ELECTRICAL APPLIANCES CONTROL UNDER COMPUTER VISION

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Abstract

The objective of this paper is to develop a public automation system using image processing techniques to control different kinds of electrical appliances. Because of carelessness and negligence many instances occur in establishments where the electrical appliances are left turned on even if there is no human present. This is one of the primary causes regarding power wastage. Hence there is a need for power management system that can ensure both efficiency and effectiveness. In this system, object detection methods are used which enable us to control appliances in a specific spatial region. This project also uses the image processing techniques which are more efficient than conventional IR blaster-based home automation systems. In this system, human face and motion detection algorithms are used which enables to control particular electrical appliance in accordance with human presence. Temperature and Light sensors are also used to regulate electrical appliances. The entire operation is processed by Raspberry Pi which is interfaced with peripherals. This paper proposes a system which can efficiently utilize the lighting output and minimize the wastage of electricity by controlling the electrical appliances by detecting changes in the position of the humans in the room.

Keywords—Artificial intelligence, Computer vision, Image processing, Object detection.

1. INTRODUCTION

Automation provides the results in private domain as Home automation (A. Ad wale and e. al., 2013) system. The public domain suffers from the challenge of reducing the power wastage in many public places like hospitals, railway stations etc. In this scenario to avoid the power wastage we develop a Public automation system which aids in decreasing cost and creates better results. Our project mainly depends on the technique called image processing (D. Ganiger., 2017). It is method of obtaining information from the Picture captured. The image processing (D. Ganiger., 2017) is one category in signal processing for which, input is in the image and output is also in the attributes of the image. The image which we want to process that must be seized with Pi camera interfacing with raspberry Pi.

The Raspberry Pi has a committed camera with an accommodate port that allows customers to seize HD video and high-intention photos using Pi camera. The image seized by the Pi-Camera is processed by the Raspberry Pi. The LDR and temperature sensor also be included to camera for the detection of temperature and intensity of that place. The information noticed by the temperature and Light sensor is transmitted to the Raspberry Pi. The Raspberry Pi contemplate the signals from camera and Sensors, appropriately it will operate and regulate the speed of fan and vary the intensities of light. The remaining of information of this paper is described below.

2. LITERATURE REVIEW

There is always a need to identify the major components required for the product. Our project mainly focuses on the automation. Based on the review, we thought of using Raspberry pi which triggers relay based on the motion of a human. Future add-ons to the product can make it as a complete independent working model. We have compared our system with different automation systems.

A. Home automation using infrared: Home automation using Infrared sensor [1] works on the concept of changing the functional state of the appliances when the ray is obstructed Localization although possible it isn't employed easily. An array of sensors is needed to be deployed in the place and managed simultaneously to control appliances by processing information collected by each of the sensors. This system involves control and maintenance of large number of sensors, which can be replaced by a single camera in the system proposed in this paper (an existing CCTV can also be used too).
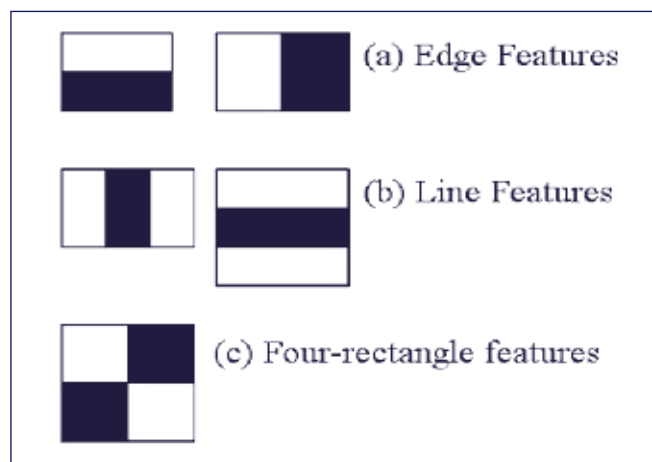
B. Home automation using object detection: This paper on automatic control of power supply in classroom using Image Processing [2] is image processing based, however, no localization is involved as object recognition involves predicting only the classes of objects present in the image and not exactly where the object is located. In the System proposed humans are localized, hence the appliances can be controlled segment wise instead of a single control for the entire area covered by the camera.

