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RESEARCH ARTICLE

Investigation about the Impact of Robots in Educational and Medical Field

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Abstract— Robots have been playing a dominant role in the modern world. Novel developments in computer technology introduce wide advancements in the field of robotics. They can have application in the medical field, educational field, military purposes, space exploration, home assistantship, entertainment and so on. This paper focuses on the study of various robotic applications in the medical field and educational field. Robotic surgery is done by the robots with the help of human assistantship. According to the situations, each of the surgical systems reacts to the environment in a different way. Effective learning or constructive learning is implemented inside the classroom for maintaining a healthy learning with the help of robots. Compared to traditional learning methods, an error corrective feedback mechanism is followed in robot learning. This paper also discusses the effectiveness of machine learning algorithms in each of the application areas.

Keywords— Constructive Learning, Robotic Surgery, Home Robots, Machine Learning, Robotic Models

I. INTRODUCTION

Robots are introduced in various fields for assisting humans in different situations. Most of the difficult tasks which were previously done by the humans are now done by the robots. This greatly improves the efficacy with which work can be done [1]. The human -robot interaction determines the capability of the robot to intermingle effectively with humans. The electronic media learning is expected to bring a revolution in the education system by providing efficient opportunities to impart profuse information and knowledge [2] [5]. IROBI was the human friendly Intelligent home Robot established under the e-Learning technology that provides home monitoring, entertainment, messaging, home tutoring and security[2]. They provide various facial expressions like happiness, calm and sadness to interact with the environment [2]. In comparison with other media like tapes and books, robots make diversities in the outcome of learning [2] [5]. Robotic assisted minimally invasive surgery, microsurgery and other type of surgeries are comparatively a new technology that guarantees some features compared to the traditional open surgeries. The problem due to the non availability of doctor is avoided to some extent and service can be obtained from any place for continuing the surgery.

II. ROBOTS IN EDUCATIONAL FIELD

Robotic deeds are considered as precious tools to boost the problem solving skill, teamwork skills, communication skills, social skills, creativity and imagination [5]. Home robot embodying e-Learning technologies provide voice, gestures and multimedia contents [2]. It was investigated that the significance and effectiveness of the robot as a learning tool to provide more effectiveness compared to other web based interaction or audio tapes [2]. This leads to the proposal of constructive learning using robots. The robots should scrutinize the students and perceives the emotional transitions of the students from positive state (happiness, surprise) to the negative state (sad, disgust) [1].

A. Educational Home Robot

This robot is introduced for learning activities for children at home. IROBI [2] is a typical example of educational robot. These robots proven that interest towards learning are more compared to that of other media like video, audio tapes and books [2] [5]. They can also provide emotions like happiness, sad or calm [2]. But they cannot track or interact with a learning child dynamically.

B. Constructive Learning Robot

This type of robot is introduced to recognize the student emotions for learning activity. In order to enhance the learning, all the emotions are recognized using face and feature tracking algorithm [1] [5]. Once the emotion is tracked, the emotions are categorized into positive and negative emotions [1]. The main role of the robot is to provide a particular movement when there is an emotional change from positive to negative. This type of robot learning clearly increases the knowledge and also gives assistant-ship for the human teacher [1] [5].

III.PERFOMANCE OF ROBOTS WITH OTHER MEDIAS IN LEARNING[2][5]

TABLE I: EFFECTVENESS IN LEARNING

MEDIAS	EFFECT OF LEARNING	ADVANTAGES	DISADVANTAGES
Human Teacher	More interactions between student and teacher.	Teacher can perform multiple tasks and can dynamically respond to the situation of the class depending upon the students interest	Teacher is not able to identify the emotions of all the students at the same time.
Books	Depends upon the interest of the student on a particular student	Increases the knowledge rate.	Lengthy paragraphs may be referred for understanding a single topic.
Audio	Limited interaction and interest. More effective for single student	Listening skills can be developed	Handling of multiple subject is difficult task

Video	Limited interaction and interest	Human-human interaction	Interruption can occur in between communication
Robot teacher	Better memory capacity once programmed. Multiple subjects can be handled.	Interest of students is high	No dynamic error correction is possible and will not take care about the student emotions
Constructive Learning robotic teacher[1][5]	Trained to track the emotion of the student [1].	Enables a healthy learning rate by monitoring students	Robot should be highly trained to track the emotional variations[1][5]

IV. ROBOTS IN MEDICAL FIELD

The robotic system can be used for many purposes in the medical field. They mainly include complex surgeries, helping disabled children and paralyzed patients, Autism treatment and also in microsurgeries [7] [8].

