IoT Based Well-organized Hostel Power Consumption and Attendance Administration System

Geetha V*, Anbumani V², Selvi T³, Sindhuja C S⁴, Vanathi S⁵

¹Department of Electronics and Communication Engineering, Kongu Engineering College, Perundurai, Erode-638060, Tamilnadu, India
* e-mail address:geethavelliyangiri@gmail.com

Abstract. Most of the educational institutions in India are with the conservative follows for monitoring their resources precisely hostel facilities. In this project, two major issues namely energy conservation and monitoring of hostel attendance are considered. Now a days the power consumption by the educational institutions is more than 2 billion units as per the survey held in 2015. Energy demand is one of the increasing burdens for government and it is increasing exponentially in the recent scenario. Energy conservation can be the greatest key for rising energy demand. In this regard, power saving is a vital matter and it is more serious in hostels as some irresponsible students who leave the room without switching OFF the lights and fans. Another issue with today’s hostel maintenance is student’s attendance and their in/out time. Conventional system follows camera facilities. But many miserable incidents have happened to the students especially girls when they had a long travel to their hometown. Hence by means of well-organized hostel administration system with RFID reader, fingerprint sensor, PIR sensor is designed to work under two modes namely Manual Mode and Automatic Mode and provides solution for these two issues.

Keywords: Fingerprint scanner, PIR sensor, Raspberry pi, Relay, RFID card.

1. Introduction

In this era Indian educational institutions had greater development and brought education to the doorstep of publics. In India there had been a lot of educational institutions established over a decade. Maximum numbers of educational institutions are with the old conventional practices for supervising their resources specifically hostel facilities. This old methods with its inherent limitations have negative impact on the general organizational competence of this educational organizations. Subsequently, it has improved knowledge and help out to produce people of educated citizens who can effortlessly stand by the guidelines of civilized society and contribute meaningfully to the development of democratic governance. Almost all the educational institutions follow the conventional mode of managing the facilities provided by them. This conventional mode of administration leads to the wastage of resources of the management. In hostels, some irresponsible students failed to switch off the fans and lights when they leave the rooms. In accordance with the survey in 2015 over 2 billion units of electricity is wasted by educational institutions in a single year. The Energy Management and Energy Proficiency are a fragment of government policy to decouple financial progress from development in energy consumption and decrease the energy intensity of the budget says Annual Ministry of Power (MoP) report 2015-16. Increase in energy requirement is another pressure for government and energy maintenance is the only solution for this problem.
Another major concern in the conventional administration system is it increases risk factors in security provisions. Several dejected incidents have happened to the students particularly girls when they had a long travel to their home. Recording, monitoring and providing entering/leaving information to the parents is another major requirement of the educational institutions’ management.

There are numerous research papers [1]–[14] based on IoT for providing solution for many of the existing problems. Tarun Kumar Singhal et al. [1] proposed IoT based smart hostel. This provides conceptual frameworks for several problems. Abhaykumar and Neha Tiwari [2] have planned energy competent smart automation structure for home. This works under three different modes. Gunjal M. Set al. [3] proposed hostel administration through online mode. This system is designed by means of four different modules namely, student module, mess module, staff module and the SMS module. This system is efficient in terms of time saving for the students. Rajan Datt et al. [4] designed attendance management system by means of using fingerprint scanner. Student data base is prepared initially and this data base is compared each time when the student accesses the system. Hnin Nu Thaung et al. [5] have intended a arrangement which can supervise the usage of energy in the real-time and likewise the operator can remotely regulate the electricity usage.

This paper, IoT based well-organized hostel administration system aims to address and provide a common solution to these two issues in an efficient manner.

2. IoT Based Well-organized Hostel Administration System

The hostel administration system has various hitches in maintaining the consumption of power supply. Towards the diminishing of wastage of electricity IoT based well-organized hostel management system works on the basis of identification of the presence of students inside the room. In addition to that, during general permission the time at which students leave the hostel is send as a SMS to the parents. The IoT based well-organized hostel management system uses RFID Reader, Fingerprint sensor and PIR Sensor to develop a well-organized hostel administration system. It works under two modes namely, Manual Mode and Automatic Mode.

In manual mode, the students can be able to switch on and off the light or fan. This mode is enabled from 4.15 pm to next day 8.30 am. During this time, the students should swipe RFID card when they leave the room. In automatic mode, the electrical system is controlled through webpage. This mode is enabled from 8.31 am to 4.14 pm. If a student is inside the room without informing, it is detected through PIR Sensor and it gives notification in the webpage. By visiting the webpage, the administrator can be able to know the student’s presence in the room and take necessary action. For security purpose of women while going to home, before leaving the hostel their attendance is marked through fingerprint scanner. The parents are intimated that their daughter had left the hostel through SMS. So, they can be able know at which time their daughter left the hostel and can make an approximate time to reach home.

