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A Review on HRI for Child Learning

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Abstract*— Human robot interaction (HRI) becomes an effective method of interacting with kids. Many HRI's system are currently available. In this paper, a review of various robotic tutor system based on design aspects, safety aspects, mechanical and electronic aspects of robots, learning outcome of kids, type of interaction, configuration of various learning modules, real time behavior monitoring and socio centric aspect are presented in this paper. As the robot tutoring has several benefits over human tutoring because these kinds of system have various pre-installed learning modules so that without any human monitoring child learn its concept. The robotic system is now a days become very effective for the learner for real time applications.

Keywords – Child learning, HRI, humanoid, robot, system

I. INTRODUCTION

Current advancement in the field of science and technology boosts the scope of robotics and hence lead to the development of more conceivable application. The robotic tutor system is adopted in various field like programming language learning, social interaction, science, mathematics, technology learning and also area specific subjects. Comparison studies yield that learning outcomes of robotic tutoring leads to more gain in child knowledge as compared to human lectures our main target [1] is child and teenager because they both are at their erudition stage. Another approach is that learner inspiration is also very significant and this inspirational tendency can improve student academics performance and also learning results. The inspiration must play a vital role in learner personality development. The inspirational approach is the complex key factor that involves student behaviour in front of teacher and fellow mates. The learning is self-regulated and self-motivated. As education is understanding it mainly deals with how once's teach and how they both learn by the means of imparting courses and various assessment [2]. The rapid advances in the artificial intelligence techniques provides enrich and improves the educational tools, thus artificial intelligence based robot learning system provide interactions and enhance learning environment and provide effective systematic learning, although there is scientific success is seen but majority of person are against the application of robot in the area of application according to the survey [3] Europeans shows the positive attitude toward the robots like on priority basics 52% people decided robots for space exploration, 41% for military and security but only 3% of people convinced on the education on the other side 60% of them said that robot should be banned for care of child, elderly, and disabled people and 34% of them said for education robot must be banned because the main concern that robots are dangerous machine as compared to human. If we go back few years ago then tutting through robot is like a science fiction movie but now the robotics tutoring is functional in many schools all over the world. If we take the example of France, they have enrolled even primary school student in some subjects about internet technologies on the other hand high school student must pass a special exam to demonstrate their computer skills[4]. So, in this review article we also append the how motivation is tie-up with the learning as the studying outcomes, as learning outcomes reinforcement to the child. Robot tutor system objective to returns the new, skill full and highspeed workforce with the novel suggestion for industry revolution 4.0 which integrally hang on the artificial intelligence and machine learning[5]. Current trend of education consists of machines as parts of classroom. We have to appreciate the people that are ready to accept the robot tutor in the classroom now as we know the machine learning is enough capable to design robot tutor based on trained data set [6]. As the use of robot tutor in classroom is not a new concept but this technology is still maturing [7]. The main intention of this paper is to recognize the efficacy of the Machine learning on the education and expressing the encyclopedic outlook on this concept. It also spiels how the Machine learning is assist student to unravel hassle and understand how to help folks, by ameliorating the visualization and to delineation a novel educational incident [8].

II. LITERATURE SURVEY

The followed part, we briefly present the existing related work on robot tutor system. Robot tutor system are categorized based on their application like transportation, healthcare, energy, safety and security, logistics, manufacturing and education. It must be required to search the paper in the dissimilar branches to get the relevant research articles would include to our database. Our database consists of 150 research articles, as some research article is not defined the method of research. The data comprise the qualitative and quantitative research paper. The paper adoption was based on some criteria that is the teacher is used as robot [9]. The paper must have the robot in order that it must provide the feedback rather than only engaging [10]. As there are many country [11] who actually started the research in robot tutor for child this data include the North America,

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Europe and some region of Asia, surprisingly Iran is also in the list who use the robot in classroom for learning English

