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Smart Classroom Using Raspberry pi

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Abstract: Electricity plays a pivotal role in today's world; life without electricity can never be imagined. We know most of energy is generated using non-renewable resources and the more we use them, the earlier they get depleted. So everyone should take responsibility to save the energy as much as possible. Many of us forget to switch off the electrical appliances while going out due to negligence usually. In educational institutes, most of the time students forget to switch off the lights and fans while leaving the classroom, which increases the wastage of electric energy as well as electricity bill. In this paper we present an idea to give power supply to classroom based on number of students present in the class using raspberry pi and face detection algorithm. It will turn off the lights and fans when the classroom is empty, which helps to reduce the wastage of electricity.
Keywords: Raspberry pi 3, Face detection algorithm, Controlled power supply, Camera, LDR

I. INTRODUCTION

Automation is playing an important role in our life, technology is improving very rapidly, and almost everything is getting automated. The present power supply system is manually operated one so it needs human intervention every time to switch on and off the lights and fans which are difficult task as compared to automated systems. In institutes most of the time students forget to switch off the lights and fans while leaving the classroom which will result in wastage of electricity as well as increase in academic cost for institutes. So there is great need for automated system which will turn on and off the switches based on human presence or absence.

In this proposed idea, we will use existing cameras and the switch boards in the classroom to implement the system. It will detect the person and take decisions accordingly whether to turn on or off the switches which is completely automatic. Here we have used face detection algorithm to detect the presence of person in the classroom and based on that result system will turn on the respected number of lights and fans as per given conditions. Raspberry pi 3 has been used as a centre part, which controls all activities and helps to give controlled power supply.

II. PROPOSED DESIGN

Here in our proposed design we want to change manually operated switch boards into automated switch boards. The idea is to turn on the lights and fans if person detected in classroom and to turn off them if no one is detected. In our proposed design we have used raspberry pi3, camera, LDR, and a motor driver.

The proposed design is shown in figure 1. Here 5V DC Power supply is given to raspberry pi to turn on the system. Raspberry pi boots up the script and turns the camera on. The camera installed in the classroom starts capturing the pictures, and gives them as input to raspberry pi. Raspberry pi processes the images using Haar cascade face detection algorithm to detect the presence of person. And based on the number of faces detected lights and fans will be turned on as per given conditions.

Here we have given conditions like; if the numbers of faces are between 1 to 2 then one light and fan will be turned on, if the numbers of faces are between 2 to 5 then two lights and fans will be turned on and if the numbers of faces are above 5 then three fans and lights are turned on.

The conditions considered here can be changed according to requirement. The raspberry pi gives the input to motor driver IC which in turn turns on the fans according to number of faces detected. LDR helps us to detect the dark conditions, in such situations raspberry pi turns on the lights along with the fans according to number of faces detected. If the algorithm has detected no face in the image then raspberry pi turns off all the lights and fans.

So this system will turn off all the lights and fans in the classroom if the classroom is empty which will help us in reducing the wastage of electricity and also to lessen the electricity bill. Monitor is used to display the number of faces detected and also to display the faces.