C. Viola and Jones' Haar-like features and cascade classifiers: The typical cascade classifier is the very successful method of Viola and Jones for face detection [3]. Generally, many object detection tasks with rigid structure can be addressed by means of this method, not limited to face detection. The

cascade classifier is a tree-based technology, in which Viola and Jones used Haar-like features for human face detection. The Haar-like features by default are shown in Figure, which can be used with all scales in the boosted classifier and can be rapidly computed from an integral version of the image to be detected in.

Fig.1 Haar-like features from the OpenCV source distribution

The characteristics of Viola–Jones algorithm which make it a good detection algorithm are:

- Robust – very high detection rate (true-positive rate) & very low false-positive rate always.
- Real time – For practical applications at least 2 frames per second must be processed.
- Face detection only (not recognition) - The goal is to distinguish faces from non-faces

The algorithm has four stages:

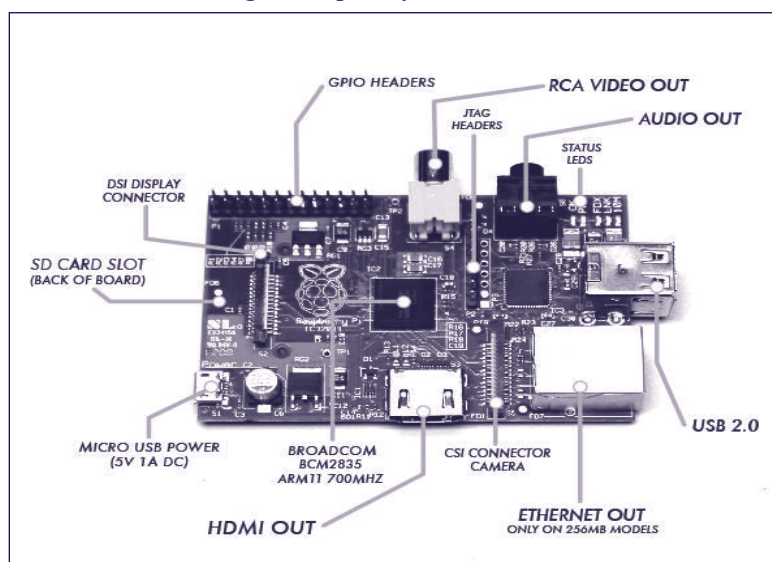Haar Feature Selection, Creating an Integral Image, Adaboost Training, Cascading Classifiers

The features sought by the detection framework universally involve the sums of image pixels within rectangular areas. As such, they bear some resemblance to Haar basis functions, which have been used previously in the realm of image-based object detection. However, since the features used by Viola and Jones all rely on more than one rectangular area, they are generally more complex. The figure on the right illustrates the four different types of features used in the framework. The value of any given feature is the sum of the pixels within clear rectangles subtracted from the sum of the pixels within shaded rectangles. Rectangular features of this sort are primitive when compared to alternatives such as steerable filters. Although they are sensitive to vertical and horizontal features, their feedback is considerably coarser.

3. METHODOLOGY

3.1. Hardware Details: A. Raspberry Pi: The Raspberry Pi is credit card sized single board chip. It permits the user to attach Monitor of laptop moreover as TV to the Raspberry Pi through USB ports user may able to connect peripherals to the Raspberry Pi. It can be used as a mini pc. It runs on Raspbian OS. Secure Digital cards are accustomed store the OS and program memory. The OS supports the software system used, associate degree external integrated camera for capture the live feed

