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DEVELOPMENT AND TEST IMPLEMENTATION OF SMART CLASSROOM USING RASPBERRY PI & ANDROID APPLICATION

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ABSTRACT: In this growing world human works are being automated by science every day. For that growth IoT plays a major role. This work focuses on the automation of electric and electronic devices in schools and learning institutions classrooms using IoT tools. The boon about this project is all about reducing wastage of electricity by switching of electric appliances automatically by detecting human presence. This work uses camera and a microcontroller to detect the human presence and monitor the status of electric appliances through an android application. Automatic detection of human for turning of the electric appliances is the new technology introduced in the project. At last one can overcome the wastage of electricity by eliminating the manual usage and by introducing new technologies involving automation.

KEYWORDS: MIT, Cloud, Pygame, LCD

I. INTRODUCTION

Electricity wastage is mainly due to the usage of our common appliances such as fans and lights. These types of appliances are more in schools, colleges, learning institutes and offices. Due to the carelessness of the people who are using, these appliances will be running over time and consume more power which plays a major role in the wastage of electricity. Manual usage of these appliances is the main reason of the wastage of electricity. So automation of these will reduce the wastage of electricity. Already many technologies are existing to automate these things. Using human detection to automate things is the new part of our project. These appliances can be operated by both manual and automatic modes by using an android app developed by using MIT app inventor. Status of the appliances can be viewed by using the same app. Every classrooms and offices has to circulate their day to day information so we have modified and developed the same app to display the circulars and display it to the common LCD display.

II. LITERATURE SURVEY

Through literature reviews we have formulated some of the existing methodologies and designed our system based on the difficulties faced by the existing authors [2, 4-13]. There are two methods which is being followed previously. In many classrooms after the class is over the students and teachers leave the classroom without switching OFF them, at the time of closing the classrooms the security staffs tend to switch OFF them. Hence electrical energy is wasted during the unwanted time. To overcome this PIR [1] sensor and LDR are used to automatically Control them. PIR detects the human presence inside the classroom and switches ON only if there is any human inside the class. LDR detects illumination of the room. During dark hours it will switch on the Lights and vice versa. When the light of the class room is low, LDR sends information to the microcontroller and the lights are turned ON and when the light of the class room is high, LDR sends information to the microcontroller and the lights are turned OFF. PIR sensor also sends information whether to turn on the fans and lights when they detect the human movement by using infrared signals. The disadvantage of these PIR sensor is that they cannot detect the humans who are far away from them and they can detect any other objects while moving so when a bird and animal crosses the PIR sensor it sends the information to the microcontroller and turn ON the fans and lights. So to overcome this issue detecting human presence using camera is a better and an efficient way. Using LDR to detect is also won't be so accurate to switch on the fans and lights.

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III. METHODOLOGY

To control, manage, and monitor the class room appliances in a comfortable, effective and secure way, a raspberry pi microcontroller is used in this work. Along with this a camera is used to capture the peoples available in the class room. A LDR is used to control the light intensity. Status of the appliances can be monitored through an android application to send and display day to day circulars through an app in the display unit [3]. Other devices are being controlled by a relay circuit. The detailed block diagram is given in the figure 1.

