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SMART ATTENDANCE SYSTEM USING RASPBERRY PI AND ULTRASONIC SENSOR

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ABSTRACT

In recent times, the traditional time consuming chalk and board class room teaching methodology are transformed into smart classroom teaching which involves digital devices such as laptops, projectors, speakers and more. These de- vices improve the interaction between teachers and students, but the cost is a major factor that still restricts most of the institutions to adopt digital technology. Also, the con- ventional attendance taking system requires involvement of teachers and be present at the laptop to navigate through the slides for which a significant amount of time is lost from the allotted time slot. The main objective of this paper is to design and implements a cost effective technology-aided system which enhances the quality of service teaching by effectively utilizes the teaching time. The proposed system consist of four modules smart projector with PowerPoint Presentations(PPT) upload and download feature, gesturebased PPT control, smart attendance system and Google voice assistance system. All these modules are implemented on a low cost single controller platform using Raspberry Pi. The smart projector module is aimed to substitute laptops with Raspberry Pi which will not only reduce the cost in- volved, but also will help achieving quality of service as the system will consume a smaller amount of power. The second module consists of ultrasonic sensor interfaced with Rasp- berry Pi to control the PPT displayed in projector using hand gesture action based on the distance. The third mod- ule is to automate the student attendance using biometric system. This system consists of Finger print sensor attached to the Raspberry Pi to record the student presence. The fourth module allows faculty to search the internet verbally without the need for typing the query in a web browser by adding the Google voice Assistant to the Raspberry Pi. By integrating these entire four modules in a single microcon- troller platform (Raspberry Pi) we may reduce the cost and improve the quality of service in an effective way.

***Key Words*:** Raspberry Pi, Finger- print sensor, ultrasonic sensor, attendance system, Google voice assistant.

1. INTRODUCTION

Today, almost all institutions have eliminated the conventional chalk and board teaching method by replacing it with laptops provided for every faculty. To display the content, there are projectors in- stalled in every classroom. Each laptop costs around a minimum of Rs20,000 and the list includes a varied range of laptops from various popular brands such as Dell, HP, Acer, Asus, and Lenovo. So the total expenditure on laptops alone when the cost of each one is mul- tiplied by the number of faculty members is disastrous and is totally wastage of huge amount of money that can be spent on improvising other facilities. The next major challenge of classroom teaching is taking attendance by every slot faculty. The teacher has to call out the name of each and every student that consumes a

significant amount of time slot allotted for teaching. To eliminate the time wastage and improving teaching efficiency we should not involve teacher in attendance process. There have been instances where teachers wishing to share some fact, theorem, definition, meaning or some other interesting thing which is not part of the curriculum but is important to explain currently discussing concept to stu- dents and find it difficult to recall which affects the effectiveness of the teaching. Google, an American multinational technology com- pany had introduced an application called Google assistant which is a virtual personal voice-controlled smart assistant. There are few systems present which address few of the objectives mentioned above in their implementation like attendance system using finger- print module. These systems only focus on improving one aspect of the existing methods. The proposed system focuses on multiple aspects as discussed above in the objectives.

2. LITERATURE SURVEY

The paper titled ”Make space for Pi” [1] focuses on various features available in an R-Pi and its different models and the advantages of all the models. This paper helped us in identifying the perfect model for our proposed system. But this paper only focuses on using the pi as an additional tool but not as the device itself. The study and experiments carried out in the paper titled ”Perfor- mance analysis of fingerprint sensors” [2] indicates that the error occurred due to poor calibration causes a greater impact on the generated overall system output and serious usability issues with respect to handling of fingerprint sensors. Comparison of various fingerprint enrollment sensors shows that Radio Frequency, Optical sensor techniques provides highest accuracy and compatibility. The paper ”Using Kinect to develop a smart meeting room” [3] aims to solve the predicament that smart meeting rooms are costly and contributes a higher quality to the smart meeting room. The au- thor combines Microsoft Kinect and Bluetooth techniques to build a smart conference system with personalized Bluetooth supported equipment to identify each participant’s identity, and use these IDs to search the central database in order to retrieve his/her contact information (phone number, email, web storage space and text, or meeting records).