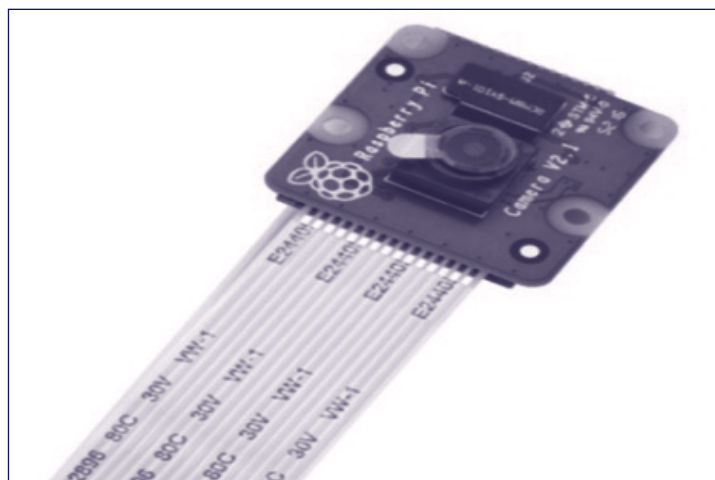**Fig.2: Raspberry Pi 3 b module**

The Raspberry Pi boards carries with it following ports:

USB ports, HDMI post, DSI port, Audio jack, forty GPIO Pins, In-built Bluetooth, wireless local area network then on its ARM compatible processer and on-chip graphic process unit. Its operational speed varies from 700 MHz to 1.2 gigahertz and its On-board memory varies lies between a pair of 56MB to 1GB RAM. These options which permit property with all the elements to the raspberry Pi.

B. Pi Camera: The Raspberry Pi 3 has a camera interfacing port called as CSI port. The Pi-camera v2 module is helps to seize video frames, and also images.
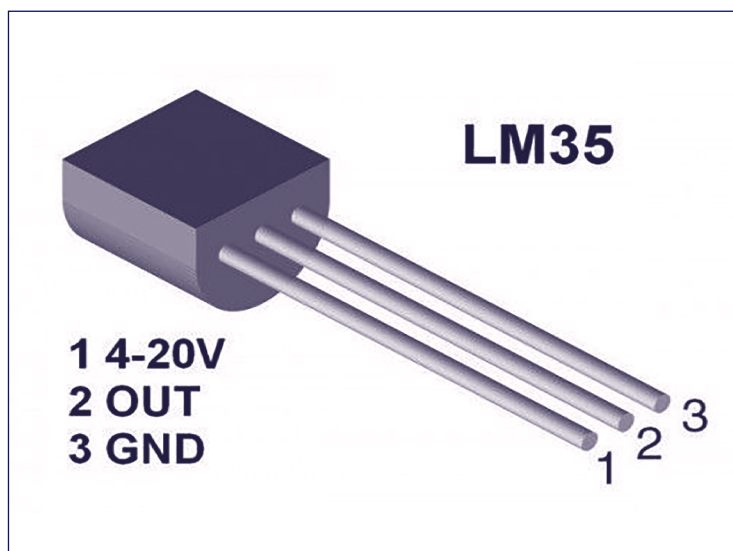
Fig.3: Raspberry Pi Camera v2.

It interfaces with raspberry Pi via a 15cm flex cable to the CSI port on the Raspberry Pi. The connector of ribbon cable was opened by dragging the connecter tabs in the up direction towards the Ethernet port. The cable of camera should be in placed carefully into the CSI port of raspberry Pi, and not to bend the cable at too acute angle which causes the damage of camera module. After attaching the camera ribbon cable, the tabs of the connector should then be pushed toward down direction while the flex cable is held in place. Any camera can be used for sensing objects can be connected to the Pi and delivered frames can be used for detection.

C. Temperature Sensor (LM35): Temperature sensor is an incorporated circuit, that gives the voltage at yield that fluctuates relies upon the temperature of the room or zone. It is an ease and a little measured sensor which can have the option to assess temperature extend anyplace in the middle of - 55°C to 150°C. On the off chance that the temperature is 0°C, at that point the yield voltage will likewise be 0V.At the end of the day the yield voltage of the temperature sensor is legitimately relative to temperature of the room or territory. Alongside the adjustments in the temperature of the room and the speed of the fan can be regulated.

For each degree Celsius ascends in temperature, there will be an ascent of 0.01V. As indicated by the signs from camera and LM35 the fan speed can be worked.