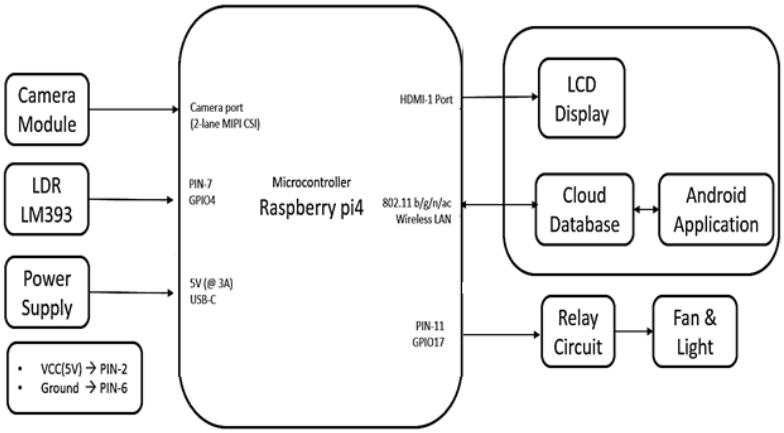

Figure.1 Block Diagram

Working Principle

The working principle of this work is started with the Raspberry pi. Which is connected to a wireless network while booting. Once the raspberry pi is booted up it automatically runs the codes that has to be executed at a prescribed time. The codes are written on the basis of individual models. Every individual models are explained with a flowcharts in the forthcoming sections.

Human Presence Detection in the Class Room

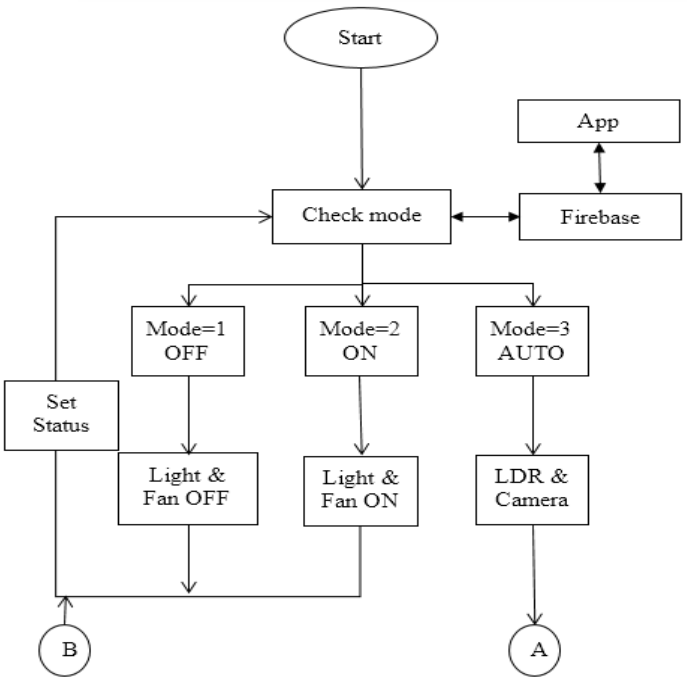

Figure.2.a Flow diagram

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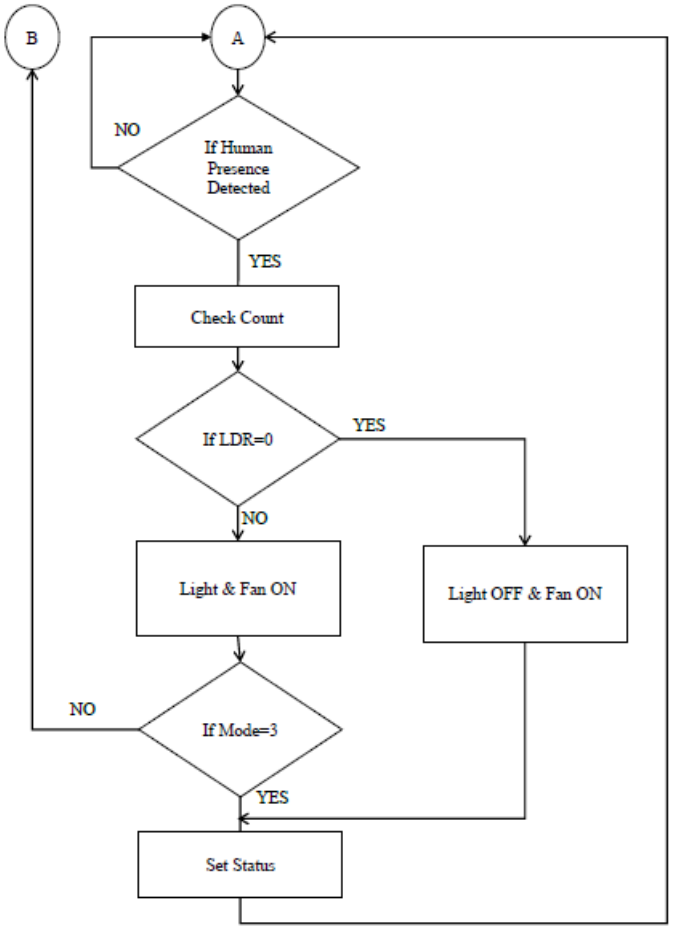

