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Role of AI in Control System Design for Robotics

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Abstract

In this study, the role of AI in controlling the robotic system has been discussed in a comprehensive manner. For executing this study, AI has been introduced with its features, implications and loopholes that directly affects the universal digital technology. Places and sectors that have adopted AI to bring growth have been discussed in this chapter. Nowadays different types of advanced technologies have been invented to track human body motion and other features that make people's life more easy and advanced. Here cognitive implementation of technical systems has been discussed briefly along with its loopholes that need improvement to overcome these barriers. Assistive kitchens with their equipped tools have been mentioned in this study with brief description and manufacturing and other business industries have also discussed here that adopt AI technology to bring growth.

Keywords

AI, Cognitive technical system, control system, industry, robotics, and sensor.

INTRODUCTION

Realisation of analytic capability like learning, perception, planning, reasoning and execution for technological systems has been established by ***cluster of excellence*** (CoTESYS). It includes a flexible manufacturing system, humanoid robotics along with autonomous vehicles such as blimp. Ultimate goal of this cognitive system is to use the knowledge and experience of human beings to make a better future that can raise the capabilities of an individual [1]. Robotics and automation systems are adding up a level on the existing digital system that makes human life more comfortable and easier. Cognitive technical system is immensely flexible, adaptive, reliable and robust that makes quick cooperation and interactions with human beings.

Cognitive technical system (CTS) is an information processing technology that includes artificial actuators and sensors, embedded and integrated into the corporate system. In this study the role of AI in controlling robotics systems has been discussed comprehensively. Artificial robotics (AI) is an extremely powerful combination that has been designed to conduct automatic tasks of the factory setting [2]. Implication of AI in the robotic industry, implementation of cognitive technical systems has been discussed in this study with its loop in action. Hence it can be stated as AI is immensely smart decision making technology that solves complicated problems at a glance.

AI IMPLICATIONS IN ROBOTICS

Implication of AI in robotics is needed as it accomplishes tasks simply with right orientation and positions. CTS requires AI technology along with solid grounding systems that have insight from the CoTESYS, cognitive structures that perform empirical study and fundamental research in the context of testbeds of demonstration [3]. It has been predicted that the number of robots is going to increase in the future. However, autonomous systems and robots are expected to be widely exploited in society in the future that includes service robots and self-driving vehicles at home and at work platforms. Technologies and systems that have surrounded us are taking different shapes to bring improvement in human life. AI contributors have different perception and object related orientation in respect of the robotics industry. It has been observed that AI research inspires technological systems that are to be equipped with mechanisms that are related to cognitive.

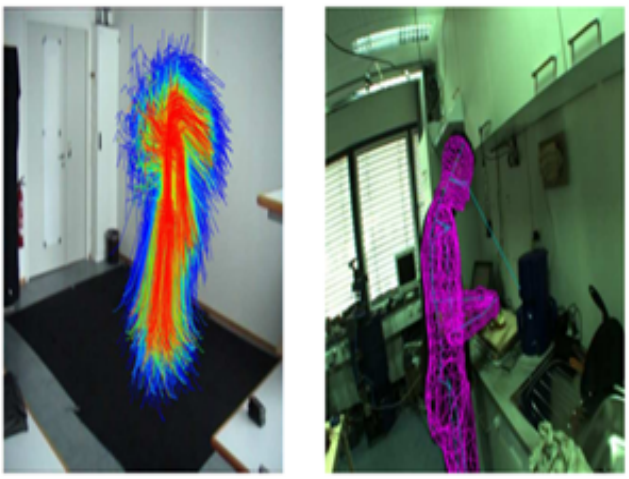

Figure 1: Body motion tracker based on 3D vision (Source: [3])

Trajectory data and accurate motion requires focus from AI technology that can track multiple digital images from human bodies. Tracking human body parts needs learning components in the appearance model. AI method measures the highly effective performance of the robotic industry that has context with embedded applications of robot and sensor equipped [4]. It is immensely important that AI researchers should study research from a close view in respect of research disciplines. For example it can be stated as research on motion planning and manipulation has surpassed AI

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planning technology. Driving AI research can be based on cognitive technical systems that prove relevance to realise high performance of autonomous systems of robotics.