![Figure 1. Block Diagram of IoT Based Well-Organized Hostel Administration System](image-url)
The hardware components that are used in this structure are Raspberry Pi, PIR Sensor, Fingerprint Scanner, RFID Reader, Relay, and Bulb. The Raspberry Pi is provided with 5 V power supply. The RFID Reader is associated to the Raspberry Pi 3 to read the card which is given to the individual rooms. The PIR sensor is coupled with Raspberry Pi 3 to detect the motion of the students inside the room. Relay is linked to the bulb and controller to control the bulb. Fingerprint scanner is used to scan the fingerprint of the students and send the SMS to the parents via Twilio.

3. Process
The entire process of the IoT based well-organized hostel management system is elucidated from the flow diagram Figure 2.

![Flow Diagram of IoT Based Well-Organized Hostel Administration System](image)

**Figure 2. Flow Diagram of IoT Based Well-Organized Hostel Administration System**

The system operates in two modes as manual mode and automatic mode. In manual mode during 4.15 pm to 8.30 am, the students can be able to switch on and off light or fan. When they need to leave the room, they should swipe out through the RFID Reader and it turns to automatic mode. The electrical system of hostel is monitored through the webpage.

In automatic mode during 8.31 am to 4.14 pm, the rooms controlled through webpage. To detect the students, present inside the room during college working hours, PIR Sensor is places inside each room. When PIR Sensor detects the motion, it intimates through webpage. The authorized person can visit the room and take necessary action. In the webpage, it shows the on and off state of light and fan of each room. During general permission from hostel, for safety purpose of students, the leaving time is informed to their parents.

Fingerprint Sensor senses the student’s finger prints of the students and using Twilio parents can be intimated with SMS that their daughter left the hostel by which they can fix the approximate time of arrival to home.

4. Hardware Components

The following are the hardware components that have been used for the implementation of IoT Based Well-Organized Hostel Administration System.
4.1. Raspberry Pi
In the Raspberry Pi 3 Model B+ boasts a modernized 64-bit quad core processor running at 1.2GHz with integral metal heat sink, dual-band 2.4GHz and 5GHz wireless LAN, very high speed, super-fast (300 Mbps) Ethernet, and PoE (Power over Ethernet) ability by means of a discrete PoE HAT. The Raspberry Pi 3 Model B+ continues the equivalent mechanical footprint as jointly the Raspberry Pi 2 Model B and the Raspberry Pi 3.

4.2. RFID Reader
Electromagnetic fields are used in Radio-frequency identification (RFID) to repeatedly find and trail tags dedicated to substances. The tags comprise electronically-saved data. Passive or inactive tags bring together energy since a neighboring RFID reader's interrogating radio wave. Active tags have a resident power font (similar to a battery) and may work few hundreds of meters as of the RFID reader. RFID belongs to a group of technologies mentioned to as Automatic Identification and Data Capture (AIDC). AIDC methods automatically find substances, gather information near them, and arrive those statistics directly into computer schemes through minute or not any human involvement. RFID approaches employ radio waves to realize this. Information composed via the tags is then transported over a transport network interface to a host processor arrangement, where the statistics can be kept in a database and investigated at a future time.

4.3. Fingerprint Scanner
Fingerprint scanners are safety arrangements of biometrics utilized in police stations, safety businesses and utmost newly, on smart phones. The inscriptions on the fingers cannot be detached or transformed. These inscriptions have a pattern called as fingerprint prints and it is unique for each person. As fingerprints are unique for everyone, fingerprints have become a perfect means of identification. There are two creation arrangements: one is motionless and the other one is moving fingerprint scanner.
- Motionless: It is necessary that the finger should be drawn over the minor scanning range. This is inexpensive and a reduced amount of dependable when compared with the moving form. If the finger is not frequently drawn over the scanning area then the image quality is not good.
- Moving: The finger is placed on the scanning area, despite the fact that the scanner rounds below. As the scanner rounds frequently on the fingerprint, the pictures of fingerprints are improved.
Both structure categories are now obsolete, as new, more fingerprint sensors have become more common.

4.4. PIR Sensor
PIR sensor is a reflexive infrared sensor that estimates infrared (IR) light radiating from matters in its field of sight frequently used in PIR-based motiondetectors.

5. Software
The following are the software packages that have been used for sending e-mails and face recognition.

5.1. Python
Python is an interpreted, advanced, general-purpose programming established by Python Software Foundation. It was chiefly developed for emphasis on code readability, and its syntax permits programmers to express concepts in a lesser number of lines of code. Python and maximum of its libraries are cross-platform, which means the code inscribed on a Windows machine needs slight or no change to run on a Mac OS or Linux. On the Raspberry Pi, RPI is the only library that is not cross-platform. Python has wide built-in provision for arbitrary-precision arithmetic. Integers are obviously switched from the machine- maintained highest fixed-precision (typically 32 or 64bits).