A. *Robotic arm for Disabled children*

One of the major achievements includes assistantship for disabled children. Children who are unable to independently impart and deal with objects due to some physical infirmities may not be able to expound their learning level [7]. Adapted robotic systems allow these children to reveal their skills. The major steps include the following [7]:-

Step 1: Familiarizing the arm of the selected child. This helps the child to interact with the robotic arm.

Step 2: Predefined tasks shall be executed.

Step 3: Movement is controlled by the student.

Step 4: Student programming is carried out.

Step 5: Movements are stored for later playback.

B. Robotic arm for Paralysis patients

This robotic arm was proficient in obtaining high resolution EEG signals using switches and toggling [8].Working of this arm is based on three steps. They are [8]:-

Step 1: Robotic arm is designed which is controlled by switches. All the input is driven from the switches.

Step 2: The inputs given in the arm are EEG signals which are a thought controlled arm.

Step 3: A complete arm is developed using an EEG acquisition device.

C. Robotic System for Surgery

Robotic surgery systems are classified as controlled robotic surgery system, automated robotic surgery system and semi-automated robotic surgery system [10]. Controlled systems are designed to improve the traditional minimally invasive surgery which is carried out through small openings [10] [13]. They can be also used in neurosurgery, gynecology, orthopedics and cardiothoracic surgery [10]. Automated systems chase accurate, pre-programmed instructions given by the surgeon. Semi automated systems bounds the surgeon with a force controlled handle for safe surgery [10].

C. Robotic System for Autism treatment

The robot can be incorporated into autism treatment. The role of robots in therapy can be defined using the following steps [11]:-

Step 1: Engage the person's attention.

Step 2: Activate social exchanges between the child and robot.

Step 3: Activate social changes between the child, the clinician and the robot.

V. ROLE OF MACHINE LEARINING ALGORITHMS FOR ROBOTS

Machine learning algorithms can be used for the analysis of important predictions, forecasting tasks in medicine [18], extraction of medical knowledge[18], therapy planning support and patient management [18]. They also play a major role in robot learning .Learning can be done using algorithms. The effect of artificial intelligence software make capable of robots for decision making under different circumstances. Learning is done through previous experiences and social interaction with human teachers.

VI. ROBOTIC MODELS IN MEDICAL FIELD [21]

TABLE II
DIFFERENT ROBOTIC MODELS

ROBOTIC MODELS [21]	SPECIALITIES	APPLICATION AREAS
Robodoc	Uses 3D data from CT scan to plan orientation	Hip replacement
Zeus	Micro Wrist technology using computer is used for tracking the patient.	Laparoscopic surgery
Puma 560	CT guidance is required	Neurosurgical biopsies
Aesop 3000	Small cameras are placed inside the patient. Surgeon will also provide necessary voice commands.	Minimally invasive surgery
Orthopilot.	Motions are determined using sensors fitted on the patient's body	Knee surgery, Tibial Osteotomy
DLR MIRO	Light weight system that can assist human surgeon for making holes in bones	Key hole surgery
NeuroMate.	Computer controlled system that has amazing imaging capabilities like 3D viewing.	stereotactic brain surgery
NeuroArm	It is an MR compactable machine that have high precision and accuracy	Micro surgery
Da-Vinci	Controlled by the humans using the high definition 3D vision system and tele-operation unit[13][21]	Key hole surgery

VII. CONCLUSION

Robots can be used in different application areas including medical and educational field. While considering the educational field main motivation is to acquire knowledge with a great deal of interest to improve the learning rate. Robotic systems like IROBI were designed to meet such goals by providing certain emotions. Constructive learning was comparatively new approach to knowledge acquiring by analyzing the student emotions. The main objective is to track and classify the emotions to positive and negative. Robots also provide a prominent role in the medical field, especially in surgeries. Currently, all the available robotic surgical systems are functioning only with the help of human intervention and other computerized systems.

VIII. FUTURE SCOPE

More developments can be incorporated into the constructive learning by adding the facility to monitor all the students of the class. The main objective is to take the emotion of all the students for healthy learning. At the most a human teacher can be replaced by the robotic teacher. While focusing on the medical field, all the systems are operated with the help of humans and other softwares. For a particular patient, a replanned methodology is required for each system for performing surgical operations. This should be modified in the future by incorporating some machine learning softwares, which makes capable for decision of its own. That is, dynamic interactions should be made possible between the robots and the humans.

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