AI and robotics includes autonomous transportation, cooperation and coordination mechanically, ethics and value to digital technology and intelligence augmentation that has been currently focused by World Economic forum (WEF) [5]. Hence it can be said that the robotics industry is getting advanced and improved day by day by using AI technology efficiently.

EVALUATION OF ACTION LOOP

It has been observed by CoTESYs that CTS have some close loops in perception and action based systems. The image represents that the architecture cognitive system has perception of multiple sensors, cognition like knowledge, and learning and action plan along with action. At top level, key components of environmental models, management related to learning and knowledge have connected tightly to physical action [6]. From the given image it has been obtained that perception of mapping technical systems onto cycle of perception action should recommend modules of functional decompose cognition. It consists of a module of motor action performed, another single reasoning and others [7]. From the right figure it reveals that different types of cognitive capabilities should be more interconnected and intense in order to succeed needed synergies [8]. CoTESYS investigated that common loops have been obtained in key components like ***action, knowledge, perception, learning*** and more.

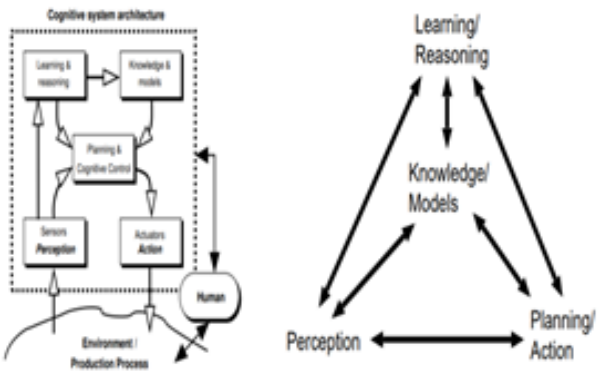

Figure 2: Architecture of cognitive system
(Source: [8])

Perception is accession of data and information related to an actor's body and environment. AI is a sub part of computer science that is basically concerned with action and perception; perception is closely related with estimated probabilistic problems [9]. In addition to that, estimated states are gradually transformed into figurative representations that authorise the systems to reason and communicate about the way of perception. Complicated ***action*** sequences and plans at upper level and primate brains using a range of quasi-hierarchy from lower elementary motor has created close loops in the cognition perception.

COGNITIVE IMPLEMENTATION OF TECHNICAL SYSTEM

Assistive kitchen is an omnipresent sensing, actuation environment and computing with robotic assistant that targets enlarging cognitive capabilities along with monitoring people's safety and health. For achieving these goals assistive kitchens need to interpret, perceive and learn models in respect to household chores. In addition to that, assistive kitchens can use the acquired model to monitor safety and health assessment [10]. Image that is presented below shows varieties of sensors that have been provided by the environment of the sensor that includes RFID tags, laser range finders and more. AI is used to design the control system of a robot to operate the overall activities of the robotic industry. It also leads an immensely important role in growth of technological development of a country.

