

Survey of Literature on Various Hybrid Intelligence Approaches in AuI

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Abstract— To enhance benefits while minimising flaws, Augmented Intelligence combines Artificial Intelligence and Human Intelligence. When human and device capabilities are integrated, efficiency is improved when compared to independent HI and AI techniques.

We give a review of the literature to see how AuI has been used in the past, including the functions of HI and AI, AI techniques, characteristics, and operations. We present a check of expert analysis to answer four main concerns to understand the experts' suggestions on AuI, including a) the description of AuI and importance of HI with AuI

b) human intelligence in AuI's functions c) AuI's present and future operations in industry, research, and the general public, and also its benefits and drawbacks.

I. INTRODUCTION

With the following hypothesis, augmented intelligence (AuI), also known as hybrid intelligence, advocates a cooperation between people and machines (or computers)

- AuI = HI (50%) + AI (50%)

This hypothesis allows devices and humans to work together in synergy by learning from one another and leveraging each other's strengths to achieve common objectives. Because artificial intelligence (AI) is so prominent, AuI has indeed been viewed as a combination of artificial intelligence in association with human intelligence (HI). The introduction of HI

with AuI aids in the incorporation of ethical, legal, and societal values of people into decision making, such as justice, accountability, and honesty. Traditionally, AI has attempted to emulate human intelligence in order to succeed in tightly defined objectives.

In contrast, AuI is to intensify rather than to put back human cognitive ability, or to make a single person or a community better in basic terms. Hence, AuI is an intelligence with human focus whereas AI is an intelligence focused on machines.. It is a human based intelligent system that allows individuals to communicate with one another in order to enhance existing talents and capabilities or to develop new ones, allowing them to reach even greater heights while providing new opportunities.

ADDRESSING LIMITATION OF ARTIFICIAL INTELLIGENCE USING AUI

Traditionally, the aim of artificial intelligence has been to develop powerful computers and devices with human-like intelligence, such as completing the Turing test .Various AI technologies, particularly machine learning approaches (e.g., random forest), have been employed in a wide range of applications (e.g., traffic signal control) and industries to accomplish various HI-required tasks (e.g., transportation, healthcare, and packing industry,).

Lee Sedol, top strategy board gamer, has been using deep learning to defeat Google's DeepMind AlphaGo in the game of Go. In the AI field, there is a lot of buzz about turning non-smart devices into clever ones, smart systems into smartest ones, and even reaching AuI superior-to-human intelligence.

The arrival of improved technology such as big data, the IOT, and so on .AI is anticipated to play significant roles in various fields such as healthcare, manufacturing, and also in upcoming technologies, such as self-driving cars.

Even though AI is not without flaws. It is naturally a black box with no clarity. The faults in the results are difficult to recognise and measure. The problems could be caused due to lack of dataset, faulty configuration, or other factors. Consider the life-or- death decisions being made in medical diagnoses; the unclear choices made by AI are intolerable. Because HI and AI are being interconnected , the classic flaws of AI are being passed down to AuI.

II. BACKSTORY AND REASONS FOR THE DEMAND FOR AUGMENTED INTELLIGENCE

A. HUMAN VS. ARTIFICIAL INTELLIGENCE COMPARISON

In respect to gaining information, making judgments, and carrying out tasks, both Human intelligence and Artificial Intelligence have various strong and weak points. Recognizing the benefits of both kinds of intelligence allows Augmented Intelligence to benefit on them, while understanding the flaws allows Augmented Intelligence to remedy them.

1) GAINING KNOWLEDGE

HI has a greater capacity for knowledge acquisition. To begin with, HI achieves a stronger learning capability in a high-noise environment. Second, HI improves the ability to learn from unquantifiable data and situations in order to make intuitive judgments. Third, HI improves the ability to learn from arbitrary data and situations, even when training data and experience are inadequate. While AI can only execute well-defined jobs, HI can perform both. Fourth, HI has a greater potential to learn soft skills such as creative ability, creativity, adaptability, imaginativeness, intuition, and sensibility.

2) DECISION MAKING

Human Intelligence and Artificial Intelligence struggle to make objective judgements.

