

A Survey on Artificial Cognition for Human-Robot Interaction

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ABSTRACT

Artificial Cognition refers to the simulation of Human Intelligence in Computers or Robots. Robots are known as artificial agents, which has diverse capacities of perception and action in the physical world. The use of Robots can be generalized in factories but in the recent years, the robots are mostly found in the technologically societies like military battle, search and rescue, mine and bomb detection, scientific exploration, medical care and entertainment. Human-Robot Interaction provides a powerful and dynamic interaction, which can work with partially unknown environments that were not only designed for robotic tasks but also involves social interaction with humans. This paper discusses about the various abilities and aspect of robot in human interaction. In this paper, the measurement tools namely Distributed Camera System and Wizards-of-Oz were discussed for a room observation application and also two analysis tools namely SAMA+ANVIL and MOVE-IT tool were also illustrated for the same application to analyze the collected video streams and to provide a multi view analysis of human and humanoid interaction.

Keywords

Artificial Cognition, Human- Robot Interaction, Intelligence, , Social Interaction

1. INTRODUCTION

Cognition means interaction between the system and humans which enables the system to learn and reason with a purpose which is the next step of artificial intelligence. They are used for providing answers to numerical problems and it is also a well-founded system for reasoned arguments and recommendation. Human plus machines are very stronger than computer and hence the cognitive systems with Human-Robot interactions were build.

2. TECHNIQUES FOR HUMAN-ROBOT INTERACTION

Human-Robot Interaction can be implemented in various domains using variety of techniques in several ways. It can be applied in fields such as medicine, military services, automation and in many other fields.

2.1 Artificial Cognition for social Human-Robot Interaction

The author provides a brief description of Human-Robot Interaction and the way in which cognitive technique is implemented in artificial intelligence[1]. There is a broad variety of situations where the robots can understand and interpret humans naturally. Many artificial intelligence techniques involving symbolic reasoning cannot involve in any social interaction with humans. To overcome this hurdle, Human-Robot Interaction is introduced by combining the cognitive abilities with artificial intelligence.

2.2 eSMAC: An affordable modular Robotic kit for integrated stem education

The author elaborates the usage of robot in learning and problem solving[2]. Problem solving can be improvised by introducing robots in learning environments. Here the students have to complete the task assigned by robots. Now various governments worldwide aim in increasing number of STEM [Science, Technical, Engineering, Mathematics] graduates. Thus by introducing robotic kits the education standard can be increased with real-world application. eSMAC modules contains input, output, mobility, communication and powering.

2.3 Human-Robot Interaction-status and challenges

The author describes the human –robot interaction in social life and discusses the status and challenges in it. Robots have been build for incorporating artificial intelligence and under human supervisory control and satisfying various human needs[3]. Human-Robot Interaction is used in fields like medicine, military services, automation. The evidence of robot success is live demonstration which describes its capabilities. Mit's kimsnet is one such example where it is a social intelligence robot. The toys which are both in human and animal form is with computer-based technology, speech recognition are now evolving in markets.

2.4 Current trends in Human-Robot Interaction towards collaborative and friendly machines

The author describes about the current trends and Human-Robot Interaction design interfaces [4]. Robots continue to perform tasks which are repetitive in wide variety of environment. When a person interacts with a robot it should not have any new form of

interaction. Thus social intelligence is a required for the robot. There are a various kinds of natural interaction such as multi touch surfaces, tangible surfaces, speech enabled interface. Multi touch surfaces enables the interaction with hands and fingers, tangible surface is one where the physical objects are embedded with computational sensing, speech enabled interface is considered to be the most intelligent design interface.

2.5 An atlas of physical Human-Robot Interaction

The author describes the physical robot interaction in securing the human and also about the robot safety[5]. Robots for physical assistance should ease the work of humans, reduce their stress, increase the speed, accuracy and quality of work. Robots are also used in safeguarding humans. Thus it is also mandatory for the robots to take independent decisions. Software, mechanics, electronics should be designed for the robot safety. These robots are used in many industries and in automation field. For ensuring robot safety the main standard factories is ANSI/RIA R15.06.1999 (American National Standard for Industries).