Fig.4: Temperature Sensor (LM35)

D. Light Dependent Resistor (LDR): A Light dependent resistor is a sort of factor opposition whose obstruction esteem is differs as indicated by the measure of light forces that around it.
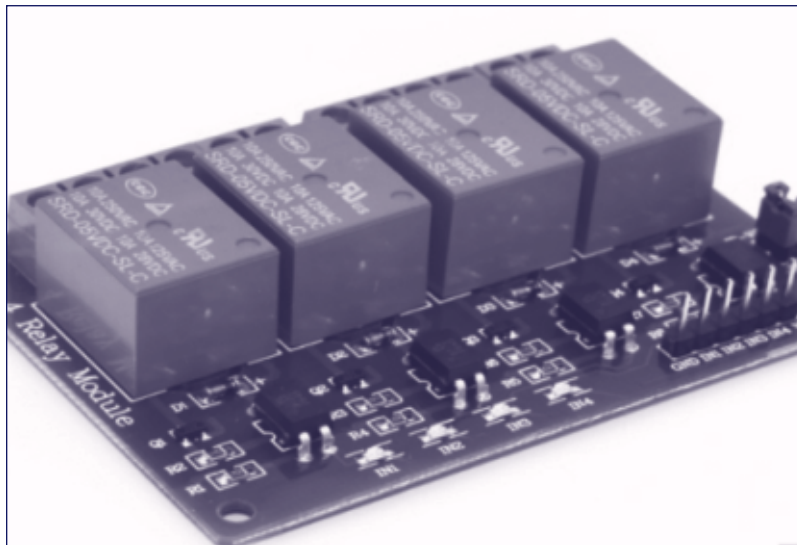
Fig.5: Light Depend Resistor

This permits them to be utilized in lightweight detective work circuits. The LDR device Module assists with characteristic of distance of sunshine and estimating the facility of sunshine as obstruction. The yield obstruction of the LDR goes high if there's lightweight falls on that and it seems to be low if there's no lightweight. The affectability of the sign location is often balanced utilizing potentiometer.

E. Relay: A relay is associate degree electrically worked football play switch. It contains of a great deal of terminals for a solitary or numerous management signals, and a great deal of operating contact terminals. The switch might have any variety of contacts in varied contact structures; for instance, build contacts, break contacts or blends thence. Whenever it gets 5v supply from raspberry Pi the coil of the relay channel get magnetized.

Fig.6: 4 channel relay module

3.2. Software Details: A. Opencv-Python: Open CV is a library of programming functions mainly aimed at real-time computer vision. The library is cross-platform and free for use under the open-source license. Python is an interpreter, high-level, general-purpose programming language, Python's design philosophy emphasizes code readability with its notable use of significant whitespace. Its language constructs and object-oriented approach aim to help programmers write clear, logical code for small and large-scale projects. Open CV supports some models from deep learning frameworks like Tensor Flow, Torch, PyTorchand Caffe according to a defined list of supported layers. And it is also a cross-platform library using which we can develop real- time computer vision applications. It mainly focuses on image processing; video capture and analysis including features like face detection and object detection (K. Sravani., 2014).

