It is the interactions between computers and human language where the computers are programmed to process natural languages. Machine Learning is a reliable technology for Natural Language Processing to obtain meaning from human languages. In NLP, the audio of a human talk is captured by the machine. Then the audio to text conversation occurs, and then the text is processed where the data is converted into audio. Then the machine uses the audio to respond to humans. Applications of Natural Language Processing can be found in IVR (Interactive Voice Response) applications used in call centres, language translation applications like Google Translate and word processors such as Microsoft Word to check the accuracy of grammar in text. However, the nature of human languages makes the Natural Language Processing difficult because of the rules which are involved in the passing of information using natural language, and they are not easy for the computers to understand. So NLP uses algorithms to recognize and abstract the rules of the natural languages where the unstructured data from the human languages can be converted to a format that is understood by the computer.

Automation & Robotics

The purpose of Automation is to get the monotonous and repetitive tasks done by machines which also improve productivity and in receiving cost-effective and more efficient results. Many organizations use machine learning, neural networks, and graphs in automation. Such automation can prevent fraud issues while financial transactions online by using CAPTCHA technology. Robotic process automation is programmed to perform high volume repetitive tasks which can adapt to the change in different circumstances.

3. Machine Vision

Machines can capture visual information and then analyze it. Here cameras are used to capture the visual information, the analogue to digital conversion is used to convert the image to digital data, and digital signal processing is employed to process the data. Then the resulting data is fed to a computer. In machine vision, two vital aspects are sensitivity, which is the ability of the machine to perceive impulses that are weak and

resolution, the range to which the machine can distinguish the objects. The usage of machine vision can be found in signature identification, pattern recognition, and medical image analysis, etc.

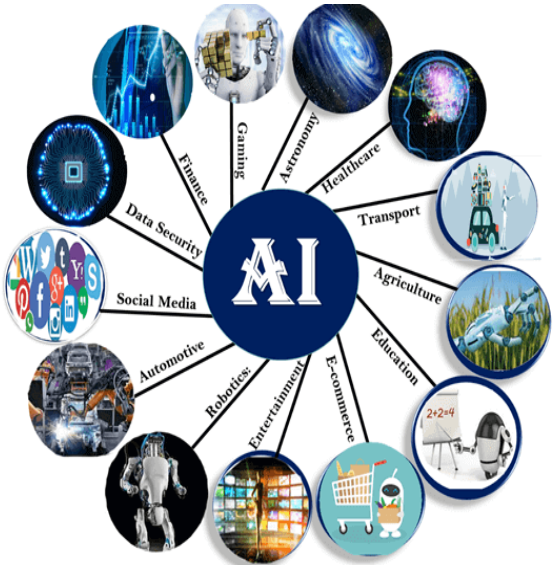
4. Knowledge-Based Systems(KBS):

A KBS can be defined as a computer system capable of giving advice in a particular domain, utilizing knowledge provided by a human expert. A distinguishing feature of KBS lies in the separation behind the knowledge, which can be represented in a number of ways such as rules, frames, or cases, and the inference engine or algorithm which uses the knowledge base to arrive at a conclusion.

5. Neural Networks:

NNs are biologically inspired systems consisting of a massively connected network of computational "neurons," organized in layers. By adjusting the weights of the network, NNs can be "trained" to approximate virtually any nonlinear function to a required degree of accuracy. NNs typically are provided with a set of input and output exemplars. A learning algorithm (such as back propagation) would then be used to adjust the weights in the network so that the network would give the desired output, in a type of learning commonly called supervised learning.

Applications of AI



I. AI in Astronomy

Artificial Intelligence can be very useful to solve complex universe problems. AI technology can be helpful for understanding the universe such as how it works, origin, etc.

II. AI in Healthcare

In the last, five to ten years, AI becoming more advantageous for the healthcare industry and going to have a significant impact on this industry. o Healthcare Industries are applying AI to make a better and faster diagnosis than humans. AI can help doctors with diagnoses and can inform when patients are worsening so that medical help can reach to the patient before hospitalization.

III. AI in Gaming

AI can be used for gaming purpose. The AI machines can play strategic games like chess, where the machine needs to think of a large number of possible places.

IV. AI in Finance

AI and finance industries are the best matches for each other. The finance industry is implementing automation, Chabot, adaptive intelligence, algorithm trading, and machine learning into financial processes.

V. AI in Data Security

The security of data is crucial for every company and cyber-attacks are growing very rapidly in the digital world. AI can be used to make your data more safe and secure. Some examples such as AEG bot, AI2 Platform,

are used to determine software bug and cyber-attacks in a better way.

VI. AI in Social Media

Social Media sites such as Facebook, Twitter, and Snap chat contain billions of user profiles, which need to be stored and managed in a very efficient way. AI can organize and manage massive amounts of data. AI can analyses lots of data to identify the latest trends, hashtag, and requirement of different users.

