CONGNITIVE SCIENCE

PROJECT NAME

Cognitive Science with Artificial Intelligence

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1. ABSTRACT

His paper encompassed around the interdisciplinary study of cognitive science in the field of Artificial Intelligence. Past as well as current areas of research have been highlighted such that better understating of the topic can be ensured. Furthermore, some of the present-day applications of cognitive science artificial intelligence have been discussed as these can be considered as the foundation for further improvement. Prior to discussion about future scopes, real-time complexities have been revealed.

2. INTRODUCTION

Cognitive science is the interdisciplinary, scientific study of the mind and its processes.[1] It examines the nature, the tasks, and the functions of cognition. Cognitive scientists study intelligence and behavior, with a focus on how nervous systems represent, process, and transform information. Mental faculties of concern to cognitive scientists include perception, language, memory, attention, reasoning, and emotion; to understand these faculties, cognitive scientists borrow from fields such as psychology, artificial intelligence, philosophy, neuroscience, linguistics, and anthropology.[2]The typical analysis of cognitive science span many levels of organization, from learning and decision to logic and planning; from neural circuitry to modular brain organization. The fundamental concept of cognitive science is that “thinking can best be understood in terms of representational structures in the mind and computational procedures that operate on those structures.”[3].

Brief overview of Cognitive Science and Artificial Intelligence The science of psychology came into focus since 1800s with several researchers searching for common yet specific human mind characteristics. Cognitive Science has been first highlighted in the 1930s in context to psychology as this concept is considered to be an indicator of reaction to a given stimulus. With time, this topic was backed up with computer models that enabled simulation of levels of human thinking [4]. Cognitive Science is now referred to as the study of every detail about mind and includes varieties of research science in the fields of philosophy, education, Artificial Intelligence, Neuroscience, Linguists and anthropologists associated with the cognitive sciences study behavior and intelligence, focusing on the ways the central nervous system processes, transforms, and represents information. The goal of cognitive science is to understand the principles of intelligence so that better understanding of the mind and learning can be facilitated. Moreover, artificial intelligence or artificial intelligence is a simulation of human intelligence that is processed by computerized systems.

This made it possible to obtain information and use established rules to arrive at a specific conclusion so that self-correction could be enhanced [5].

3. Artificial Intelligence within Cognitive Science

The branch of artificial intelligence and the cognitive behavior of machines. However, technological advances have allowed AI to encapsulate concepts of cognitive science and focus on ways to store human, animal or machine information. This led to the development of intelligent machines with which it became possible to recognize speech or emotion, learn, plan, solve problems, and think. [5]. It is also a fact that traditional AI techniques offered limited scopes, in terms of optimistic predictions, which became possible over time with the invention of cognitive robotics. According to the ideas of [6], robots with a broad spectrum of cognitive powers are referred to as cognitive robots. These robots can perform open tasks without human assistance. Integration with a custom processing architecture enabled these bots to learn and thus respond to complex situations. However, knowledge acquisition has not yet been explored due to the broad requirements of prediction systems such as artificial neural network.

The investigation of models of human-like intelligence began from the early 1990s using SOAR. Semi-symbolic modeling, in contrast to neural network models, consists of the fact that the brain is an amalgamation of several simple nodes. As a result, it is found that the problem-solving ability is derived from the communication between these nodes [7].

4. Related Work

Past and current research in cognitive science and artificial intelligence Technological advances and innovations have made it possible for scientists to stimulate the human brain on a computerized system with greater precision and accuracy. In other words, artificial intelligence is the cognitive science that has ensured the effective use of the power of computers to supplement the thinking ability of humans. Therefore, computer simulation in artificial intelligence can be described as a reproduction of the behavior of a system so that simple and complex goals can be achieved [8].

5. Central principles of cognitive science and artificial intelligence

A central tenet of cognitive science is that a complete understanding of the mind/brain cannot be attained by studying only a single level. An example would be the problem of remembering a phone number and recalling it later. One approach to understanding this process would be to study behavior through direct observation, or naturalistic observation.

