Yantramanav: a humanoid to spread literacy among rural children through eGurukul education system

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Abstract eGurukul system is derived from the ancient Indian’s Gurukul education, where students gather in one place and learn from their master. Early childhood is the right time for children to improve their foundation skills. Children in Urban areas are exposed to such an environment where parents put their kids in kindergarten school. In rural areas, children would be admitted in school only at the age of eight years. Also, in our current education system, many rural schools across India do not have sufficient teachers to educate the children. So, we propose an eGurukul system, teaching aid to engage the students to learn the basics of communication language without the presence of a teacher/human. The Yantramanav is designed to teach the students with basic language (English, Tamil & Hindi) alphabets writing, pronunciation of the alphabets and rhymes, also the basics of Mathematics to the rural kids under the age of eight. The Yantramanav is designed with a mini projector, camera & speakers as a teaching and monitoring aid during time of activity. The humanoid uses the projector as a major tool for teaching. The projector helps the students to gather in one place and make the students to be attentive during the activities. The humanoid takes the attendance using the camera with the help of face recognition. Humanoid uses the speakers’ to deliver audio contents during activities. The entire activities are controlled by a MCU Board, which operates based on the programmed instructions. Switches are used to choose the communication language and activities. The content can also be delivered to other regions of various districts through online mode at the same time.

Keywords Humanoid · Rural · Online education · e-Learning · eGurukul · Synchronous learning · Asynchronous learning · Blended learning

1 Introduction

Online Education provides knowledge transfer or sharing of knowledge through internet [1–3]. Online Education is also termed as electronic-Learning or Online study [4]. Electronic-Learning [5] involves gaining of knowledge with the usage of electronic gadgets like computer or devices like cellular phone, tablet and also provides educational training through materials available over internet. This technology uses tool that provides computer-based education, which enables everyone to learn anywhere and at any time and also easy access for upgradation of knowledge & skills. This transfer of knowledge enables to deliver training & education via digital resources and materials. This Electronic-Learning Technology Tool has bridged the geographical gap between the student and technology. These modern technology tools make us feel as if we are in physical class room. This Virtual classroom technology can be used to spread and increase literacy among rural kids using Yantramanav. This Technology can also be used to provide basic Education not only to rural kids but also to adults in rural area who are not educated. Most of the adults are not even aware to fill the details provided in Bank Challan, these people seek help...
from others. Using this Technology Literacy could be spread in vast at no cost method.

This paper presents benefits of e-learning, when e-learning, categories of e-learning, reason of mass spread of e-Learning, a survey on e-learning practices in teaching & learning from students, teachers & parents [6]. Based on the survey we proposed Yantramanav design to spread literacy among rural kids.

Benefits of e-Learning [7]:

1. e-Learning Technology allows to share materials in different types of formats like visual material, presentations, word documents and in Portable Document format.
2. e-learning technology also provides the learners with the ability to fit learning environment with their lifestyles. Thus, this learning technology suits even the busiest people to move ahead in their career and helps to achieve new qualifications.
3. In comparison with the traditional classroom learning, electronic-learning technology is faster & cheaper.
4. Online education provides access to technology & to improve their knowledge towards every household people
5. Electronic-Learning provides flexibility to all the users.
6. Online learning is more affordable, location is not the major concern and accessibility of material is not an issues.
7. Scheduling the class timing and enrol the students can be done throughout the year without maintaining a fixed timetables.
8. It delivers what learner exactly wants.

Hence, e-Learning helps students to learn anytime anywhere around the globe. Also it provides great opportunity to learn their academic and new technological subjects with affordable price and more quality. e-Learning helps in various scenarios such as:

1. A large geographically dispersed workforce.
2. High turnover rates.
3. To cut down training cost.
4. Faster rollouts to outsmart competition.
5. To train new hires quickly.
6. To keep up-to-date with the regulatory demands.

e-Learning can be categorized in to many types, options and styles. Below are the two major categories [8] of e-Learning, which are popularly used in current education era:

1. Synchronous Learning
2. Asynchronous Learning

2 Synchronous learning

Figure 1 shows the synchronous Learning, where the instructor delivers the contents to online learners. There must be minimum one end user or learner at the same time in the synchronous learning. The tools used for the learning would be decided by both the learners and instructor. Computers or any electronic devices with video/audio/chat tools can be used to perform the synchronous learning in face-to-face training or chat based instant messaging. The latest tools are extremely helpful for the instructors to schedule the class and to conduct the exam at anytime.