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A. Block Diagram

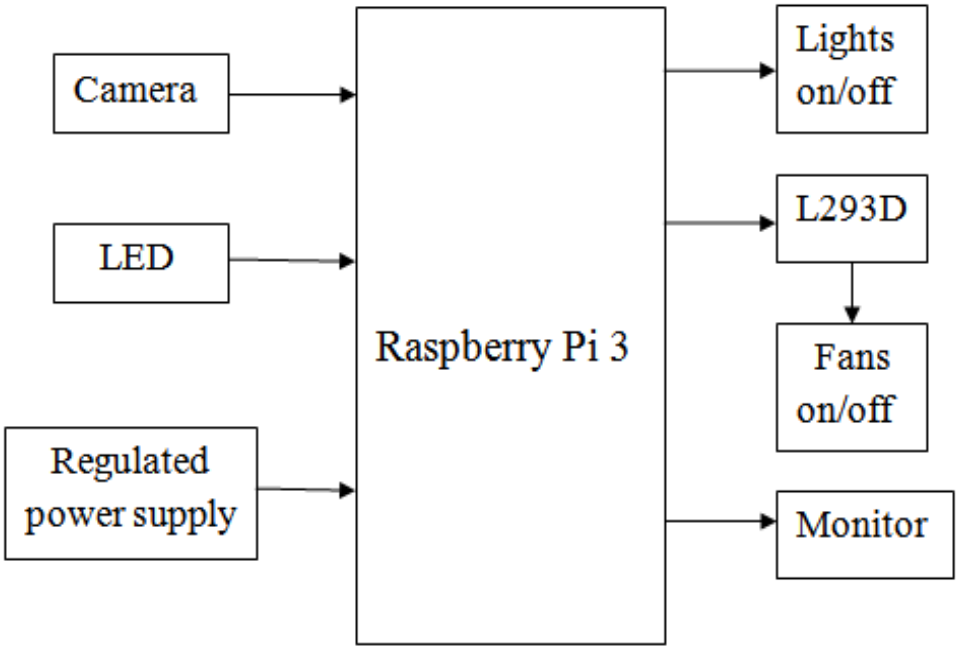

Figure 1: the proposed system for smart power supply in classroom

III.HARDWARE COMPONENTS AND SOFTWARE USED

A. Power Supply

Regulated power supply is used to give a constant power supply to raspberry pi. Transformer used here is 230V/0-12V. Primary of transformer is connected to mains and secondary is connected to diodes to convert AC to 12V DC voltage. And it is regulated to 5V using IC 7805.

B. Raspberry pi 3

Raspberry pi is a computer on single chip. Raspberry pi 3 has BroadCom BCM2837chip, 64bit CPU with 1.2GHz operating frequency, Quadcore ARM-Cortex processor, 4 USB ports and 1GB SDRAM memory. It has Bluetooth and Wi-Fi support and also Ethernet socket. It has CSI camera port for raspberry pi camera and also a micro SD port. It has 26 GPIO pins which helps it to communicate with other devices. Here raspberry pi takes input from the camera through USB port and gives output to GPIO pins to control the power supply given to classroom.

C. Camera

Here we have used Frontech jil 2244 webcam. It is a video camera which continuously captures the images from the classroom and displayed on monitor. It is 20Mega pixel camera with 640x480 resolutions and can transmit 15 frames per second. It is connected to raspberry pi through USB port.

D. Motor Driver

L293D motor driver IC is connected between raspberry pi GPIO pins and DC motors. Here it is used to provide current amplification. It amplifies low current signal from GPIO pin to high current signal that can drive DC motors which are nothing but the fans in the classroom.

E. LDR

Light Detection Resistor is a component whose resistance varies according to the intensity of light falling on it. Here we have used it to detect dark condition; it gives input to raspberry pi. If it is night then the raspberry pi turns on lights in the classroom based on number of faces detected.

F. Monitor

Monitor screen helps to display the number of faces detected and also it shows the images captured by camera.

G. Haar Cascade Face Detection algorithm

It is based on object detection proposed by Paul Viola and Michael Jones used to detect faces in the images captured by camera. Positives and negative images give cascade function. Images with faces are considered as positive and without faces are considered as negative images. Haar features include edge features, line features and four rectangle features. Each feature is obtained from matrix subtraction that is sum of pixels in white box are subtracted from sum of pixels from black box. The features help to distinguish between face and non-face region.

IV. EXPERIMENTAL SETUP AND RESULTS

In the system camera is connected to raspberry pi through USB to give input to it. Raspberry pi is connected to motor driver IC through GPIO pins. LDR is connected to raspberry pi through GPIO pins which gives input to detect dark condition. Raspberry pi is connected to monitor through USB port to display the faces captured by camera. When the image captured by camera has presence of person raspberry pi will turn on lights and fans accordingly, if there is no presence of person then raspberry pi will turn off all the lights and fans in the classroom.