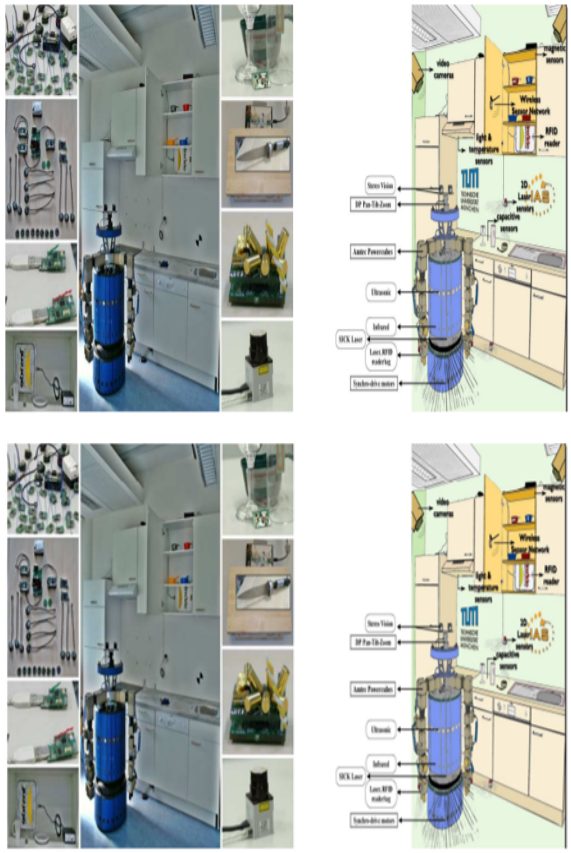

Figure 3: Assistive kitchen contains different types of sensors and robot
(Source: [10])

Hardware and software integration of the kitchen consists of network sensing and mobile robots that are embedded physically with the environment. It disposes of sensor furnish furniture, sensor in respect of global environment and appliances related to web enabled, " smart" objects and more [11]. The Discussing kitchen contains cameras on the shelf that cover the wide area of the kitchen with high resolution in the working segment. Furniture that contains varieties of sensors such as cupboards with undiminished

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RFID that gives authorization to know identities of tagged objects insight into the system [12]. In addition to that, kitchen tools and utensils are furnished with integrated sensors. For example a knife that is made based on a 6DOF torque sensor that enables it to record force direction over extended time. AI systems are used in the robotic industry to control the overall design that can give the desired level of outcome expected by scientists and researchers.

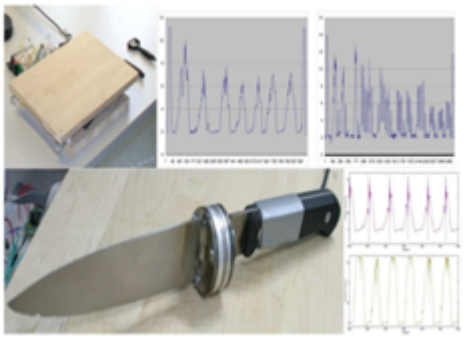

Figure 4: Knife with wireless network sensor (Source: [12])

Cognitive network for sensor estimates the events of domains that include interpreting, combing, abstracting and interpreting the sensor data of various sensors over a long time. For example it can be stated as RFID acceleration sensors to utensils the environment to recognise states of four dynamics like pick up or put down objects [13]. Identification of dynamic force states is crucial for segment activity by meaningful sub actions. Networks have played a significant role in monitoring particular activities in a comprehensive way.

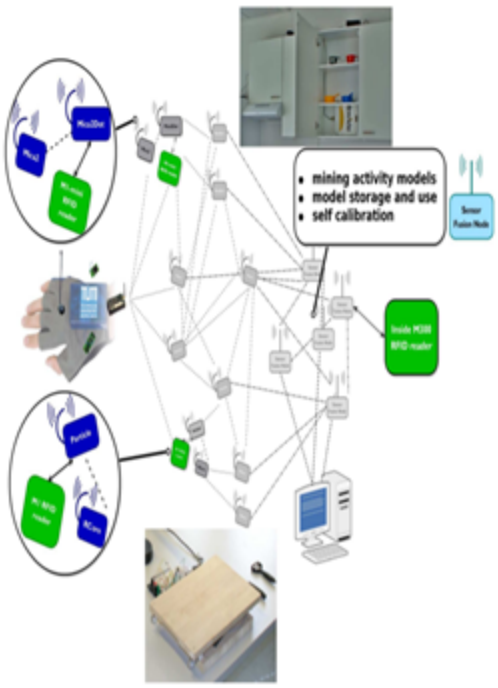

Figure 5: Assistive kitchen's sensor network (Source: [13])