A person could be presented with a phone number and be asked to recall it after some delay of time. Then, the accuracy of the response could be measured. Another approach to measure cognitive ability would be to study the firings of individual neurons while a person is trying to remember the phone number. Neither of these experiments on its own would fully explain how the process of remembering a phone number works.

Even if the technology to map out every neuron in the brain in real-time were available, and it were known when each neuron was firing, it would still be impossible to know how a particular firing of neurons translates into the observed behavior. Thus, an understanding of how these two levels relate to each other is imperative. The Embodied Mind: Cognitive Science and Human Experience says, “the new sciences of the mind need to enlarge their horizon to encompass both lived human experience and the possibilities for transformation inherent in human experience.”[9] This can be provided by a functional level account of the process. Studying a particular phenomenon from multiple levels creates a better understanding of the processes that occur in the brain to give rise to a particular behavior.

6. The Soar Cognitive Architecture

Soar is a general cognitive architecture that integrates knowledge-intensive reasoning, reactive execution, hierarchical reasoning, planning, and learning from experience, with the goal of creating a general computational system that has the same cognitive abilities as humans. In contrast, most AI systems are designed to solve only one type of problem, such as playing chess, searching the Internet, or scheduling aircraft departures. Soar is both a software system for agent development and a theory of what computational structures are necessary to support human-level agents. Over the years, both software system and theory have evolved. This book offers the definitive presentation of Soar from theoretical and practical perspectives, providing comprehensive descriptions of fundamental aspects and new components.

This cognitive programming-based system has been developed at the University of Michigan in order to simulate the human brain. This system can be referred to as an alternative approach due to the fact that SOAR system stores and retrieve information from working memory [10].

Reinforcement learning that tunes values of rules and altogether, helps in creating numeric preferences is also supported by this cognitive system. In order to enhance flexibility, a structure within the working memory is created which considers rewards.

SOAR has also enabled stimulation of virtual humans that supports face-to-face collaboration and dialogues [11].

In spite of the fact that this application has integrated capabilities of natural language understanding, emotion, action and body control however, it is criticized as it is suitable only for the virtual world. Whether aspects of psychology need to be minimized such that better approximation of the knowledge level of symbol processing can be acquired is still under question. This is because SOAR architecture attempts to replicate the evolutionary design process in order to result in better symbol system.

7. Stimulating creativity

Most of the current papers related to simulation of human level intelligence within the process of decision-making have been witnessed to be emphasizing on significance of imitating creativity. It is the fact that past experiences and knowledge is the foundation of decision-making and also to suggest for changes. However, creativity is depicted to be a gifted ability of human beings with which, it is possible to solve problems, think, interfere and develop. Creativity is of three types namely, concrete, abstract and artistic[12].

Creativity in the field of engineering applications is however, mainly concrete as this type is about the generation of innovative, new and unique solutions in an environment full of conditions and restrictions.

Time has succeeded in achieving these concepts which were once just an assumption. For instance, AI enabled informed creative decisions, not to recreate the human mind, rather to interact with humans and to inspire

creativity. Increasing use of AI for augmenting human capabilities has assured super creativity and assisted human mind in a way where achievement of better results in a short period of time has become possible. This era of man versus machine has now become the reality with everyday humancentric processes are now done automatically, without the need of human beings. For instance, giving presentation of clients or conduction of interviews no more requires physical presence of human beings [13].

8. Applications and importance of Cognitive Science-Artificial Intelligence

There is a wide range of importance along with many applications of cognitive science with artificial intelligence. It is a fact that the concept of cognitive science and artificial intelligence has undergone massive transformations over time, leading to an era in which it became possible to develop programs that would take into account the cognitive abilities to solve complex thinking problems. and emotionality in how thoughts and feelings are reflected in bodily response systems with artificial intelligence including peripheral physiology, facial features and body movements.