Figure.2.b Flow diagram

The Human Presence Detection is explained using the flow diagram depicted in figure 2a and 2b. Initially the Mode is checked which is set from the mobile application. Once the mode is checked it operates based on the mode. If the mode is 1, it performs a default OFF of all the electrical and electronic appliances in the class room. The detection of human is not performed under this mode and the appliances are OFF by default. If the mode is 2, it performs a default ON of all the electrical and electronic appliances in the class room. The detection of human is not performed under this mode and the appliances are ON by default. If the mode is 3, it automatically switches on and off all the electrical and electronic appliances in the class room without any human intervention. The pi camera which is connected to the raspberry pi4 starts capturing images at a frame rate of one frame per second. The real time detection of human is performed with the help of Open-CV, which act as a real time computer vision. The frame which is captured by the pi-camera is initially converted to a neural style image with the help of Tensor flow. Once the image is converted to a neural style image the features of the image is extracted from the image. Then the extracted features from the image is compared with the trained models with the help of tensor flow. The Id and Name of the trained model which matches with the extracted features is stored in an array. Now the array is checked for the Id and Name of human. A variable is set to true if the array contain human. All appliances other the light is ON when a human is detected in the class room. Once the human is detected in the class room, the value from the Light Dependent Resistance (LDR) is checked. If the output of LDR is zero it specifies that the intensity of the class room is low and it is necessary to switch ON the light. If the output of LDR is non-zero it specifies that the intensity of the class room is high and it is not necessary to switch ON the light. Then the status of the class room whether it is on or off is set so that it can be viewed in the mobile application with the help of firebase cloud. Now the above steps are repeated for real time human presence detection in the class room.

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Displaying the Circular

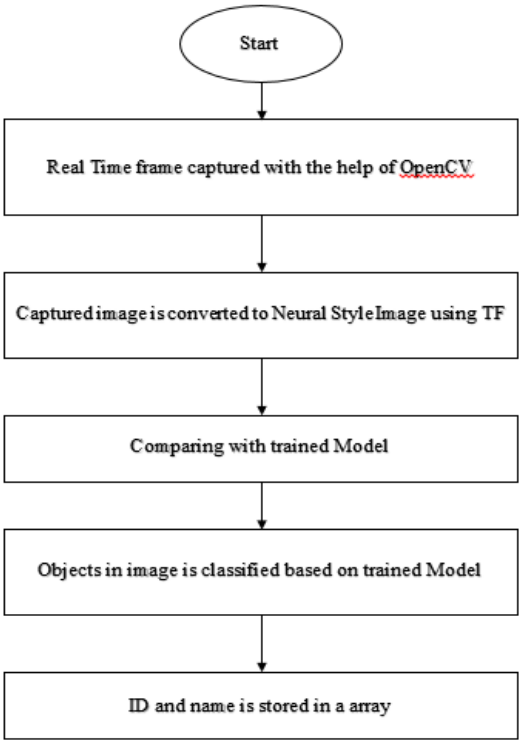

Figure.3 Circular display Flow diagram

The circular which is to be displayed in the class room is typed in the mobile application as title and content and send to cloud when the send button is clicked. Once the data is send it is stored in the Google firebase. The title and the content from the cloud is fetched in the program. Once the data is fetched it is displayed in the LCD Monitor which is connected to the raspberry pi4 through the HDMI port with the help of pygame software. The frame size, fond, text size, position and colour is set by the program and the title and content is displayed accordingly. The above process is repeated so that any change in the circular will get displayed on the LCD monitor.