3 Asynchronous learning

Figure 2 shows the asynchronous learning, it connects the learners in various modes like e-mail, open forums to post the messages and messenger tools. In asynchronous learning, learners have to study on their own. It enables self-study [9] kind of learning on their own pace. The entire material and contents of the course would be available in different formats like text documents, audio or video visuals and software/tools. Asynchronous learning is more effective and can provide fabulous experience for students and learners, if they use simulation tools/software which help them understand new techniques.
4 Blended learning

Figure 3 shows the blended learning [10], which is also called as hybrid learning. It is a combination of synchronous and asynchronous learning, where the materials are available for self-paced study along with traditional face-to-face mode. Students gain knowledge on their own through asynchronous learning. The offline classes are also available for a certain period of time (classes), where the instructor provides more information or doubt clearance. Nowadays most of the industries use blended learning for their internal transition.

5 Mass spread of e-Learning in community

The outbreak of coronavirus leads to the closure of many industries and non-essential business establishments including schools and universities. As the number of coronavirus cases increased and the virus spread was too vigorous in the human community, the mortality rates were also increased parallelly. To reduce the spread of the pandemic and also to keep the students intact with their education, the Commission on Higher Education they formulated a new way of learning through e-Learning [11]. The teachers in schools used the e-Learning tools [12] to reach out to students during pandemic. This reduced the disruption of education (Table 1).

6 Students’ acceptance on e-Learning

The e-Learning system is very much useful for the students in various aspects like academics, personal growth, extra-curricular [13] and co-curricular activities [14]. The survey was taken from various schools and departments of Vels Institute of Science, Technology and Advanced Studies and also from Sri Venkateswara College of Engineering, Chennai. The data collected from students as survey questions and plotted the below graph. It shows how much percentage students are interested towards e-Learning system. The survey was collected from 182 students from various engineering departments (Computer Science and Engineering, Information Technology, Artificial Intelligence and Machine Learning, Distributed Systems, Mechanical, Electronics and Communication Engineering, Electrical and Electronics Engineering). Table 2 is the list of survey questions with response from the parents.

From the above Fig. 4, it is clearly understood that the majority of the students are getting more benefits from the e-Learning system to improve their skills and knowledge.

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### Table 1 Survey questions with responses by students

| Sl. no. | Survey questions                                                                 | Responses (Number of students answered) | Total number of responses: 182 |
|---------|----------------------------------------------------------------------------------|----------------------------------------|--------------------------------|
| 1       | How much you are engaged in your e-learning classes?                             | 137 29 10 4 2                          |                                |
| 2       | Do you get more opportunities to reflect on what you have learned in e-learning classes? | 142 20 13 5 2                          |                                |
| 3       | Is there more opportunities to collaborate with other students in e-learning classes? | 131 33 9 8 1                           |                                |
| 4       | How well your e-learning classes experience has increased your opportunity to access and use information? | 154 19 5 1 3                          |                                |
| 5       | Do your doubts/queries are clarified in e-learning classes?                      | 136 31 12 2 1                          |                                |
| 6       | Can you manage my own learning better in e-learning classes?                    | 146 14 14 6 2                          |                                |
| 7       | Is the assessment of your academic progress is more accurate in e-learning classes? | 132 19 21 9 1                          |                                |
| 8       | Is the response time from teachers and assistants is quicker in e-learning classes? | 143 22 8 7 2                           |                                |
| 9       | Do you think that the time management is very much helpful in e-learning class to improve your Academics/extra-curricular/co-curricular activities? | 143 30 4 3 2                          |                                |
| 10      | Do you get more time to learn latest technologies after your e-learning class?   | 164 12 2 1 3                           |                                |
|         | Percentage                                                                      | 78% 13% 5% 3% 1%                       |                                |
Parents’ acceptance on e-Learning

Parents are been the major support for child’s education and learning, therefore questionnaire was prepared to get the opinion from parents to know their child’s educational and technical growth through e-Learning system. The survey was collected from 126 parents who hold different roles and responsibilities in the society. Table 2 depicts the survey questions with response from the students.