While bad habits and behaviours In Human Intelligence, can be caused by perpetuation, brief, prejudices, and preference; in Artificial Intelligence, biases can be generated by the effects of biased information and its limitations.

TASKS REQUIRING PERFORMANCE

Artificial Intelligence and Human Intelligence has demonstrated the limited ability of detecting a huge number of faces. Although AI can visualise multidimensional data and emotions, HI has a better ability to discern patterns since it can understand related inferences in patterns. On the other hand, AI has a better memory; In the big data world, computers process a significant volume of data produced by a quantity of entities, and statistical and analysis activities. AI has better left-brain capabilities than humans, and HI has better right- brain capabilities than humans. Due to AI's flaws and disadvantages, a "human element" is required, inspiring the development of Augmented Intelligence.

B. APPROACHES FOR IMPLEMENTING AUGMENTED INTELLIGENCE (AuI)

Here we discuss the many ways used to implement AuI, such as HI and AI's responsibilities in AuI, AI techniques in AuI, and the aspects.

1) HI AND AI'S RESPONSIBILITIES IN AuI

In AuI, Human Intelligence and Artificial Intelligence have three major responsibilities: a) Human Intelligence can aid Artificial Intelligence using the HI-AI technique. b) Using the AI-HI technique, Artificial Intelligence can suggest Human Intelligence. c) The combination of Human

Intelligence and Artificial Intelligence decision- making approach utilizes both AI and HI concurrently.

a) To begin, HI acts as the beginning point for providing inputs to the AI choice engine in the HI-

AI strategy. This contributes to a system's context awareness and accuracy. Without being explicitly programmed, AI generates local judgments derived from real personal information given by humans and sensors. Human inputs can be divided into three categories. To begin, variations in brain activity were recorded using functional near-infrared spectroscopy (fNIRS) signals and electroencephalogram (EEG). Second, data from body sensors that detect pulse rate and body temperature, such as the Ms Band. Third, crowdsourcing, which allows ordinary people to give information.

b) Second, with the AI-HI strategy, AI is used to produce information and provide insights or advice

to the human engine for taking decisions. They aid in the improvement of human decision-making accuracy. AI is utilized to assist surgeons in medical procedures, for example.

c) Finally, on combining Artificial Intelligence and Human Intelligence judgments, both Artificial

Intelligence and Human Intelligence data are considered at the same time when making the ultimate decision.

The various methodologies described above could be used to create various AuI techniques for various applications. In terms of software development debugging, the Human Intelligence-Artificial Intelligence approach obtains guidelines from Human Intelligence to assist Artificial Intelligence in resolving bugs, whereas the Artificial Intelligence-Human Intelligence proceed towards getting guidance from Artificial Intelligence to assist Human Intelligence in resolving bugs.

2) AI AUTHENTIC INTELLIGENCE

APPROACHES

In the literature, deep neural network and convolutional neural network are two popular AI methodologies applied to AuI.

The DNN is a three-layer feedforward network. To begin, there is an input layer. Second, there are multiple hidden layers between the input and output layer. Finally, there's an output layer.

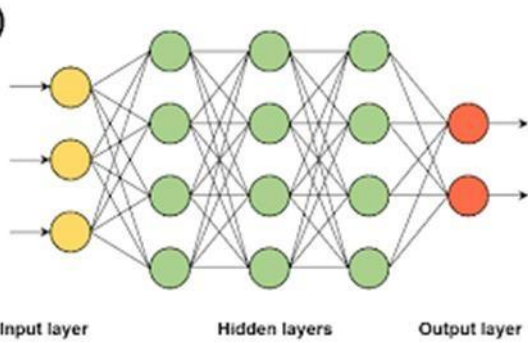


FIGURE 1. A Deep neural network architecture example

From recognising human vision and detecting facial features to heart issues identification and classification, For image processing applications, a convolutional neural network is a valuable tool.