One specific question along this line of research is how perception and influence manifest themselves in the dynamics of general body movements. Advances in this field can be accelerated with motion tracking systems that are inexpensive, non-intrusive, portable, scalable, and easy to calibrate. To this end, a simple but effective software project has been created that uses well-established computer vision techniques to estimate how much a person has moved from a video of a person engaged in a task.

The system works with any commercially available camera and with existing video footage, thus providing an inexpensive, non-intrusive, portable and scalable estimation of body motion. Strong between-subject correlations were obtained between motion estimates and recorded body motions.

9. Manual approaches

Most manual approaches consist of trained human coders observing individuals' body movement and making judgments about what movements were made. This can be done in real-time, but more often, videos of individuals' movement are recorded for later analysis. For example, Friesen, Ekman, and Wallbot [14] trained judges to classify hand movements from videotapes of conversations into three categories: speech illustrators, body manipulators, or actions conveying symbolic information. Other coding schemes include the Body Action and Posture Coding System (BAP) [38] for classifying body movements and postures, and the Davis nonverbal state and nonverbal communication scales [15,16] for coding nonverbal aspects of communication and movement behavior, among others[16–17]. In these systems, high inter-coder reliability is generally demonstrated, but the coding process can be labor intensive in terms of human capital, as video is sometimes coded frame-by-frame to ensure accuracy[17].

10. Cognitive science algorithm project with AI

We implemented motion tracking algorithm for Windows 10 devices using. NET using the OpenCvSharp library (C# wrapper for OpenCV). OpenCvSharp includes functionality for generating silhouettes. Currently, the program runs only on the Windows operating system, although OpenCvSharp is inherently cross-platform. It should be noted that this algorithm can easily be ported to platforms other than Windows in other programming languages. For example, it can be easily used with Mono, which is an open source cross-platform system. NET which is dual operating system compatible with Microsoft's.net platform. Other OpenCV wrappers are also available, such as the EmguCV library, which is cross-platform. NET compiler that can be easily compiled using Mono.

The project you developed provides a graphical user interface (GUI) for live or pre-recorded image processing. The following figure shows a screenshot of the program. The GUI contains four panels: 1) the current video frame (top left), 2) corresponding motion silhouette (top right), 3) an animated time series of estimated motion (the proportion of displaced pixels in each frame), and 4) controls the program. Options are available to show or hide visualizations and set internal parameters. Individual video files (eg, .avi, .mp4) as well as entire directories containing video files can be processed at once. The program creates a text file containing the estimated movement of each frame in the image and the frame number.

I tested the project on myself directly, as shown in the following figure:

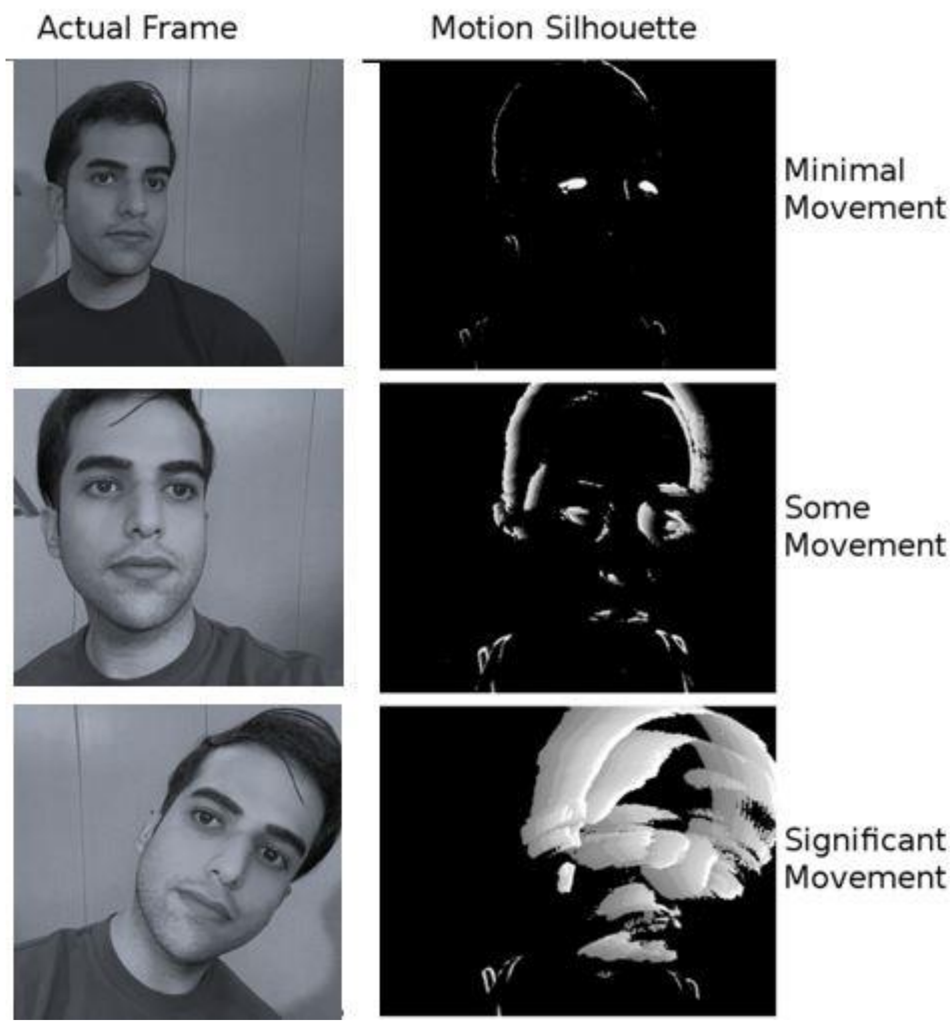


Figure 1 The image in process is shown in the top left panel, while the corresponding motion silhouette is shown at the top right. The lower left panel shows an animated graph of the movement indicator over time. The program's controls, which allow the user to select the image to be processed, whether to show visualizations, and where to save the output files, are located in the lower right panel.

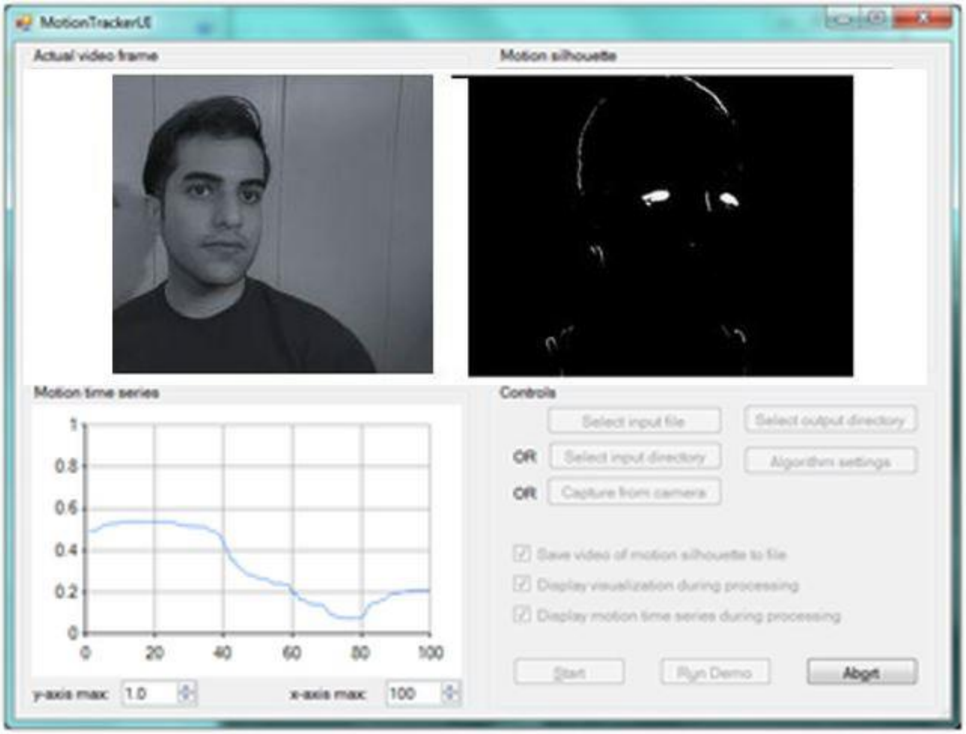
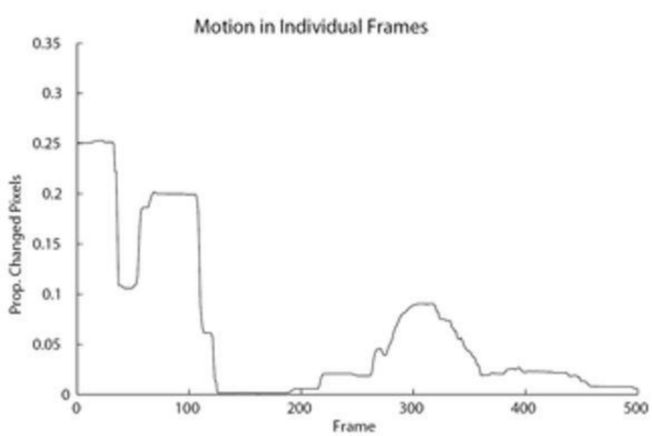