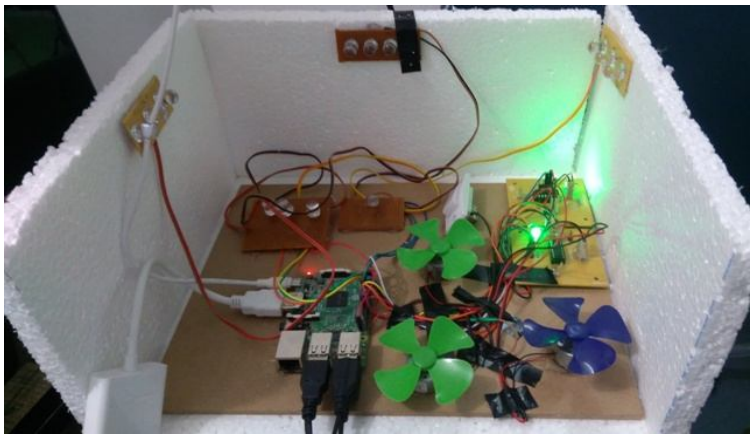

Figure 2: experimental setup

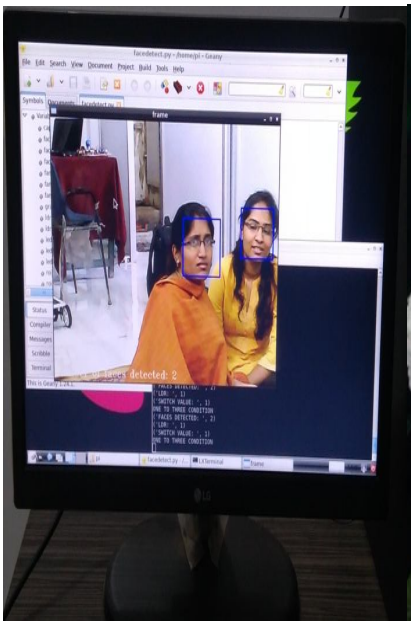

Figure 3: face detection for first condition

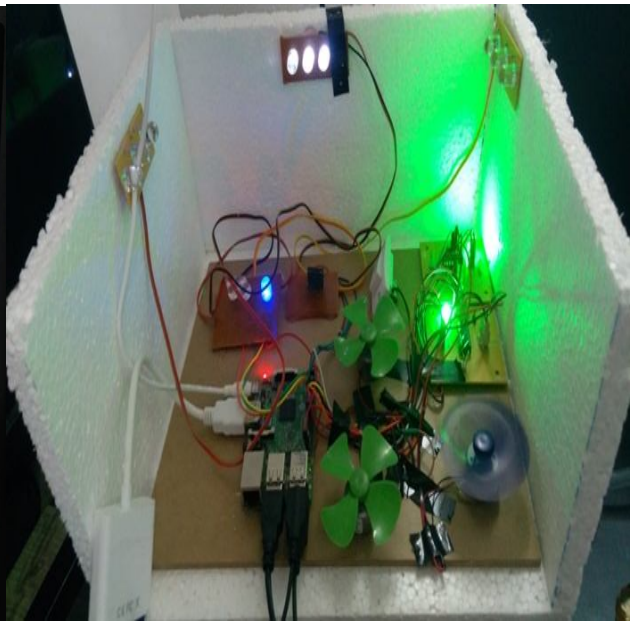

Figure 4: one fan and light are turned on

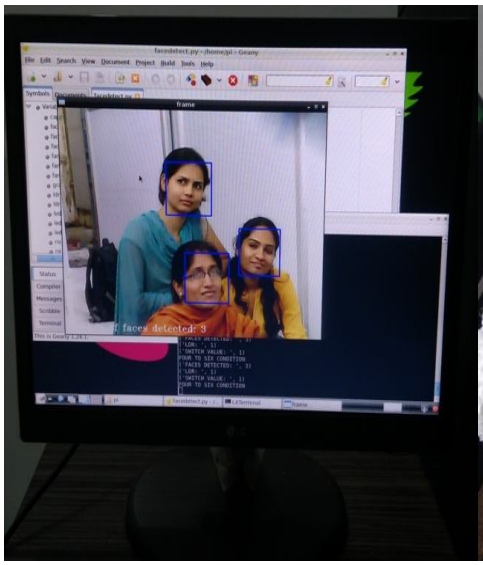

Figure 5: face detection for second condition

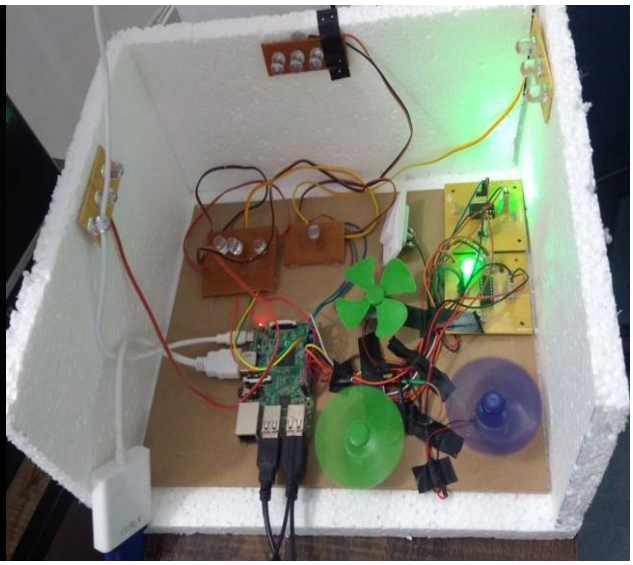

Figure 6: Two fans are turned on

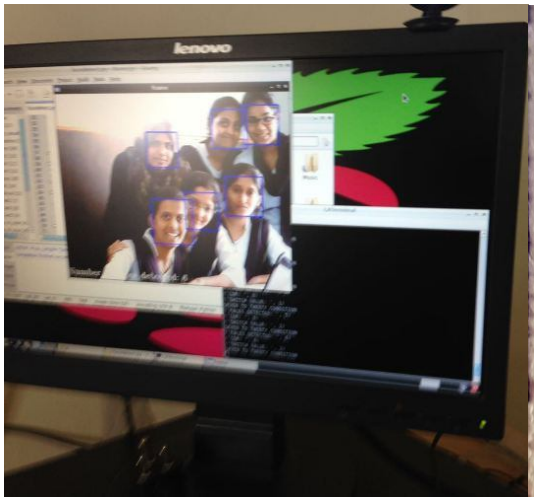

Figure 7: face detection for third condition

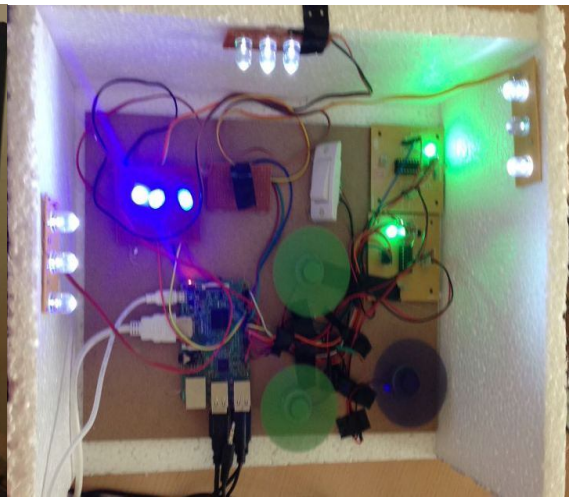

Figure 8: Three fans and lights are turned on

IV. CONCLUSIONS

In this paper, the design of smart power supply in classroom has been implemented. Raspberry pi takes input from the camera and processes the images using face detection algorithm. Light Detection Resistor (LDR) is connected to raspberry pi to detect the dark condition. Based on the number of faces detected raspberry pi will turn on the lights and fans through motor driver as per given condition. If the classroom is empty that is the image captured has no face detected then raspberry pi will turn off all the lights and fans in the classroom. Thus it helps to reduce the wastage of electricity effectively.