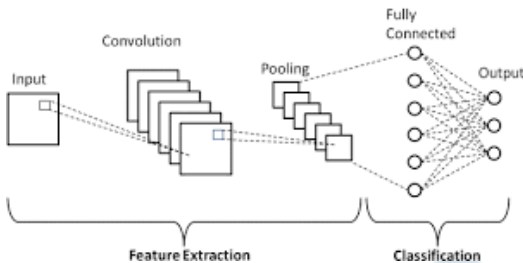


FIGURE 2. A Convolutional neural network architecture example

FEATURES

1) EVALUATION OF HUMAN INTELLIGENCE AND ARTIFICIAL INTELLIGENCE DECISIONS' CONFIDENCE

As in the presence of uncertainty, the perceived possibility that a choice will be accurate is measured by confidence level. In general, AI makes a choice and assigns a credibility rating for AI to it. If The AI judgement has a strong AI probability value, indicating that it is reliable; otherwise, it is forwarded to HI. Although HI is thought to be more dependable and capable of correcting errors, if the HI credibility value is low, it may be discarded., in which case the AI choice is favoured. If the HI confidence score is lower, the final choice can be taken without using HI, which helps to minimize human intervention.

2) MODELLING HUMAN PERCEPTIONS

Individual views of the underlying concept influence human behaviour, that can't be changed or managed like sensor nodes. Prelec reweighting function, a probability reweighting function based on cumulative prospect theory, is used to analyze human behaviour logically or to analyse any threats Because noise can alter human perception, the Reweighting method in Prelec is explored considering Gaussian and exponential noise, and it has been proven that it will not encompass all belief patterns. that approximate ideal

agent behaviours. When using the AI-HI method, the local AI decision should be made in a low-noise setting, the Human-Artificial Intelligence output is preferred.

3) WORKLOAD-BASED ADJUSTMENT OF Person AND Robot Involvement

In a person-robot collaborative task, the levels of machine and robot engagement can be dynamically modified to keep the person's workload in the appropriate boundary.

Like, The LOA is often used to improve machine autonomy, with only a greater LOA rating indicating greater machine participation and conversely. As the LOA value grows, the human operator's workload increases, allowing the machines to share more workload. In an urban environment, only one human controller works with a swarm of UAVs to look for numerous objectives, and to modify machine involvement, its LOA value is computed. according to the human operator's busy level. When the LOA value is low. These UAVs are directed to seek objectives by an operator, and whenever the LOA level is greater, all UAVs go through their own in pursuit of aims.

III. APPLICATIONS

BRAIN-MACHINE INTERFACES

Brain computers allows users to control external gadgets like robots, IOT gadgets through the ability of thinking. Certain Sensors are located on user's face to observe the physiological expressions with the help of EEG, EOG, EMG sensors to keep track of user's facial expressions. This helps users to control external gadgets with their very own eyes and facial gestures, instead of brainwave indicator only. There are six styles of physiological indicators when HI- AI is integrated with CNN. Using Sliding window these signs are caught inside quick time period which is then converted to a energy spectrum which is then fed to through a input layer of CNN. This then generates messages which are sent by human expressions.

PRODUCTION INDUSTRY

Many Business enterprises and manufacturing units try to provide good quality products at feasible cost, which plays an important role in competing with other enterprises.

1) Product Innovation

HI introduces innovative and creative ways of implementing new products without the use of complex engineering processes for building a model. AI helps in accuracy of computing and to execute procedural and iterated duties with high efficiency.

2) Packing

In 2D packaging, using of AUI helps to maximize the amount of products with unconventional shapes and sizes to be placed into a 2D shaped rectangular box. This helps in

reducing the space inside the rectangular box which in turn reduces shipping price and increase space usability. Although HI plays an important role in optimizing space it has a drawback, which is time consuming.

3) Tele-Robotic Machines

Telerobotic systems uses both human commands and AI commands to make it as a single command for controlling robots which plays an important role in manufacturing units and hazardous places. These commands should not exceed the limit of operating parameters of the machine. The robotic arm is moved using both user and AI commands which is then altered using the observed movements. The positioning of the spaceball is controlled by human and the force applied to it is controlled by AI. These two are controlled simultaneously to ensure that robotic arm has a smooth movement and can face any unexpected circumstances. The system output is referenced to alter the actions of both human and AI to adjust their actions based on the results.