Android Application

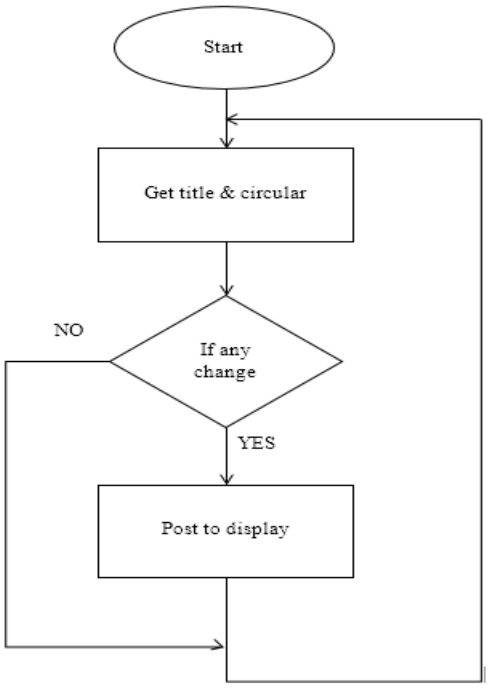

Figure.4. Android Application Flow diagram

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Initially when you open the Smart Class android application in mobile a login page will appear. Type appropriate user name and password to login. It leads to a page where it displays control and circular. Clicking the control will display the status of the class room. It also have three buttons which sets the mode such as Automatic, ON and OFF. Clicking the circular will lead to a page where you can type the title of the circular and the contents. By clicking the send button the circular is send to the cloud and then displayed in the LCD monitor in the class room. Clicking the clear button will clear all the text which is already existing.

IV. RESULTS

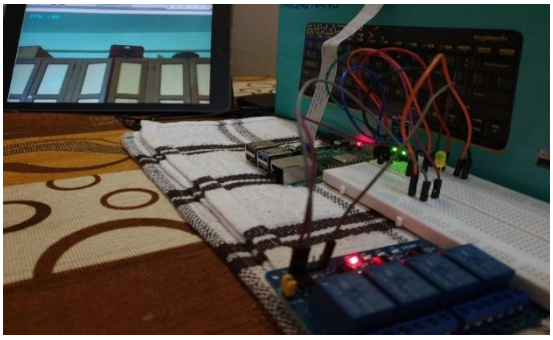

Figure. 5 Hardware Interface

In the above figure 5 one can see the setup of the hardware components that are interfaced.

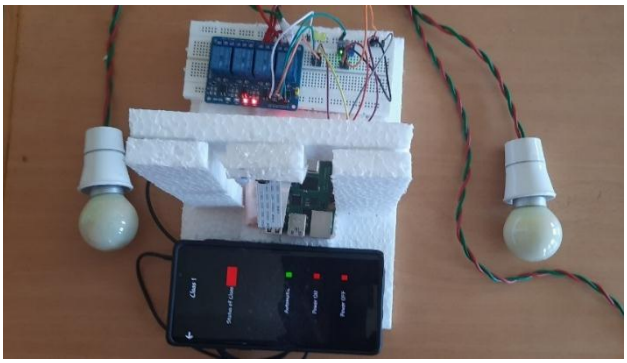

Figure. 6 No Human Detected

In the figure 6 due to no human presence the lights and fans are in off condition in the classroom. By using the android application it is possible to control the electrical appliances present in the classroom manually and the status is notified.

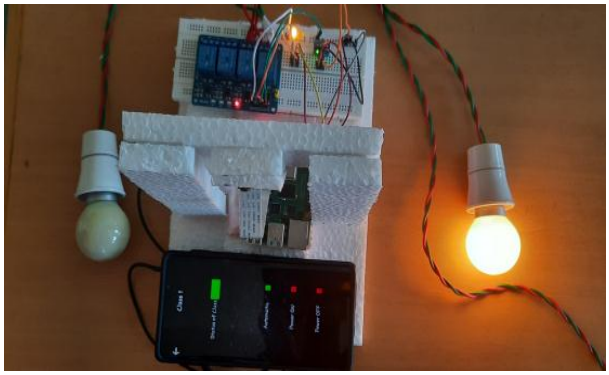

Figure.7 Light Intensity High

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In the above figure 7 since the intensity of the classroom is high light is in the OFF condition and fan is turned on automatically.