B. Raspbian Jessie: Raspbian Jessie is the version of operating system for Raspberry-Pi, previous to the latest stretch. So, there are still a lot of people preferring Jessie as the OS for their Raspberry-Pi devices. Raspbian Jessie is free standard operating system for Raspberry Pi board. An operating system is the set of basic programs and utilities that make your Raspberry Pi run.
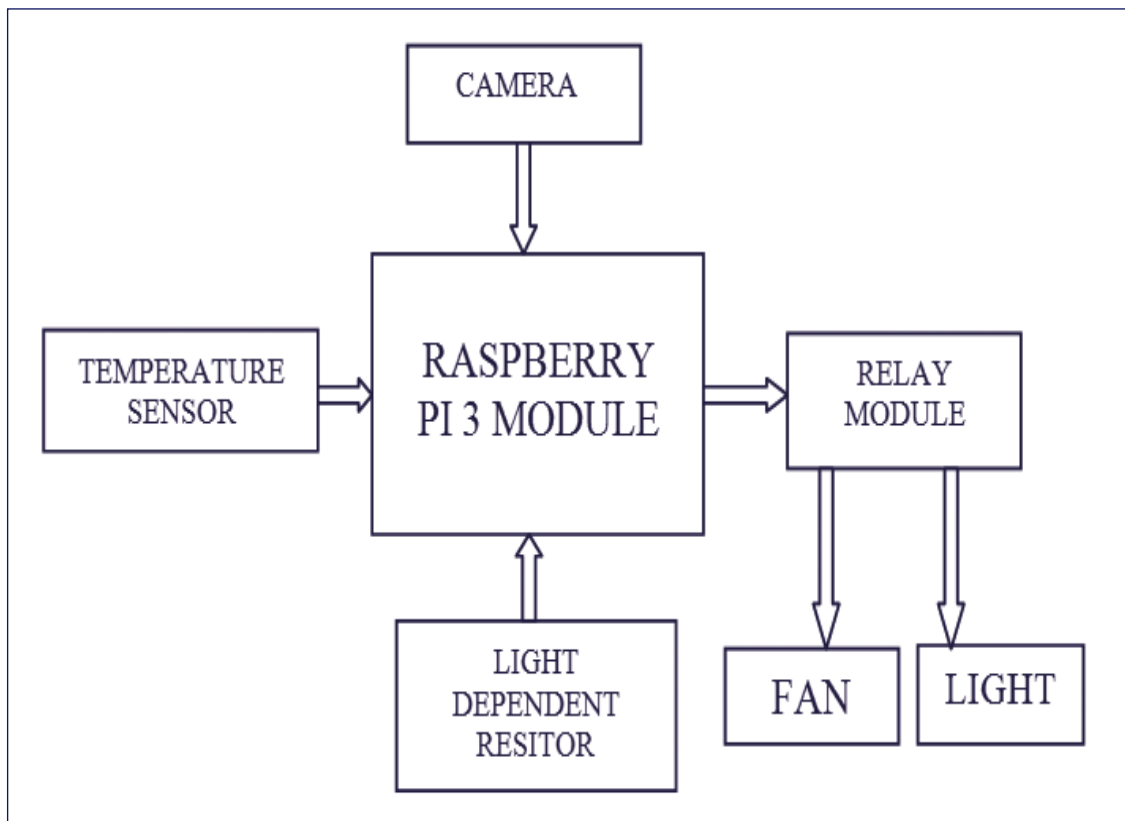
4. DESIGN AND IMPLEMENTATION

The live feed from Pi camera is prepared by utilizing segmentation method which is one of the strategies of image processing. The Picture got from the Pi camera is divided utilizing division strategy called as segmentation. As per the human nearness and non attendance in that specific fragment, the electrical apparatuses at that specific portion will be turned on/off.

Raspberry Pi not just processes the data from the Pi camera yet in addition processes the data from the both yield signals from sensors and Pi camera. For instance, during mornings, there is no need of light to be turned on. So the light is turned off by the raspberry Pi utilizing light sensor which recognizes the power of light even within the sight of human. Different sensors like light and temperature sensor.

Fig.7: Block Diagram

Likewise at whatever point there is a change at the yield of temperature sensor the fan speed can be fluctuated. The transfer module is a 4 channel hand off board that goes about as a switch. In the event that there is a human nearness the Raspberry Pi sends a signal relay.

5. WORKING MODULES

Image Processing Techniques: This comprises of two parts: image segmentation and object detection image processing

Image segmentation: The Image segmentation is called as one of the most significant strategies of image processing. It is additionally called as Picture division or partition of Picture. Picture division is a significant and testing procedure of Picture handling. Picture division system is utilized to segment a Picture into significant parts having comparable highlights and properties. The primary point of division is rearrangements, for example, speaking to a Picture into significant and effectively analyzable way. Picture division is important initial phase in Picture examination. The objective of Picture division is to separate a Picture into a few sections/ fragments having comparative highlights or properties. The fundamental utilizations of Picture division are: Content-based Picture recovery, Medical imaging, Object identification and Recognition Tasks, Automatic traffic control frameworks and Video reconnaissance, and so forth. The Picture division can be grouped into two fundamental sorts' Local division and Global division. The Picture division approaches can be ordered into two sorts dependent on properties of Picture.