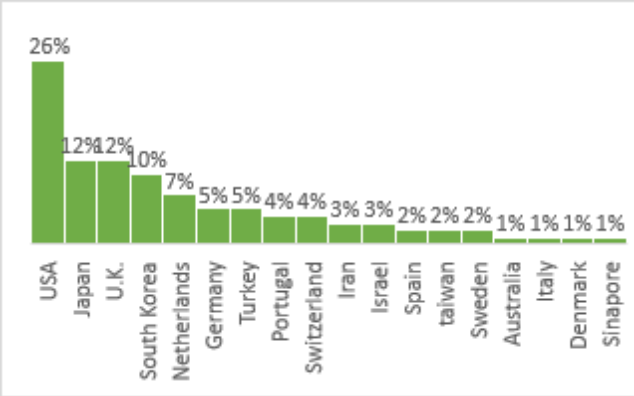

Figure 1. Nations where the research studies were carried out

Yousif et al. [12] identified that the how the student will respond to question of preprogramed NAO robot, they adopted the for teaching category and also an opinion poll, their opinion poll consist of set of written question and they identified the number of participant who is supportive or who is not supportive in robot tutoring concept. Author reviewed the latest published scientific literature on robot tutor on the class room. Ramachandran et al. [13] introduced the idea that how for the child, robot is reducing effort in learning the concept which should also reducing the mental effort. The designed system also reminding the child when it is not familiar with the problem statement, promoting the child when child forgot something related to the problem statement, reflecting the child when child made wrong attempt also providing the proper guidance to the student. Adamson et al. [14] designed the system that should both learn and teach, they make the system that play the musical harmonies, the system uses the Bayesian Knowledge Tracing (BKT) and deep Knowledge Tracing (DKT). By observing the teacher, their system will learn the music harmonic playing and after training it will now able to teach the other student how to play the given music harmonic. Cuadrado et al. [15] research approach consist of getting feedback from child by their facial expression for that they use the Full Convolutional Neural Network (FCNN) and FER2013 dataset and after validating their data set with other data set which contains the facial expression of child. Their protype successfully detected the facial expression of child and their system accuracy is 69.15%. Clunne et al. [16] this research include, analyze of interaction between the humanoid robot system (PAL REEM robot) and human they have include the various modelling strategy and conclude a result that how a party is replaced by humanoid robot. Shi et al. [17] build their system for the children suffering from the Autism disorder. By training lot of machine learning algorithm in supervised learning they have put the limited personal data of child with autism and small quantity of personal data of normal child. Adoption of Bayesian network [18] in robot tutor for skill endorsement and to determine the behaviour of robot. Gordon et al. [19] designed the robot so that it teaches the new word to the student on repeated tutor sessions and then it observed the facial record to student so that proper analyzing of response of student is made. Reinforcement Learning (RL) approach is adopted by [20] to monitor the activity of user without any discomfort to the user. Rossi et al. [21] uses discriminative random regression forest algorithm to evaluate the user performance. Sorostinean et al. [22] used RL based robot to monitor the elderly people with the use of long term conventional learning approach. Lee et. al [23] used Bayesian learning model to determine the synonymous of object and task name, the model that they designed is built through the human tutor during the collaboration with the robot with child. Oudah et al. [24] used repeated stochastic game is proposed for online learning, is effective way to interact with the people. An another Machine learning algorithm followed in [25] to predict the shopkeeper reaction from interaction of customer, Attention network utilizes the neural network to learn firstly and the Interaction network provide the interaction of shopkeeper. The principal component analysis based learning and engaging application of child is described by [26]. Moro et al. [27], where the system is designed so that it learns from the demonstration (LFD) and RL approach is used to enhance the behaviour of system for the learner. LFD used various another machine learning approach [28],[29]. Gao et al. [30] robot tutor solve the nonograms which is a puzzle by the approach of RL algorithm. Park et. al [31] proposed a model based on RL approach to show how personalized policy improve the learning experience through the robot tutor result of that research show how child engagement and motivation is improved by reshaping the personalized policy. Sequeira et al. [32] used artificial neural network, data clustering algorithm and decision tree to know the response of social interaction of robots. Rosenthal et al. [33] consist of RL based learning approach on various humanoid robot which involve the playing card game based on trained dataset via RL, result outcomes shows that learning behaviour of robots can be significantly improved. Ehsan et al. [34] designed a system based on encoder decoder network to describe the behaviour of person playing video game in term of home language explanations. Hayes et al. [35] explains the multiple ML, RL and deep learning algorithm are beneficial for various kind of robot designing and controlling the task.

III. ROBOT PLATFORM

NAO is humanoid robot developed by Softbank robotics. NAO is programed by user custom as it has various abilities such as it can dance, walk, speak and recognizes faces and objects. NAO speak two languages one language is English and other language is selected from command center. Wakamaru a household robot [36] developed by Mitsubishi and able to communicate with persons and used in various houses of Tokyo. It has various feature such as it communicates the people by keeping the eye contact, detect the various person and serve each people in gathering. It has obstacle avoidance system such that once it takes the position

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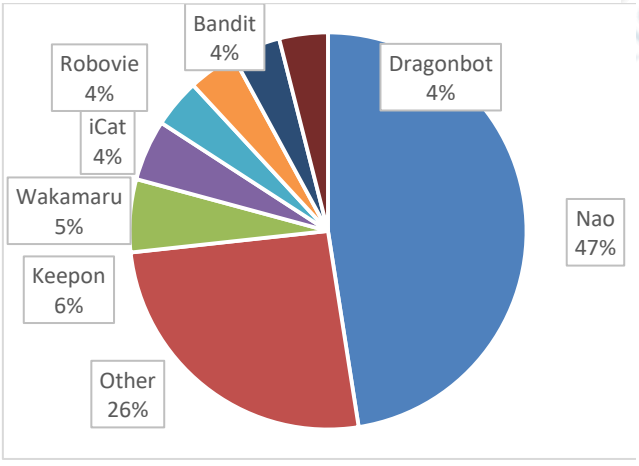
of walls, furniture and obstacle and store it on local map. Apart from that it consists of antitheft system that it detects moving object when it is alone in house and email the owner.