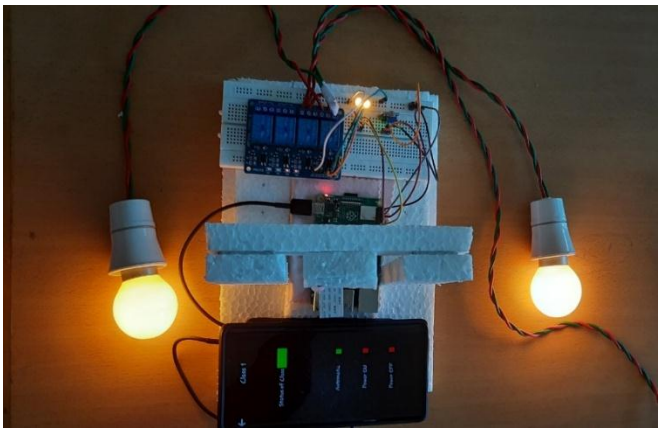

Figure.8 Light Intensity Low

In the above figure 8 the intensity of the classroom is low so that both light and fan are turned ON automatically.

LCD Display

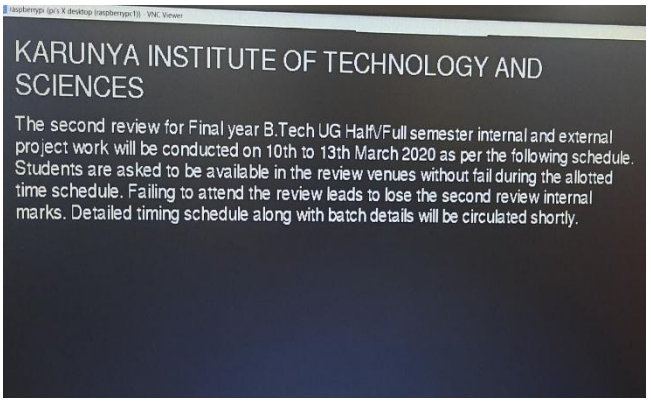

Figure.9 LCD Display

In the above figure 9 the circular which is sent using the android app developed is been displayed on the LCD monitor.

Android Application

Initially when you open the Smart class android application in mobile a login page will appear. Type appropriate user name and password to login. It leads to a page where it displays control and circular. Clicking the control will display the status of the class room. It also have three buttons which sets the mode such as Automatic, ON and OFF. Clicking the circular will lead to a page where you can type the title of the circular and the contents. By clicking the send button the circular is send to the cloud and then displayed in the LCD monitor in the class room. Clicking the clear button will clear all the text which is already existing.

Cloud interface and working

In this work all the operation are based on real-time, so Firebase Real time database is used to store the real-time data. Firebase Real time Database is a Cloud hosted database. The data is stored in JSON format. The android application is linked with the Google Firebase with the help of the database secret key and the database address. In this project there are three real-time variables that are used in order to store the real-time data with different tag name. The data is stored and retrieved using the tag name. The First variable holds the mode in which the application has to operate that is mode 1, 2 or 3. It is set from the

mobile application. The second variable holds the status of the room which indicates the presence of human in the room. This variable is set by the controller and it can be monitored in the mobile application. The third variable holds the circular data that is send from the mobile application and it is retrieved by the controller to display it on the display.

V. CONCLUSIONS

This project is very efficient in terms of technology and is easy to use. It uses electricity efficiently and automate all the electrical appliances in a class room. It also reduces the manual control of the appliances. The main advantage of this project is that the status of the class room can be monitored and controlled using a user friendly mobile application. It also has the feature of displaying the circular in the class room which can be send from the application.

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