Consequently, the system uses Kinect as a gesture recognition de- vice to detect each person’s skeletons with multi functions (Con- trolling the computer, sending information, auto-uploading files, or recording personal meeting records in database). This paper is mainly focused on creating a complete system for meeting rooms by using Kinect sensor. We were inspired by this technology and tried to implement proposed system which has failed because of the lack of certain software to realize the Kinect in an RPi. The paper ”Portable attendance system integrated with learning management system like Moodle” [4] gives an idea about a portable attendance system which was designed and implemented using Rasp- berry Pi as an embedded Linux board for the management of atten- dance mainly in educational institutes. With the help of biometric sensor a unique identity is assigned to each individual student. And this ID is stored in database with the help of Raspberry Pi to show the student is present for a class. And these data is sent to a server like Learning Management System (LMS) like Moodle via Wi-Fi which will produce a report of attendance for all students. This pa- per presents a fully automated portable attendance system which can be used to keep attendance log of students in educational in- stitutes. This module is useful to take attendance of students for individual lectures and to produce an attendance report as per the need. This paper has helped us in getting a brief outline of the attendance module which was used in proposed system. The paper ”Raspberry Pi voting system, a reliable technology for transparency in democracy” [5] presents a voting process which makes use of Raspberry Pi which has improved reliability and trans- parency over currently used systems. This system employs biomet- ric identifiers. Pre-collected details of all the voters in the country will be maintained as a central database by the government. This data is rechecked at the time of voting to ensure the identity of voters. Usage of Raspberry Pi for web casting the complete voting process and time to time display of polling percentage etc., details will tremendously affect the reliability of the process. Transparency and minimum usage of personnel is achieved at a cheaper cost and simpler process with this Raspberry Pi and its peripherals.

3. SYSTEM ARCHITECTURE

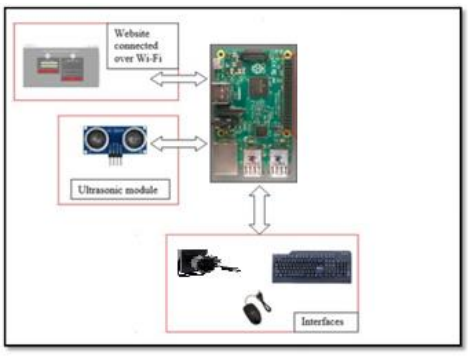

Figure 1 Block Diagram of the proposed system

The system architecture of the proposed system is shown in Fig. 1. The Raspberry Pi is installed in a classroom along with necessary peripherals. The R-Pi is connected to Wi-Fi over which it would be able to access the website designed for uploading and downloading PPT. The main objectives of the proposed system mainly have four modules. Module-1: To allow the faculty to upload the PowerPoint Presentations for the lecture in a website with the provided login credentials from anywhere and download it in the class onto the Raspberry Pi (RPi) and give lecture. Module-2: To navigate through PPTs by using the distance measured by the ultrasonic sensors and perform the respective action. Module-3: To update the attendance of the students for every slot by recording it using the fingerprint module attached to the RPi [6] and storing it in an excel sheet. Module-4: To help the faculty to search the internet verbally without the need for typing the query in a web browser by adding the Google voice Assistant to the Raspberry Pi.

4. METHODOLOGY

The system can be divided into four modules which are combined to provide the required solution. The first one being the smart pro- jector [7] with a website to enable faculties to upload and download PPT. The main objective of this module is to give the faculty free- dom to upload and download lectures into the website instead of taking the laptop to the class. The website is designed to provide separate login credentials to each faculty to uniquely identify them and allot a separate space in the server to store the uploaded doc- uments[8]. The website checks the username and password entered by the user and matches it with the created user database. If the login is successful then the page redirects to the next page which provides the user options to upload and download documents and logout option is also displayed. The user can use the required op- tions and then logout from the portal. Then R-Pi can be connected directly to projectors and start to presenting the PPT. The second module is based on the idea that providing the faculty with the option to navigate [9] through the PPT without having to stand at the system but with a mere gesture. In this module the Raspberry Pi is attached to two ultrasonic sensors which constantly measure the distance and report it to the R-Pi which performs the required task based on the distance reported by the ultrasonic sen- sors. To implement this module python programming language is used and pyautogui module assists in moving the slides forward and backward. The next module is to reduce the time consumed in taking at- tendance by the faculty. The RPi is connected to a fingerprint module. The module performs several functions like detecting the fingerprint by searching the stored image templates, registering new fingerprints, deleting the existing fingerprint templates. The mod- ule after recognizing the fingerprint sends the information to the RPi which creates an excel sheet and stores the student informa- tion in it. This file can be uploaded in to the website to save it online for future reference and also can be accessed remotely for the convenience of the faculty. The final module is the Google assistant which is installed in the RPi using the Google Assistant Application Interface (API) avail- able for developers to use for free and improve the user satisfaction. The voice assistant improves the system by providing voice feed- back and answering simple questions without the need for typing in the web browser. The assistant is capable of conversing with the faculty and gets activated headless upon the start of RPi. The assis- tant uses the Universal Serial

Bus (USB) Microphone for recording the voice and interpreting it and then analyze it and perform the necessary task. The assistant uses the speaker to respond to the users queries with a headphone jack.