(a) (b) (c) (d) (e) (f) (g)

Figure 2. Example of robot used in tutoring

Following robot are pictured (a) Wakamaru (b) Keepon (c) Nao (d) iCat (e) Robovie (f) Dragonbot (g) Tega

Tega [37] is android based robot with animated face that consist of smartphone which run the software that controls the motor and sensor data. Various facial expressions such as laughter, frustration and excitement is detected by Tega. It can do full body up down and left right its battery packs last up to six hours. Audio tracks played by text to speech system. Robovie [38] is designed for human robot interaction. As it consists of audio and video sensor in order to communicate with the human. Its physical appearance looks like humanoid robot, operating system built in Linux, Pentium III board is used for processing the data. Keepon [39] is small robot designed for communication with the child. Behaviour of robot is obtained from psychological experiments. A small creature like robot is Keepon. It is mainly designed to perform nonverbal, simple and natural communication with children. Keepon mechanical structure is such that it tilts forward backword and turn left and right. Keepon in automatic mode runs set of modules which is designed in such a way that it detects faces, moving object and toys.



An another iCat [40] robot is fall under the category of personal robot to study the HRI. The design of iCat is similar to cat so that it established the social relation with the child. It recognizes the user, tilts its head left right and able to make facial expression such as happy, angry and surprised. DragonBot [41] is based on Socially assistive robots to teach the about nutrition in the food. The system is toy-based dragon which is very attractive in shape and interaction of robot involves the promoting good habits and behaviour in the child in order to check the engagement between child and system response time of child is calculated. Results shows that robot is able to build the good relationship with child. LEGO MindStorms [42] robotic kit is used in computer lab to exercise the curriculum of operating system from beginning to advance. In order to control the activities of robot programming of robot is done using C++, Lisp and java. Proposed system is dedicated to school student so at that age physical appearance of system plays an important role in learning.

IV. PROPOSED SYSTEM

We proposed robot tutoring approach for the child engaging and motivation, depending on the common feature there are various kind of robot involved in the previous studies. Humanoid robot such as Nao having advantages because such kind of system provide the human like gestures like interaction, and incorporate the physical movement of Arm and Legs but this kind of system are very expensive and not affordable by most of learner. The proposed system is able to communicate with the child and provide the proper response to improve the learning ability of the child. The system having face and speech recognition system which help the child to engage with system. Daily lesson is integrated in the system memory and display module display the daily lesson. Indication unit is also added to the system in order to check system is working. The block diagram of system is given below.

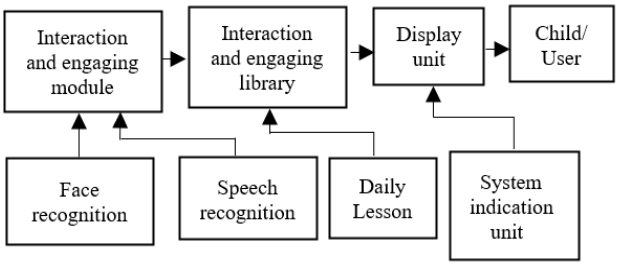


Figure 4. Block diagram of system

V. DISCUSSION

This review approach is to find out the how robot tutor and engaging is beneficial to child and how the robots are trained by algorithm so that robot tutor will provide effective learning and better engaging to the child, to exceed the motivation for the learning so that personality of each child will significantly improve. No doubt there are many challenges for social acceptance of robots for child tutoring and engaging and current state of art requirements to upgraded significantly in terms of efficiency, accuracy, optimization and robustness. In the current scenario the reinforcement learning and artificial neural network are widely used to train the model for child tutoring robots because for low computational cost and better success.

Learning through the robot tutor provide a motivation and learning environment this environment will attract the child so that the child is self-motivated to initiate the learning[44]. The effective building of planning provides significant and better way to learn the new concept for the human being. Interactive thinking of the child is enhanced as combination of robotics in education field.

VI. CONCLUSION

In this review paper the engaging of child in class room or home is described with the use of robot tutor system. In 21st century industrial revolution 4.0 is now started so learning concept is changing very rapidly new technology will be coming so that engaging child with the technology is necessary to increase the motivation in the student for learning new things, with the use of robot tutoring system the curiosity of child more enhanced because as child is more comfortable in front of machine as compared to human. The robotic tutor system will provide opportunity to being learn machine learning with the use of this concept one can transfer the idea to the real life. As various machine learning algorithm enhancing the accuracy of social robot to great extent. A student or child itself can found out a very high degree to motivation. By the use of this technology the overall growth and academic performance of student is also improved, provides the global opportunity to the student of all age and domains. Now this is pure reality that after some period of time this technology is all around us and new problem can only be solved with the help of machine learning and robotics

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