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Artificial Intelligence: Mobile Robots Working as Team Exhibiting Artificial Intelligence

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ABSTRACT
The need to automate various industrial tasks has led to the development of mobile robots which are capable of providing cognitive behavioral responses. Developed in the mid 1950s, the mobile robots have been widely used in a number of fields. These range from exploratory, surveillance, inspection and also planetary roving. Currently, mobile robots are widely used in artificial intelligence and other cognitive areas in order to carry out various tasks in industrial environments. Mobile robots are mostly used in areas which are hostile to human beings, such as underwater, planetary roving and also toxic environments. The visual, auditory and cognitive behavioral features that are installed in the mobile robots can make them make appropriate decisions in situations which demand complexity of alternatives.

INTRODUCTION

With the current profound need to change the way operations are carried out in the various fields, development of mobile robots has become a viable practice. The application of the mobile robots is basically determined by their ability to move around in an autonomous way. Since the designing of mobile robots in the early 1950s, these objects have been used widely in a number of fields [Nehmzow, 2003]. Such areas in which the mobile robots have been utilized include exploration, surveillance, guidance, transportation and also inspection, among others. However, the deployment of mobile robots in the fields of cognitive sciences, artificial intelligence and psychology has enabled the study of intelligent behavior in humans [Nehmzow, 2003]. This paper explores the various applications of mobile robots as sources of artificial intelligence.

METHODOLOGY/APPROACH

This research will use the descriptive method to explore the aims of the study. This methodology will employ the use of developmental aspects in order to determine the application of mobile intelligent robotics in the workplace. A descriptive methodology seeks to answer the questions 'what' 'who' and also 'how' of a certain research question. The approach that will be used in this research will therefore entail elucidating the various aspects of mobile intelligent robotics that are applicable in a teamwork environment. In addition, this descriptive methodology will attempt to explore the capabilities of the mobile intelligent robotics that are useful in various industrial environments.

Technology of mobile robots

There are two main technologies which are used to model mobile robotics. These include tele-manipulation and numeric control. In the tele-manipulation, the mobile robots are controlled by a control devise that is operated by a human being [Niemueller & Widyadharma, 2003]. In the numeric robots, the control system is enabled by a set of coordinate systems, which are programmed precisely to control the system [Niemueller & Widyadharma, 2003]. A simple architectural platform of a mobile robot contains sensors, effectors, power sources, wireless networks and supportive body parts. The sensors serve as the perceptual interface between the robotic object and the surrounding environment [Niemueller & Widyadharma, 2003]. Effectors, on the other hand, are the mechanisms used by the mobile robot to manipulate the environment, move or restructure their programs [Niemueller & Widyadharma, 2003]. The movement is effected by differential and synchronous drive systems installed in the wheels, tracks or artificial legs.

Mobile robots working as a team and exhibiting artificial intelligence

Mobile robots have portrayed immense potential in improving agricultural activities. When programmed and located at the strategic place, mobile robots can carry out various farm activities through auto-piloting [Ceon-bremen, 2011]. In the wheat farming, autonomous robotic vehicles can work as a team to harvest the produce and provide intelligent information about the procedure [Ceon-bremen, 2011]. The artificial intelligence that is installed in the robotic machines is necessary in making cognitive decisions in the course of various operations [Ceon-bremen, 2011]. The widely used technologies in the mobile robotics in agricultural platforms include Global Positioning System (GPS) and the Global Navigation Satellite System (GNSS) [Ceon-bremen, 2011].

Mobile intelligent robotics are also used in assembly lines in the automotive sector [Dudek & Jenkin, 2010]. In this platform, the intelligent mobile robots are capable of integrating a whole system through synchronized communication. However, such robots have to be fitted with the necessary actuators, processors and user interfaces [Dudek & Jenkin, 2010]. The intelligent mobile robots are able to work as a team since they have serial interfaces which improve the sensitivity of the robot to the surrounding environment. In addition, the mobile intelligent robots are fitted with high abstraction levels. Such abstraction levels are a result of computational models that make the robot capable of reasoning, sensing and manipulate the environmental aspects as required [Dudek & Jenkin, 2010]. The mobile robots that are used in engineering fields use preconditions to determine whether a certain combination of tasks hold true. Alternatively, the intelligent robots can also use legality tasks to make appropriate decisions [Niemueller & Widyadharma, 2003]. In the legality tasks, the robots use an initial state of a precondition to determine whether a sequence of actions can be done [Niemueller & Widyadharma, 2003].

Modern mobile robots are also widely used as teaching aids [Strother, 2011]. The Engkey, for instance, is equipped with perceptual capabilities and locomotive modalities. These attributes make it to be a viable English teaching aid. These intelligent robots are also modeled with visual, auditory and proprioceptive sensors to enable inputs [Strother, 2011]. Moreover, the intelligent mobile robot has vocalization and facial attributes. The Engkey, designed to teach English in a Korean school, is capable of teaching 4th graders, asking students to repeat tasks and can also detect incorrect pronunciations [Strother, 2011]. However, the Engkey is said to be controlled via video conferencing, though its cognitive capabilities are quite complex.