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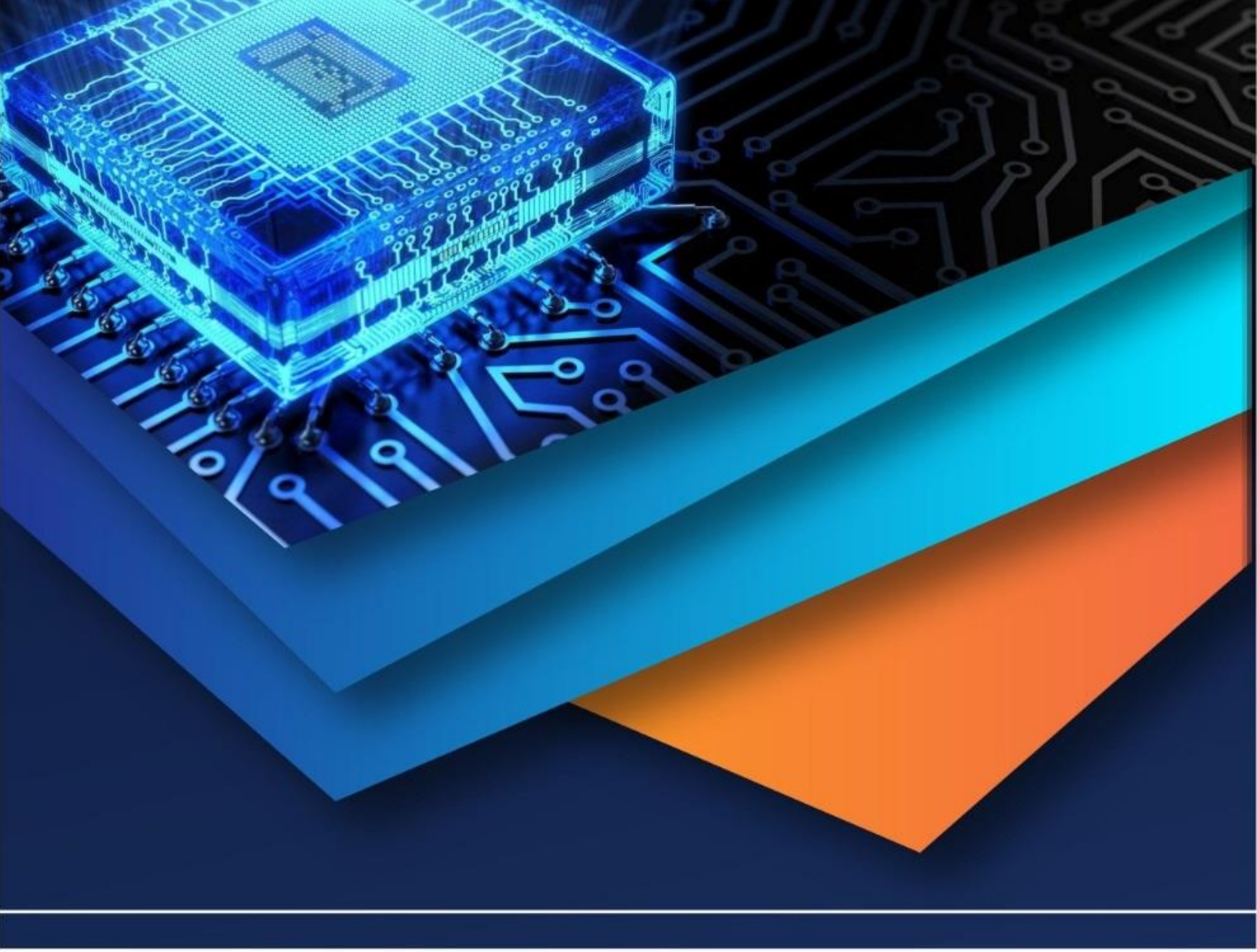

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