6. AI in Travel & Transport

AI is becoming highly demanding for travel industries. AI is capable of doing various travel related works such as from making travel arrangement to suggesting the hotels, flights, and best routes to the customers. Travel industries are using AI-powered chatbots which can make human-like interaction with customers for better and fast response.

7. AI in Automotive Industry

Some Automotive industries are using AI to provide virtual assistant to their user for better performance. Such as Tesla has introduced TeslaBot, an intelligent virtual assistant. o Various Industries are currently working for developing self-driven cars which can make your journey more safe and secure.

8. AI in Robotics:

Artificial Intelligence has a remarkable role in Robotics. Usually, general robots are programmed such that they can perform some repetitive task, but with the help of AI, we can create intelligent robots which can perform tasks with their own experiences without pre-programmed. o Humanoid Robots are best examples for AI in robotics, recently the intelligent Humanoid robot named as Erica and Sophia has been developed which can talk and behave like humans.

9. AI in Agriculture

Agriculture is an area which requires various resources, labor, money, and time for best result. Now a day's agriculture is becoming digital, and AI is emerging in this field. Agriculture is applying AI as agriculture robotics, solid and crop monitoring, predictive analysis. AI in agriculture can be very helpful for farmers.

10.AI in E-commerce

AI is providing a competitive edge to the e-commerce industry, and it is becoming more demanding in the e-commerce business. AI is helping shoppers to discover associated products with recommended size, color, or even brand.

11.AI in education:

AI can automate grading so that the tutor can have more time to teach. AI chatbot can communicate with students as a teaching assistant. o AI in the future can be work as a personal virtual tutor for students, which will be accessible easily at any time and any place.

SOME OTHER APPLICATIONS:

1. Fraud detection.

The financial services industry uses artificial intelligence in two ways. Initial scoring of applications for credit uses AI to understand creditworthiness. More advanced AI engines are employed to monitor and detect fraudulent payment card transactions in real time.

2. Virtual customer assistance (VCA).

Call centres use VCA to predict and respond to customer inquiries outside of human interaction. Voice recognition, coupled with simulated human dialog, is the first point of interaction in a customer service inquiry. Higher-level inquiries are redirected to a human.

3. Medicine:

A medical clinic can use AI systems to organize bed schedules, make a staff rotation, and provide medical information. AI has also application in fields of cardiology (CRG), neurology (MRI), embryology (solography), complex operations of internal organs etc.

4. Heavy Industries :

Huge machines involve risk in their manual maintenance and working. So in becomes necessary part to have

an efficient and safe operation agent in their operation.

5. Telecommunications:

Many telecommunications companies make use of heuristic search in the management of their workforces for example BT Group has deployed heuristic search in a scheduling application that provides the work schedules of 20000 engineers.

6. Music:

Scientists are trying to make the computer emulate the activities of the skillful musician. Composition, performance, music theory, sound processing are some of the major areas on which research in Music and Artificial Intelligence are focusing on. Eg:chucks, Orchextra, smartmusic etc.

7. Antivirus:

Artificial intelligence (AI) techniques have played increasingly important role in antivirus detection. At present, some principal artificial intelligence techniques applied in antivirus detection It improves the performance of antivirus detection systems, and promotes the production of new artificial intelligence algorithm and the application in antivirus detection to integrate antivirus detection with artificial intelligence.

CONCLUSION

This systematic literature review study provides a structured understanding of the state-of-the-art of AI research in IS. This was achieved by identifying 98 primary studies out of 1877 related AI articles over a fifteen-year period (2005 – 2020) and analysed them with respect to (i) definitions of AI, (ii) frequency of publication by year, (iii) publication channels, (iv) research method and data collection type, (v) contribution type, (vi) type of AI and (vii) business value. Clear finding emerging from this systematic literature review is the need to (i) increase the number of rigorous academic studies on AI, especially regarding tools and models, (ii) be more detailed on the definition of AI used in studies, even when it is not the focus, and (iii) build on cumulative knowledge. Research on AI in IS is still largely unexplored. While there is a relatively sizable amount of literature concerning AI in some way, a comprehensive review of what is known about AI in IS is lacking. This is especially true for the way AI is defined in IS, which is still disparate. This study examines the body of knowledge about AI in IS. This work has developed one of the very few SLRs on AI in IS and has provided a structured analysis of trends and gaps in the field. The study provides new insights to the field of IS through the utilisation of conceptions of AI definition, mapping activities to AI, and value relating to AI. We identified gaps in knowledge in the context of AI research and IS, which provides a starting point for IS researchers and IS practitioners to advance the socio-technical knowledge surrounding AI. Thus, we make a call for future IS studies to examine AI, specifically to how AI is defined in contemporary IS research.

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