3. ADVANTAGES AND DISADVANTAGES OF HUMAN-ROBOT INTERACTION

3.1 Advantages

- It achieves multi-modal and interactive symbol grounding in both complex and real world environment.
- It provides a variety of sensing and modules that use magnets and it does not involve programming thus it reduces the students effort to learn coding. eSMAC robotic kits are designed interoperability and it is of low cost.
- They are used in all space and industrial tasks having specialized telerobots under human supervisory control.
- When the robots can interact in human understandable way it comforts the human since the task becomes much simplified.
- The robot can provide security to the user and hence it can also be used in military services.

3.2 Disadvantages

- It involves many challenges like communication and human aware execution.
- They cannot be implemented practically as this scheme cannot be supported in all the countries education system.
- Not all human society will accept a robot with social intelligence.
- All the interface design is not utilized efficiently.
- When it sees any unexpected behavior in humans at public place there are chances for humans being harmed.

4. MEASUREMENT TOOLS

4.1 Distributed Camera System

The author in the paper[6] describes about the tool, which is used to capture the micro behavior of a room using seven different cameras. The observation room had one window on a wall to observe the experiments from outside. The Camera-1 is used to measure the facial expression of a person. It is placed before the person so that it is used to capture the expression of that person.

Camera -2 is used to measure the side view of a person, so that it can determine the degree of body lean posture relative to a vertical reference line. Camera -3 is used to measure the overhead view of the table and also the overhead view of the person, so that it observes the choices made by the person during the task as well as any hesitation. Camera - 4 is called as the head-mounted camera that measures the gaze direction of the person as well as the persons object of attention. Camera-5 is considered from humanoids own cameras. This camera is used for recording what is directly observable by humanoids own sensors and followed by any vision detection algorithms created. Camera - 6 is a Sony high-definition DVCAM camera, which gives a wide field of view of both humanoid and the person face to face in order to observe the whole body movements of the person. Camera - 7 is a Sony Handy cam which gives an another view of the face from a different angle. Also, the wide-array receiver microphone was used to synchronize with the first five Cameras 1. All the samples of data were time stamped to the same clock, eliminating the need for manual synchronization and digitizing. This tool had saved the users from countless hours of manual processing as we collected over 5 TB(Terabyte) of audio and video data for analysis.

4.2 Wizard-of-Oz (WoZ)

The author also describes about the second tool called as Wizard-of-Oz (WoZ). This tool is a process of controlling a robot secretly, by hiding the human operator from the robot, such that even the person interacting with the robot is unaware that the robot is under human control and believes it is acting autonomously [6]. The method is a prototyping tool, which is useful for evaluating perception and behaviour algorithms prior to investing the effort to implement them.

5. ANALYSIS TOOLS

5.1 SAMA+Anvil

The author describes about the analysis tool namely SAMA and ANVIL [6]. SAMA is a Subject Automated Monitoring and Analysis Tool. An ANVIL is a multimedia annotation and analysis tool, which captures the 3D viewing of motion data and allows a more precise annotation of human movement. Also, Cross-modal association analysis can be used in ANVIL to detect correlations between specific event classes from different modalities The main goal of designing SAMA with ANVIL tool is to analyse the information collected from various cameras and to give a complete view on human-humanoid interaction. The SAMA collects the video data in multiple views during the recording phase and for each time slice, it gives a semantic annotation tag as output. Anvil is used for analysing the data given by SAMA and examines the unobserved long range relationships between the human and humanoid.

5.2 MOVE-IT

The author describes about the analysis tool namely MOVE-IT[6]. This is a Monitoring, Operating, Visualizing, Editing Integration Tool, which is a software framework used for combining interactive visual elements together to create cohesive applications. This tool can be used to create a multi-modal analysis in order to obtain a synchronized access to pre-recorded video and physiological skin conductance data streams. Anvil can handle only a short term video whereas MOVE-IT can handle very large high quality video streams. Thus, MOVE-IT is a very

good tool for monitoring, operating, visualizing, editing a very large video streams and finally can be integrated with other tools for various applications.

6. CONCLUSION

Artificial Cognition for Human-Robot Interaction provides a very powerful and dynamic method, which was used to design to perform robotic tasks as well as for social interaction with humans. This paper had discussed about the various abilities and aspect of robot in human interaction. The paper also listed out the advantages and disadvantages of the Human Robot Interaction. In this paper, the measurement tools namely Distributed Camera System and Wizards-of-Oz were also discussed for a room observation application and also two analysis tools namely SAMA+ANVIL and MOVE-IT tool were also illustrated for the same application to analyze the collected video streams and to provide a multi view analysis of human and humanoid interaction.

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