5. HARDWARE AND SOFTWARE

A. Raspberry Pi 3 model B

The Raspberry Pi 3 [10] Model B is the earliest model of the third-generation Raspberry Pi. It replaced the Raspberry Pi 2 Model B in February 2016. It has 4 USB ports and a HDMI port. The RPi is a very useful single chip computer with many advan- tages over the conventional computer the main being the cost.

B. Ultrasonic sensors

The ultrasonic sensor HC SC04 [11] is used in this system. Two ultrasonic sensors continuously measure the distance and report it to the R-Pi.

C. Fingerprint moule

SM-621[12] is an optical fingerprint module that has large capac- ity and high digital signal processing function. It has a low power ARM processer with Flash memory and has CMOS technology. The module can perform tasks like fingerprint enrolment, storing templates, matching fingerprints, and searching fingerprints.

D. USB microphone

In this system a USB microphone [13] is used to detect the speech and is used by Google voice assistant to record the com- mands. The software used for creating the website is Hyper Text. Markup Language (HTML) [14] and Hypertext Preprocessor (PHP). For interfacing the ultrasonic sensors with the R-Pi, python lan- guage is used. And for interfacing the fingerprint module also python language is used. For implementing the PPT navigation PYAUTOGUI module [15] is used. This module implements vir- tual keyboard by passing commands. For implementing the Google voice assistant in the R-Pi, the API from Google is added installed in the R-Pi.

6. RESULT AND DISCUSSION

The proposed system successfully carries out the required objec- tives to achieve the goal of implementing a smart classroom using Raspberry Pi. The developed system allows the authenticated users to upload and download files to the website. It allows new users to register by entering the details such as name, phone number, e-mail id, and a password. Thereafter the registered users can use the portal just by entering their e-mail and password. Fig. 2. screenshots of all the pages of the website which allows faculty to upload/download PPT for lecturing.

Figure 2(a) Layout of the website

Figure 2(b) Upload and Download portal

Figure 2(c) Upload page

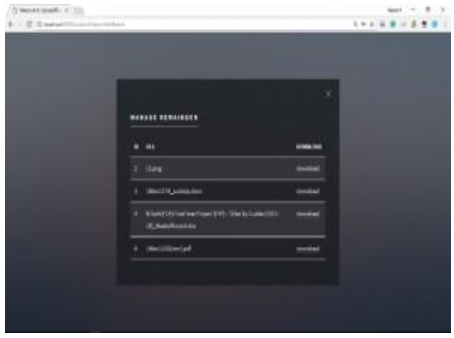

Figure 2(d) Download page 9

The smart attendance system allows the faculty to take attendance without their involvement. The fingerprint sensor verifies and stores the names of present students of a class in a spread- sheet. Fig. 3. Shows the hardware setup of automated biometric attendance system. Fig. 4 shows the snapshot of the generated attendance sheet in excel format.

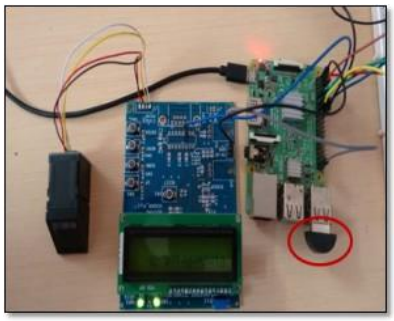

Figure 3 Fingerprint module attached to R-Pi

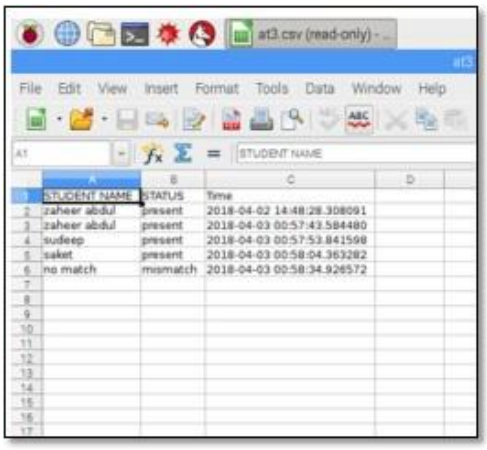

Figure 4 Fingerprint module attached to R-Pi

Also the setup provides a gesture based PPT slides controller as shown in Fig.5. This involves ultrasonic sensor to detect the distance between itself and the hand of faculty. It checks for the predefined range that the calculated distance lies within to execute the code that performs corresponding action on the slides. The sys- tem also has an interactive assistant called Google assistant that helps faculties by reminding definitions, facts, or formulae. It also helps to set reminders for the faculty. All the tasks can be done by saying keyword ”OK GOOGLE” followed by the query or task to do. Fig. 4 shows (encircled) that R-Pi USB interface is connected with wireless microphone module to receive a voice input from faculty. Fig.6 shows complete setup of the smart classroom system implemented using R-Pi.