5.2. OpenCV
OpenCV (Open Source Computer Vision) is a library of software design purposes mainly planned at real-time computer vision. OpenCV was constructed to offer a common organization for computer vision.
applications and to make fast the use of machine perception in the commercial products. Originally developed by Intel and the library is cross-platform and is free of cost to utilize under the open-source BSD authorization. This suite is used to capture the images with greater resolution.

5.3. NumPy

'Numerical Python' (NumPy) is a Python package formed by Travis Oliphant in 2005. It is the core library for scientific computing, which comprises a powerful n-dimensional array object, offer tools for mixing C, C++, etc. It has a huge collection of high-level mathematical functions to function on the arrays and is used to accomplish various operations. Using NumPy in Python provides the analogous process to MATLAB since they are mutually taken, and it permits the user to develop high speed programs as long as several processes work on arrays or matrices as an alternative of scalar.

5.4. Twilio

Twilio is a cloud communications platform as a service providing organization constructed in San Francisco, California. Twilio permits software designers programmatically to dial and take phone calls, transmit and accept text communications, and do other communication operations with the help of its web service APIs. In this Twilio, one can generate their own account by registering their number and can receive one account id and account token by which one can write a program in any language like Python, SQL, Java, etc. Using this one can make calls and transmit text messages and one can also write their body as what note they need to transmit.

6. Hardware Implementation

The Raspberry pi 3 board is connected to the fingerprint scanner module, PIR sensors and RFID card reader. Figure 3 shows the overall hardware setup of IoT based well-organized hostel administration system.

![Overall Hardware Setup of IoT Based Well-Organized Hostel Administration System](image)

It accomplishes as follows:

- When the PIR sensor is detected, then the message “Person detected in room 1” will be displayed in the webpage in the automatic mode.
- Then the RFID card is necessary if anyone wants to use the power in the automatic mode.
- The Fingerprint Scanner is used to scan the fingerprint of the students and verify it with the registered fingerprints.
- During the general permission the SMS is send to the parents for the safety purpose of the students.
6.1 Interfacing RFID card reader with Raspberry Pi

RFID card is interfaced with the Raspberry Pi board as shown in Figure 4 to give access to the students for using power during emergency situation in working hours. The students also use the card while leaving the room which switches off the power for the room. During working hours, if the students want to use the power, they use this card to switch ON the power.

![Image of interfacing RFID card reader with Raspberry Pi](image)

**Figure 4. Interfacing RFID Card Reader with Raspberry Pi**

6.2 Interfacing Fingerprint Scanner

In the Figure 5, the fingerprint scanner is connected to the Raspberry Pi board. The scanner is used to scan the fingerprint of the students and match them with the registered fingerprint. After the fingerprint is matched, then the message is sent to their parents. By receiving the message, the parents able to calculate the approximate time when their children reach the home.

![Image of interfacing fingerprint scanner](image)

**Figure 5. Interfacing Fingerprint Scanner**

7. Results and Discussions

During the working hours, the power system will be in the automatic mode. In the automatic mode, the PIR sensor will be ON and then detects the motion of the student. The administrator can able to see the availability of students using webpage as shown in Figure 6.
In the same webpage, others can also able to see whether the light in the room is ON/OFF. The RFID card is used to use the power in the automatic mode. By seeing the webpage, the administrator able to know how many students are in hostel during working hours. And the administrator able to know the ON/OFF condition of the light.

![Figure 6. Output-Webpage](image)

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Figure 7 shows that in automatic mode, if any person is present in the room due to emergency situation, they can be provided with the RFID card to use the power.

![Figure 7. Output- Light ON in First Room](image)

**Figure 7. Output- Light ON in First Room**

Figure 7 shows that in automatic mode, if any person is present in the room due to emergency situation, they can be provided with the RFID card to use the power.

![Figure 8. Output screen](image)

**Figure 8. Output screen**
The system will wait for the correct fingerprint as shown in Figure 8, if the fingerprint gets matched then the message will be sent to the parents for safety purpose of girl student.

Figure 9. Output- Message send to the parents

Figure 9 represents the message which is send to the parents of the girl student during general permission. The parents can able to calculate the approximate time when the students arrive the home. This helps in safety for the girl students.

8. Conclusion and Future Scope
In the IoT based well-organized hostel administration system, power wastage is reduced to the maximum. By means of PIR sensor, the motion of the students is detected and with this administrator can find out the presence of students in the hostel during working days. By this the student’s attendance can be monitored. The RFID card which is used for the power management. And also, during the general permission, the students need to keep the fingerprint while leaving home and the message with timing is send to their parents for their safety.
In future, this may be incorporated with the facilities already available in the educational institutions to make the administration a simple one.

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