ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 7, July 2017

A Study on Six Senses of Cognitive Computing

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ABSTRACT: Cognitive computing makes a new class of problems computable. It involves interdisciplinary which includes computer science, mathematics, psychology, and neuroscience. The author in this paper explains about the six senses of cognitive computing, which includes: Artificial Intelligence (AI), Haptics, Olfaction technology, Speech processing, Computer vision and Gustatory system. Cognitive computing systems are trained to predict, infer, and think using AI and Machine Learning (ML) algorithms. It may draw from multiple sources including both structured and unstructured information, sensory inputs. It can respond to complex situations characterized by uncertainty and have impacts on our healthcare, business, etc. Machines are enabled to simulate human senses of sight, hearing, smell, touch and taste. Haptics technology creates the sense of touch by applying forces, vibrations or motions. Olfaction technology is the simulation of the sense of smell, Speech processing technology can understand particularly voice commands and confine the direction of speaker, and Computer Vision is artificial systems that take information from images. Gustatory system (taste) uses food science as a basis for the development of gustatory system.

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KEYWORDS: Haptics, Speech Processing, GustatoryEnergy, healthcare

I. INTRODUCTION

Machine learning algorithms in cognitive computing is for decision making and can aid out to achieve considerable solutions by generalizing a learned model from environmental pattern instances. This technique is frequently practicable and cost-effective where manual strict rule based abstract programming is not appropriate. As more training input patterns are accessible, better-determined tasks can be attempted. As a result, machine learning is extensively used in cognitive computing and AI for handling structured, unstructured and multimedia big data. However, evolving ML cognitive applications involves a considerable amount of concept that is not available in general theories. All the algorithms mentioned above along with Cognitive technology are often used interchangeably. These terms however are quite unique in their objectives and approaches. Cognitive computing can deal with representational and conceptual information. Following are some examples of human kind of problems which include speech understanding, face detection, recommendation, medical diagnosis, risk assessment, sentiment analysis, and psychometrics to analyze psychometrics problems. Some of these problems are roughly intractable for traditional computing techniques [1].

Simulating human thought process in a computerized representation needs to be dynamic in data collecting, understanding goals, and requirements. It must cooperate with all elements in the system – processor, devices, cloud services and user. The system should retain previous interactions in a process and return information that is fit for the specific application at that point in time. Decisions made by cognitive systems continually evolve based on new information, outcomes, and actions. The system can collect and analyze data of patient including his/her history and diagnosis [2]. It becomes increasingly more accurate. Providing decision support capabilities and reducing paperwork allows clinicians to spend more time with patients. With ever-increasing volumes of data, there is a clear requirement for systems that help utilize information more effectively than humans could on their own. For example a model collects streaming data, like text and video, to create an interactive sensing, inspection, and visualization system that gives real-time monitoring and analysis. Real time cognitive system tools are IBM Watson, Microsoft cognitive services, Google deepmind, Cognitivescale, Sparkcognition and so on [3].

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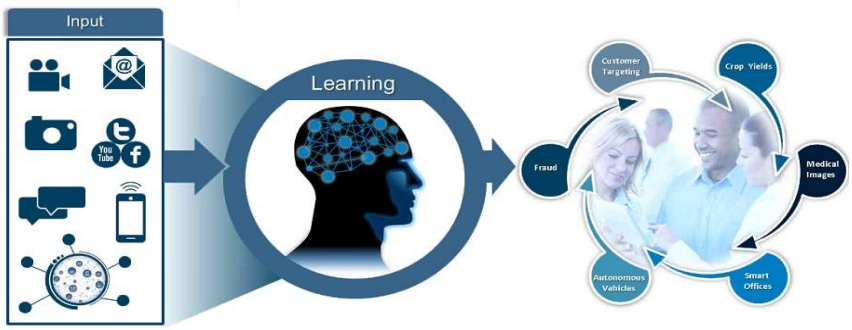

Fig.1 – Cognitive computing in general [1]

Fig.1 shows the machines that can analyze vast amount of information and learn along the way. One can take advantage of their strengths to help us solve difficult problems and make the best decisions based on more knowledge than any one person could ever hope to hold in their head.

II. COGNITIVE PROCESSING

Through Natural Language Processing (NLP) systems based on semantic technology, cognitive systems can recognize meaning and framework in a language, allowing deeper, more intuitive level of discovery and even interface with information [4]. New information and communications with people and data can help improve and refine its imminent and accuracy over time. The ability to understand language, to distinguish patterns and to be able to learn from information can facilitate companies address more meaningful and complex challenges. Table I shows the comparison between traditional system and Cognitive system.

Table 1 - Comparison of Traditional and Cognitive system

S No	Traditional system	Cognitive system
1	It can calculate numbers	Understand meaning and relationships with numbers.
2	It is programmed by logical processes	It learns and draws conclusions from interactions with information
3	It relies on structured queries and predefined rules to generate responses	It understands human, non-linear communication, relevant information and connections”
4	It cannot handle unstructured data without significant programming	It derives meaning from any kind of text and adds unstructured data into analysis

The power of cognitive computing is that we can educate its new skills and, just like a person it can progress over time as it learns from its mistakes. This ability for self-improvement is part of what makes cognitive computing a potential tool. When it sees something new it's able to judge whether it has seen something similar before and decide whether this new thing fits into an existing group or whether it requires a new group in its knowledge base. Even when

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the input is unstructured, such as images or natural speech, it has the capacity to judge it. This makes it well appropriate for recognizing and interpreting patterns, and giving them significance.

III. SENSING ABILITY

Machines are enabled to simulate human senses of sight, hearing, smell, touch, taste and Intelligence [5] as shown in Table II.