Object detection using image processing: The object detection model provides bounding boxes that are normalized for each shape of input image so they need to be de-normalized according to our input image. The de-normalization is done by multiplying the height and width of the original image to the bounding box coordinate X and Y respectively. After this step,

if the [5] detected humans are to be visualized, the bounding boxes are overlapped over the image, the confidence is also written above the box and the image is displayed on the screen or written to disk if needed. The image is divided into segments according to the number of locations that are needed to be separated .The two cases are discussed below.
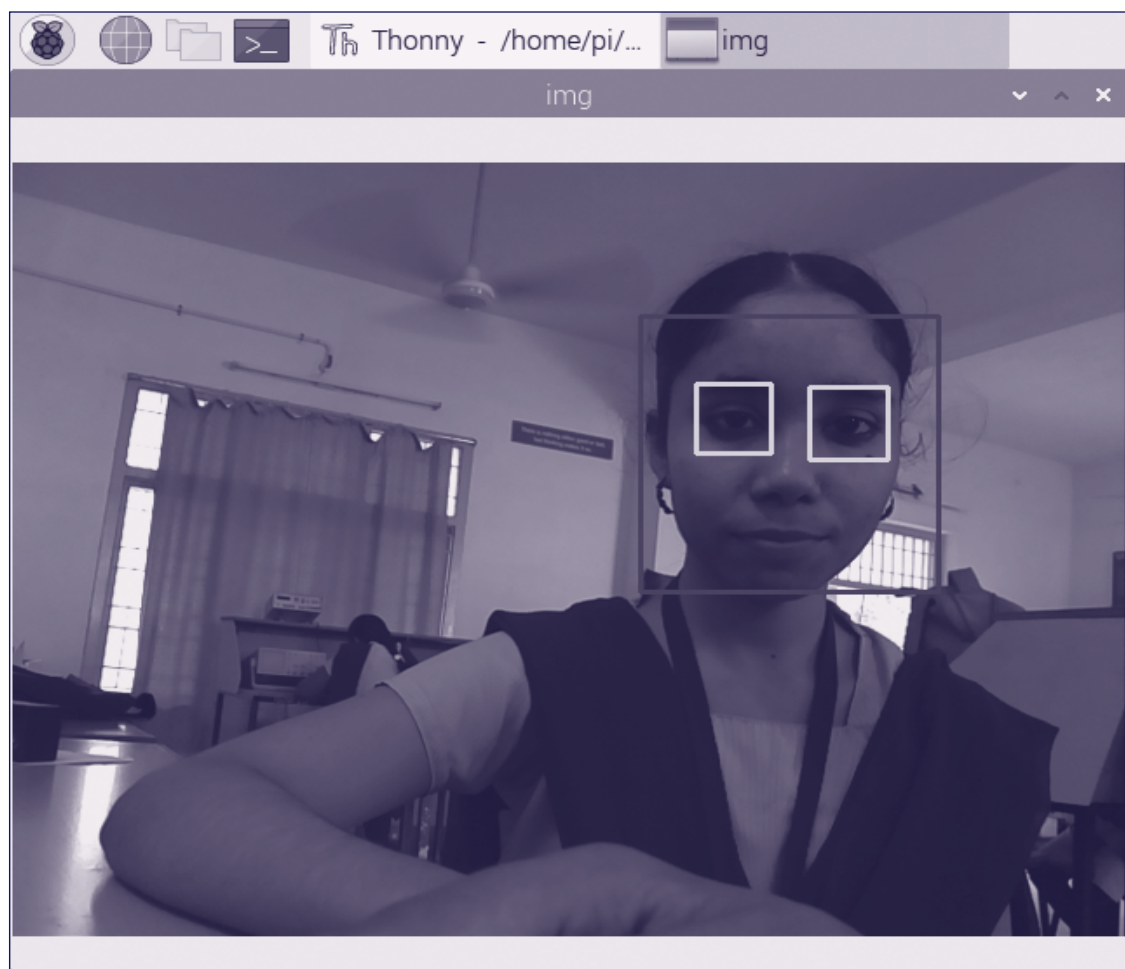
Case 1: Detect a face: Before the face going to be recognized, we need to identify facial features first. A cascade objects Detector to detect the location of a face in a video frame. The haar cascade face detection algorithm is useful to detect face as an object. Basically there are 3 steps involved in face recognition. They are Detect a Face, Identify Facial Features and Track the Face. The detected face output and the detected body output are shown in below figures.