Figure 2 Sample output from the motion tracking algorithm.

Figure 2 shows a sample output from the motion tracking algorithm. The panels on the left show single frames taken from the image sequence, and the panels on the right show the silhouettes of the corresponding motion. Pixels that have been shifted (that is, the places where movement occurred in the image frame) appear in white, while pixels that have not been shifted appear in black. In the bottom panel, there is a noticeable movement of the face and body. By contrast, in the middle panel, only some movement occurred, and in the upper panel, the body is still except for the eyes. As can be seen, the algorithm correctly filters background noise such as fixed pixels and light fluctuation, and detects both small movement such as eye blinks when the head is still (top panel), medium movement such as slight shifts in position (middle panel), and noticeable movements such as tilting Head and gestures (bottom panel).

On the left are single frames extracted from the image sequence, while the panels on the right display the silhouettes of the corresponding motion. Displaced pixels (that is, the places where movement occurred in the image frame) appear white; Pixels that are not shifted appear black.

Figure 3 shows a time slice with 500 steps of the participant's time series. Video was recorded at 30 frames per second. The histogram displays movement in individual frames as a percentage of pixels per frame changing. The lower graph displays the estimated motion, which is the absolute difference in the ratio of pixels changing across adjacent frames. The periods of stable movement are reflected in the upper chart by small spikes in the lower chart. Small bumps indicate subtle changes in movement across adjacent tires. Large spikes in the lower graph indicate larger changes in movement across adjacent frames, reflecting sharp increases or decreases in the amount of movement. For example, in the upper chart there is a stable movement until approximately frame 30, at which point there is a sharp decrease in the amount of movement. This is reflected in the lower chart as a series of very small rallies during the period of stable movement, followed by a large rise when the movement suddenly decreases.



11. Results and Discussion

In conclusion, after completing the project and obtaining the results, it can be concluded that artificial intelligence is a useful tool in the field of research in cognitive sciences, as this technological innovation facilitates the best understanding of the human mind. Useful insights into human recognition are made possible by AI-based applications such as speech to text, text to speech, natural language understanding, personalization and object motion tracking. Moreover, it is estimated that intelligence agents enhance the simulation ability of the human brain. However, there are some complications that may end up limiting the ranges of brain simulations in which improvements such as nanotechnology, cognitive science, and artificial intelligence are desirable. Specifically, these theories will enable a full understanding of the human mind along with consideration of complex problems.

https://github.com/FarkadAdnan/Body_Movement_Tracking

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