Table II - Six Sense of Computing

S No	Sense	Technology
1	Touch	Haptics
2	Smell	Olfaction
3	Taste	Gustatory
4	Sight	Computer vision
5	Hearing	Speech processing
6	Intelligence	Artificial Intelligence

A. *Haptics Technology:*

This technology creates the sense of touch by applying forces, vibrations or motions. Haptic devices may integrate tactile sensors that evaluate forces exerted on the interface. The sense of touch is of two types, such as: passive and active. By and large Haptic is frequently associated with active touch for communicating or to recognize objects. Initial battery energy (IBE) is 50Jules for each node. This technology has proved that the sense of touch in human is working well with the control of Haptic Virtual object [6]. Figure 2 shows a human hand in touch with the robot.

Fig: 2 Human hand touching a Robot

B. *Olfaction Technology:*

This technology is the simulation of the sense of smell. It is a promising application of modern engineering where cognitive computing or other automated systems are needed to measure the reality of a particular chemical concentration in air. This technology mainly holds a critical building block which helps in the progress of instruments meant for gas sensor array. These instruments are competent in sensing, identifying, and determining the compounds which are volatile. This technology is intended for human olfactory system and is considered as an artificial substitute

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for the system. The datas in this technology are multivariate in nature. It is used to detect and decide complex odors using a sensor array. In order to function, the two key components are : an electronic circuit for collecting, transporting odors to sensor array and digitize sensor responses, as well as the signal processing and pattern analysis component [7]. Figure 3 shows an image picture of Olfaction technology.

Fig. 3 Olfaction technology

C. Speech processing technology*:*

The system consists of a microphone array equivalent to human's ears. The system can understand mainly voice commands and confine the direction of speaker. Speech recognition is realized based on pattern matching. The system could recognize speech, localize speaker and get to the position of speaker. Such a thing has potential for application in somewhere voice communication plays a crucial role [8]. The framework of speech recognition refers to system where a person can speak via a microphone to a computer. The words which are spoken are translated by the system into text or command. Then this translated version of command or text is executed as a function in computer. The intelligent speech recognition enables the system to understand spoken instructions. Figure 4 shows a picture of few devices used in speech processing technology.

Fig .4 Few devices used in Speech processing technology

D. Computer Vision*:*

It is an artificial system that takes information from images. The image data can be in many forms, such as video sequences, multiple cameras, or a medical scanner. System is basically fitted with one or more cameras used as sensors to provide a secondary feedback signal to the system controller to more precisely move to a different target position. The vision system finds the position which shows the exact location coordinates of the components to the system which are spread out randomly beneath the camera's view. Figure 5 shows an image of a computer vision.

Fig .5 Computer vision devices

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E. Gustatory system*:*

Gustatory refers to taste and its displays are discussed in the literature, and it is found that no system has fully emerged that can be evaluated. Food science gives a basis for the development of gustatory system. It can be said that we know a great deal about how the sense of taste works and how to produce, chemically, some specific tastes just as olfaction but translating this knowledge into a practical application will be difficult. There are the usual challenges of producing a particular taste on demand, delivering the taste sensation to the system and then eliminating the taste as required. Beyond these problems we have the additional issues of the strong relationship between tastes and smell [9]. Figure 6 shows an image of a gustatory system.

Fig .6 Gustatory system

F. Artificial Intelligence*:*

It is the effort to artificially produce cognitive beings. Artificial intelligence is the technology of cognitive phenomena in machines. The main objective of AI is to implement characteristics of human intelligence in computers. Learning and development are the practice by which system should gain knowledge and information over time. Consciousness is the attentiveness whether something is an external entity helps the mind having the ability to experience or to feel a sense. Cognitive computing is in this esteem to be distinguished from traditional computing where the task to be performed is narrow and well-defined and the environment well-contained.

IV. IMPACT IN SOCEITY

Cognitive system can grow, exploiting the gained experience to learn from the past, both from errors and from success. Cognitive systems can be used in content curation to make dynamic content structures that settle in and reflect ongoing changes in vocabularies and knowledge domains. Threat detection is emerging as the first cognitive computing application to become prevailing. Lot of private and public organizations are using cognitive computing since these organizations cannot maintain data as such in text format. Cognitive computing can manage structured and unstructured security data. Cognitive systems can recognize terms and make connections between them. To reduce the cyber crime threats, solutions related to cognitive security will be helpful. Cognitive computing comprises of speech processing, machine learning (ML), artificial intelligence (AI), natural language processing, and robotics can reach unstructured data as well. This makes it a faster and more exact way of interpreting and detecting threats [10].

V. PROS AND CONS

A. *Pros*:

Cognitive solutions can advance the software development and testing, lead to improved efficiency and agility and boost solution design. Sales professionals get access to data for lead management and can be more efficient in their account management. Cognitive computing can also rapidly smart in threat and fraud detection and free up employees. Cognitive systems analyze the Big data which is created by connected devices in IoT with predictive and prescriptive analytics tools which observe and offer insights.

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B. *Cons*:

The cognitive systems fail at analyzing the threat which is missing in the unstructured data. Thus human intervention is necessary for risk analysis and final decision making. It increases human thinking and examination but it all depends on the human beings to take the significant decisions. The complexity of problem grows with the number of data sources. It is not easy to cumulate, combine and analyze such unstructured data [4]. A complex cognitive solution should have many technologies that coexist to give deep domain insights.

VI. CONCLUSION

Cognitive computing systems may play the role of an assistant for the user, and they may perform virtually in many problem-solving situations. It is not proposed to replace workers. Rather, It is all about computers and humans working together. The system is not autonomous; it has a partnership with a professional who makes the decisions. It is how information environments can be optimally structured for humans and machines to mutually work. Practically it is directed to algorithms for efficient search, knowledge abstraction from large databases, data mining using cognitive models and so on.

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