Sensor robotic assistant and kitchen equipment helps in accomplishing suitably large numbers of consciousness tasks. It has determined relevant objects in a cluttered sense, classifying and determining the positions that can manipulate grasp point [14]. This type of system has been controlled by using AI technology that monitors the overall integrity of robotic systems. Additional resources of meaningful semantic components of nature have been perceived by robots by using a common sensor network [15]. Different types of perceptual capabilities of humans are required detection, recognition and understanding of human body language. Perception of human activities has challenged the sensors of kitchens that can identify and interpret activities of human beings over a long time.

Robotic assistant perception systems have determined the motion and precise parameters of human manipulation tasks like having breakfast, cleaning up, preparing tea or coffee and others. Moreover, after long time observation this type of domestic AI has been used in the robotic industry to make human lives more comfortable and easier.

The AI system not only changes the scenario of domestic lifestyle, in addition to that, it has also changed the scenario of business and different industries. Organisations and companies are implementing AI in their business activities to take quick decisions and to embrace the master transformation faster [16]. Artificial intelligence helps solve complex business problems and it is a time consuming and comprehensive capital intensive system that has been proven to succeed. Message from AI and 4IR technology has taken place in the discussion of 40 high level panels and secondly in global industrialization and manufacturing. Increase of automation technology in the robotic industry has developed the technological model and decisions of companies in reputedly manner [17]. It has been observed that social robots are primarily heavier in interaction of application in comparison to robots of industries that give possible benefits in ramification of borders. For evaluating the application of social robots in the technological industry it is important to analyse beneficial effects of robots in the production system of an organisation.

Nowadays most of the countries are using AI in different economic sectors such as ***manufacturing, agriculture, service sectors*** like transportation, finance, defines and public administration. Using AI is the reason for rapid growth of GDP of a country that helps to bring growth in economic and social life of a country [18]. Technological improvement has been influenced by using AI systems being a reason for innovation in different contexts of countries. AI leads the economic development of a country that has been recommended and adopted by governments of several countries. Internet robotics has connected different platforms by a chain such as it makes a bridge between ***electrical engineering, computer science, biology, physics, cognitive science, artificial intelligence*** and so on [19]. AI connects hardware's, sensors and actuators in electrical engineering, logics, errors estimation and algorithms have

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been connected with mathematics comprehensively.

Robotic in factories has been given an important role such as enhancing experiences of customers, minimising errors by using robotic technology, increasing productivity by using 24/7 services and so on. In addition to that, AI in robotics industries has also been applied in the medical science that changes the scenario of medical sciences [20]. Artificial intelligence includes building relationships with mathematics, biology, philosophy and more. In addition to that it has adopted different types of methods, scientific perspective and technological perspective. Hence it can be stated as AI in robotics has been implemented in different industries such as medical, science, industry, manufacturing, domestic appliances and others have also adopted this advanced technology to enhance the productivity level.

CONCLUSION

Cluster of excellence investigates realisation analytical capabilities that include learning, reasoning and planning for executing technological systems. Cognitive technical systems include artificial actuators and sensors that are integrated with corporate systems. AI has uses in different segments such as manufacturing, domestic, medical science, electrical engineering and so on. It plays a crucial role in increasing the rate of GDP of a country along with it helps to change the scenario of economic and social life of a domain. Different Types of robots have been invented to measure the motion of a human body by using 3D vision. However there are also some loopholes that create some obstacles in spreading the use of AI all over the world. Cognitive technology has been used in different segments such as assistive kitchen, advanced equipment and utensils, sensor network and so on that have been discussed above. Hence it can be concluded as AI leads an immensely important role that makes human life easier and comfortable.

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