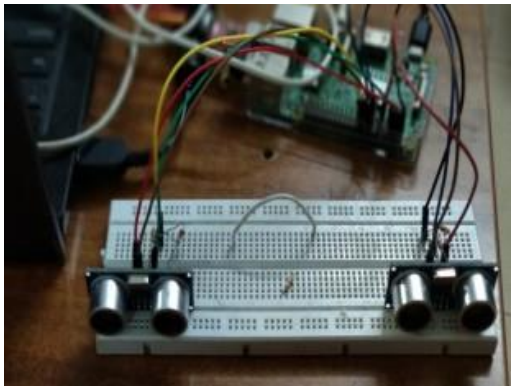

Figure 5 Ultrasonic modules attached to the Raspberry Pi

7. CONCLUSION AND FUTURE WORK

There is a need for shift in teaching methods from conventional techniques as the digital age requires the teaching to evolve into advanced methods reducing the burden on the teachers and also improving the efficiency. In this paper, we have integrated four modules such as smart projector with PPT upload and download feature, gesture based PPT control, smart attendance system and Google voice assistance system on a low cost single controller plat- form using Raspberry Pi. This proposed system can be considered as an alternative high cost smart classroom for the educational in- stitutions that tries to adopt digital technology. The presented system not only reduces the cost but also improves the quality of teaching by utilizing lecture time effectively. In future, this system can be extended by increasing the number of gestures that can be used to perform many actions on ultrasonic sensor based PPT con- troller. In fingerprint based attendance system, even though the fingerprint sensor module automates the attendance process, it is still a time consuming process. Hence, in future this can be re- placed by image processing techniques such as face detection that require no human intervention at all.

References

[1] Rebecca F. Bruce, J. Dean Brock, Susan L. Reiser. Make Space for the Pi. Proceedings of the IEEE SoutheastCon, 2015.

[2] Barbadekar Ashwini, ladhav Shivaji Digambarrao and Prof.(Dr) S.P Patil. Performance Analysis of Finger Print Sen- sors. 2nd International Conference on Mechanical and Electronics Engineering (ICMEE), 2010.

[3] Dhaval Chheda et al. Smart Projectors using Remote Con- trolled Raspberry Pi. International Journal of Computer Ap- plications, November 2013.

[4] L.Arunkumar and A.Arun raja. Biometrics Authentication Using Raspberry Pi. International Journal For Trends In En- gineering Technology, May 2015.

[5] Vishal D Gadhave, S. N. Kore. Portable Attendance System Integrated with Learning Management System like Moodle. IEEE International Conference On Recent Trends In Electron- ics Information Communication Technology, 2016.

[6] Hari Baabu V, Senthil kumar G, Meru Prabhatb and Suhail Sayeed Bukhari. Smart Classroom Attendance System. Inter- national Journal of Control Theory and Applications, 2016.

[7] Dhaval Chheda, Divyesh Darde, Shraddha Chitalia. Smart Projectors using Remote Controlled Raspberry Pi. Interna- tional Journal of Computer Applications, November 2013.

[8] Arief Budiman, Joko Triono. Smart and Simple Classroom Presentation Tools. International Journal of Advanced Re- search in Computer Science, Nov-Dec 2016

[9] Ansari Imran,Bhatkar Firoz, Chaudhary Faisal, Khan Shahrukh, Prof. Mubashir Khan. Smart Lecture Delivery Us- ing Raspberry Pi. International Journal of Advanced Research in Computer Engineering Technology (IJARCET), March 2015.

[10] https://www.raspberrypi.org/

[11] https://electrosome.com/hc-sr04-ultrasonic-sensor- raspberry-pi/https://tutorials-raspberrypi.com/how-to-use-raspberry- pi-fingerprint-sensor-authentication/

[12] https://aws.amazon.com/blogs/machine-learning/build-a- voice-kit-with-amazon-lex-and-a-raspberry-pi/

[13] https://www.w3schools.com/ http://pyautogui.readthedocs.io/en/latest/