Intelligent mobile robots have also played a great role in executing speech, gesture and gaze-related tasks [Nehmzow, 2003]. The spatial intelligence possessed by such mobile robots has found various uses in a number of tasks that require reasoning. Currently, swarms of functional robots are deployed in industrial environments to work as a group. Some of the operations that require robotic teamwork include material removal tasks such as de-burring, de-flashing, grinding or cutting [Jarvis,2006]. In addition, intelligent robotic components are used in product life cycle testing [Nehmzow, 2003]. This is because these intelligent robots can withstand constant force application. Another aspect that makes intelligent robots to work in a teamwork environment is their dual-channel interfaces. The seamless integration capability of intelligent robots is therefore a benefit to industrial firms which want to carry out various tasks through automated intelligent techniques [Nehmzow, 2003].

Intelligent mobile robots will also provide security through surveillance and military services [Ceon-bremen, 2011]. The civil defense roles that can be carried out by intelligent mobile robots include search, rescue, fire fighting and also military services [Ceon-bremen, 2011]. Currently, intelligent robots are used in surveillance patrol programs along with human operators. This patrolling can be perpetrated through observation and conducting the necessary intervention [Ceon-bremen, 2011]. In addition, intelligent robots can also be used in assessing the risk aspects of a given environment through reasonable risk analysis and reacting to unpredicted events in security systems [Ceon-bremen, 2011].

Mobile robots which are designed to provide artificial intelligence can also be used as teams in biological affairs [Jarvis,2006]. In the most recent turn of events, mobile robots with artificial intelligence have been used to provide insights on how to treat brain defects [Jarvis,2006]. Melded with biological and medical information, these robots can be used to suggest the most suitable pathways to muscle and brain functions so as to improve the treatment options. In addition, such robots are also used to develop suitable psychological models that can be used to alleviate mental disorders among patients [Jarvis,2006]. Thus, it can be construed that artificial intelligence that is provided by such mobile robots is viable in creating perceptive notions. Humans and robots can work together as a team to improve the reliability and safety in certain environments, especially in the medical field [Jarvis, 2006].

Current research on medical intelligent robotics

Vast research has been conducted on the use of mobile intelligent robotics in the medical field [Harnett, *et al*, 2008]. With the profound need to enhance treatment predictions, posture analysis and control of surgery operations, medical robotics are certainly going to be modified [Harnett, *et al*, 2008]. There are numerous applications of mobile robotics in an environment that calls for adequate teamwork, such as the hospital workplace.

Laboratory mobile robots have been designed to carry out diagnostic tests in the hospital environment [Harnett, *et al*, 2008]. Intelligent robotics can be programmed to perform repetitive tasks in a relatively higher speed than human workforce. Hospital robots have also been integrated with computer programs that can fetch, distribute and handle medical prescriptions in the hospital [Harnett, *et al*, 2008]. In the most recent developments, mobile intelligent robots can be programmed to work as a team in lifting or positioning patients who are incapacitated or amputated [Harnett, *et al*, 2008].

Tele-surgery has become the newest development in medical robotics in the world [Science Daily, 2006]. In this procedure, the robotic is controlled using an unmanned airborne vehicle (UAV) to facilitate the telecommunication [Science Daily, 2006]. In this procedure, mobile intelligent robotics carries out surgical operations on patients in different locations. A surgeon programs the robot and applies a reliable interface through which information can be transmitted from the human hands to the robotic arms [Science Daily, 2006. 9]. Sensor data is transmitted through remote control in order to make the surgeon’s hand movements consistent with the robotics hands through simulations [Science Daily, 2006].

In the High Altitude Platforms for Mobile Robotic Tele-surgery (HAPsMRT), speedy satellite communication is used [Science Daily, 2006]. The surgeon executes a surgery on a simulated patient, while the information is video-streamed through the internet to the remote location from where the human patient is operated [Science Daily, 2006]. However, according to Dr. Broderick of Cincinnati University, satellite information is also prone to delays, especially if the broadband telecommunication strength is limited [Science Daily, 2006]. This practice has shown the huge advantage of using mobile robotics in the medical field.

Algorithms used in humanoid robotics

The commonly used algorithms in learning aid robotics include genetic and Bayesian algorithms [Jhin, M. 2009]. In the genetic algorithm, the interfaces are formulated based on a number of solutions which simulate natural (real life) environments [Jhin, 2009]. The fit function in the genetic algorithm is used to train the robot through online and offline mechanisms. The Bayesian algorithm is based on the Bayesian theorem:

$P(h/D) = P(D/h)*P(h) / P(D)$ [Jhin, 20097]

Where $P(h)$ = is the probability of action ‘h’

$P(D)$ = is the probability of training data ‘D’

$P(h/D)$ = probability of ‘h’ given data ‘D’

$P(D/H)$ = probability of ‘D’ given action ‘h’

Through this theorem, the humanoid robot calculates the probability of various actions in order to choose the most likely event [Jhin, 2009].