4) Fault Recognition

Fault detection helps in detecting and diagnosing the root cause of faults in large chemical and manufacturing units in real-time. The results of fault detection helps human operators to take proper measures in order to make machines work properly. It's been a great task for humans to analyze large amount of data sent by the sensors in the plants, with the help of AI we can process huge amount of data. In the integrated HI-AI model we can detect faults more accurately and quickly. One of the ways is using Principal Component Analysis that is to use huge amount of data sent by the sensors and instruments, identify the variables that contribute to cause fault in diagnosis, this methodology concentrates on the main components that causes faults in the machines.

C. SPEECH RECOGNITION SYSTEM

Speech prediction is possible using speech recognition systems. Previously, speech recognition algorithms have focused on acoustical elements alone, disregarding the user's context. Such as the emotions of the users and the outside atmosphere, which decreases the accuracy of recognition and the personal interaction in response (or being robotic). The HI-AI engine coupled by CNN gets voice, emotion, and environmental information to improve detection performance. The prototype receives different types of information: a) acquired statement; b) the sentiment analyzer's viewpoint total value of a sentence, specifically how beneficial, impartial, or false the emotion is; and c) the ecological value collected from detectors (such as movement and light detectors) inside a wireless sensor nodes. The AuI put forward an approach that has shown to increase the recognition accuracy as compared to a standard approach which only uses voice.

D. HEALTHCARE

This section discusses the use of AuI in detection of disease and appropriate dosage determination.

1) Detection of disease

AuI is used in a test that searches for cancerous or aberrant growths within the colon. Medical specialists have traditionally used CT scans to discern between actual and spurious colorectal polyps, which has shown to be costly and time-consuming.

When HI and AI are combined, AI uses machine software to detect while HI requires human sight. In-integration, both HI and AI options are merged. The -integration technique effectively combines various good measures, like the probabilistic of model parameters, by reducing -divergence. There are two key parameters in -divergence: a) the parameter controls the features of an integrating; and

b) the load factor highlights the critical role of each positive measure. Input vector is used to discover the best and most loaded variables. This suggested AuI method has been found to improve colorectal polyp identification.

2) Drug Dosage Estimation

Classical methods are used to determine dose of the drug utilizing regular theoretical methods that have also been described as having faults such as for a lack of concern for just a physician's physiological & complexities. The HI-AI program estimates & distributes the right quantities of IV fluid and medications to treat sepsis, which is one of the main causes of death in ICU patients. This approach is split into 2 parts. a) A physician determines and prescribes the IV dose (HI). b) AI fine-tunes HI's dosage to enhance a fitness function based on a range of parameters, including the specified IV amount, statistics, pulse rate, and so on, in terms of improving the chances of survival. The suggested AuI technique has been found to treat the patients.

IV. AUGMENTED INTELLIGENCE DEVELOPMENT & DEPLOYMENT

In order to minimize unintended outcomes several authorities and professionals have drafted an approach to aid in the development, testing, and deployment of AuI. The American Academy of Dermatology, for example, has published a process for producing AuI in dermatology. The procedure includes four basic steps and involves practising specialists. I.e., 1) the target group is represented by the set of data it collects and labels as being of excellent quality. 2) The design creation stage, which employs the data input and specified data output collections to create an AuI approach, is used to model validation and analyze its security, reliability, and usefulness. The model installation and maintenance stage delivers the concept in the physical surroundings and continuously monitors and confirms it. 4) A stage called fresh

data stage is used to sift and update the model in order to keep a continuous promise of satisfaction. AuI is adopted via processes to provide creative, high-quality, and scientifically tested designs in order to increase patient results and happiness.

V. CONCLUSION

Augmented intelligence gathers the benefits of each intelligence while balancing each other's flaws (AuI). AuI is still in its early stages of development, thus additional research is needed to fully grasp its capabilities and possible uses. AuI has three main models, according to the literature: a) Hybrid intelligence is enabled by AI-HI model to make conclusions based on inputs provided by Hybrid Intelligence simultaneously; b) AI serves as inputs to strengthen HI enabled by AI-HI model; c) Hybrid intelligence is enabled by AI-HI model to make conclusions based on inputs provided by Hybrid Intelligence simultaneously. The deep neural network and convolutional neural networks are included by proven AI approaches in AuI. Evaluating AUI increases the efficiency of decision making of HI and AI, increases thinking perspective of humans and also helps in calibrating the involvement of human and AI based on the workload

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