From the above Fig. 6, it is clearly seen that four quarter of the teachers are very much interested to deliver their classes through e-Learning model. They also accept that they are getting more benefits and time management to improve their personal skills.

Related work

In [15], the NAO robot was proposed having multi-model interface to teach primary and lower school level students with touch, gesture, voice and eye gaze. The robot set up inside the classroom has taken much time.

In [16], they proposed an IDML tools to support the teachers in the classroom to engage the teaching activities during the teaching session. The robot is called Bioloid which is a hobbyist and educational robot kit produced by the Korean robot manufacturer Robotics. The limitation is that the concept was implemented in the elementary school level. This was not tested with students and teachers with various background. The robot is too small and it is very difficult to cover all the students in the classroom.
In [17], they proposed a humanoid robot with more similar human teaching features like facial expressions, gestures and reply to students questions. But it was very difficult for the teachers to train the robot for the difficult subjects such as mathematics and science and it was more expensive to implement the humanoid.

In [18], they focused peer teaching with social learning. The non-human teacher understands the queries from students and responses to the students. Due to the presence of silent detection mode feature, most of the time this robot was silent in the noisy environment. The delivery of wordings in phrases were delayed because of the socio-cultural attributes.

### 10 Proposed design

From the gaps identified in the literature review, a Yantramanav design is proposed to spread Literacy among rural kids. It is a teaching aid to engage students and make them learn the basics of popular communication languages without the presence of teacher. The queries and doubts can be clarified with the help of blended learning. The hardware parts of the Yantramanav are as follows:

1. Mini projector
2. Camera
3. Speakers
4. MCU Board
5. Metal/Aluminium case

Figures 7, 8 and 9 illustrate the Yantramanav design with three different views. The outer part/case of the proposed system can be developed with mechanical/physical

| Sl. no. | Survey questions                                                                 | Responses (Number of teacher answered) | Total number of responses: 178 |
|---------|----------------------------------------------------------------------------------|----------------------------------------|--------------------------------|
| 1       | Are the students regularly participated in your e-learning classes?               | 155 8 9 4 2                            |
| 2       | How much the students engaged/involvement have students been in your e-learning classes? | 154 10 8 5 1                          |
| 3       | How satisfied are you in the students’ academic excellence through e-learning class? | 151 13 11 2 1                         |
| 4       | Do you think that the time management is very much helpful in e-learning class to for your self growth? | 158 5 12 1 2                         |
| 5       | Do you get more time to prepare for regular classes/learn new technologies to improve teaching–learning process in your e-learning model? | 151 12 10 3 2                         |

Percentage: 86% 5% 6% 2% 1%

![Teacher Response](image1)

![Inner Parts View](image2)

![Fig. 7](image3)
fittings. Yantramanav body parts like head, neck, arms, body and legs can be designed with the help of metal/aluminium materials by assemble the parts with mechanical welding. The head and body parts has more electronics parts. Head includes mini projector to project the videos and high definition camera to take the attendance through face recognition. The open/close door can be designed in such a way to do fixing and repair work. Body includes mini speaker to provide audio support and MCU Board/Controller can be used to connect all electronics parts and the embedded program for functioning the Yantramanav based on the requirements.

The programmable controller can be designed to have inbuild memory unit which stores and retrieves the relevant audio/video on need basis. ON/OFF switch can be used to boot the Yantramanav. An extra switches can be added to choose the language and mode (Video/Audio) of content delivery.

11 Conclusion

In an education system, it is very important to get the opinion from major stakeholders like students, teacher and parents/guardians. So the survey was carried out to get their feedback and opinion, to bring the advantages of the e-Learning system. e-Learning system provides ample space for the student and teacher to improve their personal technical knowledge with very well organized time management. Sharing of material and evaluation method is so simple and efficient without any discrepancies. Also it helps the students and teacher to spend some more time on their co-curricular and extra-curricular activities. This study concludes that the e-learning system of teaching–learning process is more efficient for the students, teachers and parents. As the e-learning has become more beneficial in all aspects, e-learning system can be implemented everywhere especially in the rural schools which do not have sufficient teachers to educate the children. Also it is very important to educate the fundamentals to the children during their early school age which helps them to create a strong base for their future academic career. With the help of our proposed Yantramanav, the basic education system can be implemented to the rural school children to improve the literacy in India with minimal human/teacher involvement.

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