When a humanoid robot is in motion, it is vulnerable to deviate from the intended motion path. This displacement effect increases as the length covered increases [Song-Hao, *et al* 2011]. The displacement error should be minimized significantly in order to stabilize the robot. The units used in measuring the displacement error are based on the second-order cone programming (SOCP) and GA [Song-Hao, *et al* 2011]. The chart below shows the trend displayed by a humanoid intelligent robot when it is in motion.

Findings

Mobile robotics are operated using two main technologies, the tele-manipulation and numeric control [Niemueller, & Widyadharma, 2003]. However, tele-manipulation is becoming the most reliable method of control for robotics. Telesurgery and robotic surgery, for instance, have found great application in the tele-manipulation technology. Data is transmitted via satellite platforms in tele-maipulation, as opposed to the use of numeric codes in the numeric control [Niemueller, & Widyadharma, 2003].

Artificial intelligence in mobile robotics is applicable in a number of fields. In agriculture, these intelligent objects can be used to harvest wheat, using GPS and GNSS positioning techniques [Ceon-bremen.de, 201133]. In the engineering field, artificially intelligent robots can be used in the assembly lines to perform a number of tasks [Dudek, & Jenkin, 2010]. However, for these robots to work as a team in such an industrial environment, they have to be fitted with the necessary actuators, processors and user interfaces. Moreover, intelligent mobile robots have successfully been used in the education sector [Strother, 2011]. Teaching robots are installed with functional visual, auditory and proprioceptive sensors [Strother, 2011].

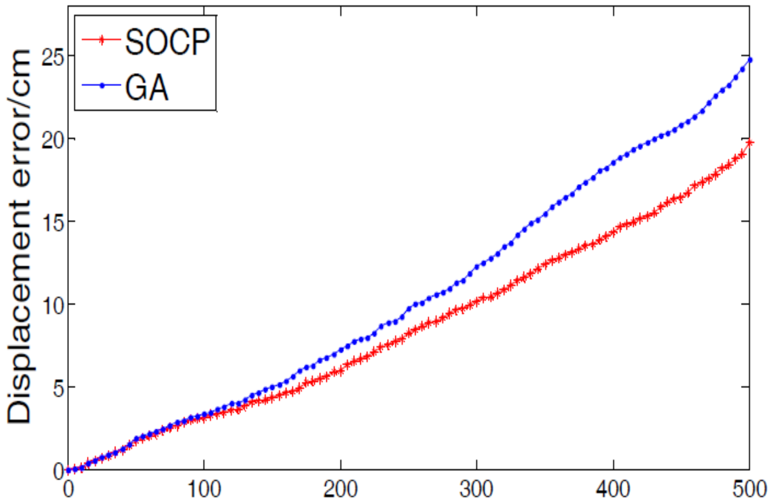

Figure 1.Displacement of humanoid robot (cm) [8]

The use of dual-channel interfaces in intelligent robots enables them to perform numerous tasks which require constant force application [Nehmzow, 2003]. This aspect ensures that these robots can work as a team. Mobile robots, for instance, can be coded effectively to carry out transport chores in busy highways. In addition, tasks such as material removal and cutting can also be executed by these intelligent objects.

The hype of artificially intelligent robots has occurred in the medical field [Science Daily, 2006]. Currently, robots can be used in the hospital environment to carry out laboratory diagnostic tests, surgery and prescription tasks. Tele-surgery is still in its nascent stages of development, and the future of this application looks bright. Some of the algorithms that are used in the artificial intelligent robots include the Bayesian and genetic algorithms [Jhin, 2009]. The Bayesian algorithm is derived from the Bayes formula.

SUMMARY

Intelligent mobile robots were developed in the 1950s. This group of robots has been used widely in a number of fields, such as exploration, surveillance, guidance, transportation and also inspection. Mobile robots are operated through tele manipulation technologies or by the use of numeric coding. The robots are fitted with complex programs which are based on cognitive capabilities so as to possess artificial intelligence. It is this intelligence that is utilized in the execution of various tasks which require reasoning. Fitted with the necessary sensors and effectors, intelligent mobile robots can be used to operate in a medical field, military sector, exploratory missions and also agricultural platforms. For instance, these intelligent machines can work together as a team to complete an assembly.

VALUE OF PAPER

This paper has presented the earlier applications of the artificially intelligent mobile robots. With the view of these applications being derived from the 20th century robotic aspects, the modern perspective has also been developed. The current applications of mobile intelligent robots, such as in surveillance and complicated medical arenas have provided a desirable picture of how teamwork in a hospital can be achieved through these objects. This paper is therefore a good read to people who want to explore the capabilities of the modern intelligent robots.

CONCLUSION

The technological advancement in mobile robots has been taken to high levels in the recent past. Intelligent mobile robots are operated through two main technologies, namely the tele-manipulation and numeric control. Some of the applications of intelligent mobile robots include undersea navigation, military operations, security, surveillance and also in agricultural activities. In the agricultural sector, wheat harvesters are fitted with satellite systems to transfer data and model unmanned operations through GPS. In addition, artificial intelligence that is melded in the mobile robots can be used as a teaching aid in academic institutions, such as the Korea's Engkey. The medical profession has received immense help from intelligent mobile robots, which operate in a teamwork manner to execute vital chores.

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