Table 1: Testing the Face Detection Module (Same with the case of Body Detection)

Task	Steps to execute	Expected Result	Actual Result	Test Result
Detect a valid face	Start the system Ask a person to stand in front of the camera	A rectangle is formed around a face to show that it is being detected	A rectangle is formed around a face to show that it is being detected	✓
Detect multiple faces at various angles	Start the system Ask multiple people to occupy room at varying distances	Rectangle should be formed around all the faces	Rectangles are formed around all the faces	✓
Detect no faces when room is empty	Start the system Empty the room of people	No rectangles should be formed	should be formed No rectangles are formed	✓

Fig.8: Detected face

The above figure illustrates us the face recognition, where the box in green represents the face and blue colored box represents the eyes of human.

Case 2: Detect human body as object: The figure shown is full body detection made with the help of Haar cascade file. It allows us to detect a human body and to analyze object detection systems in new ways. It can detect human full body by its shape using haar cascade detection algorithm and it is shown in the following

Fig.9: Human Body Detection

6. RESULTS

Each sub-system was implemented and tested separately in the first instance. Subsequently, all the features were integrated into a single automation s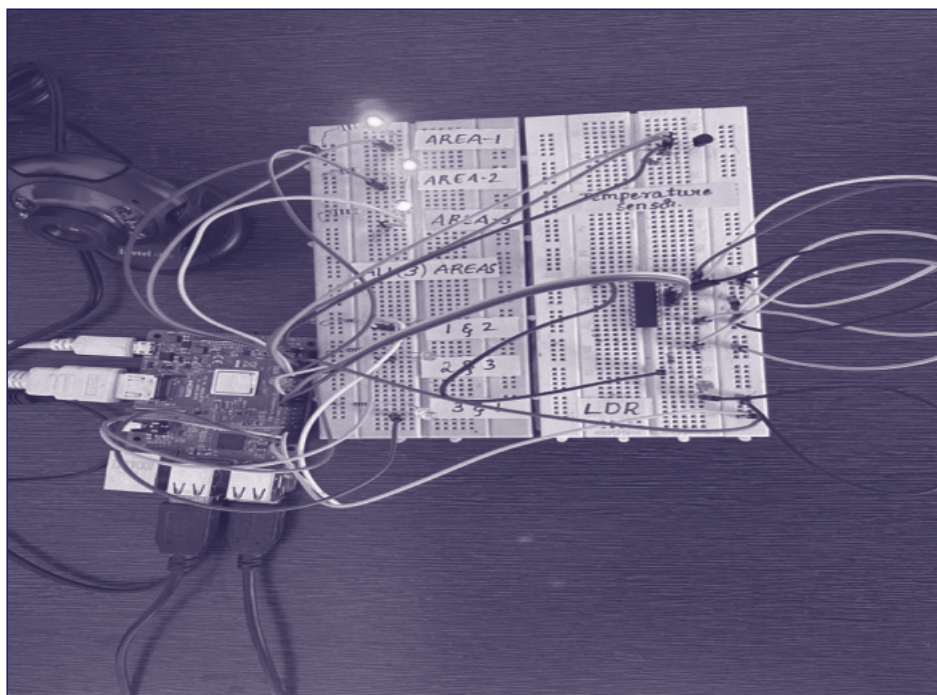ystem that provides its occupants with improved security, a better standard of living, enhanced energy efficiency. The system was tested exhaustively and various circumstances were simulated to ensure the home automation system works as intended.

Fig.10: Human Detection in all the areas

The above figure shows us the different areas where the human are present, the boxes in the blue represents the face and the boxes in green represents the eye of the human.

Fig.11: Output Shown in the kit using LEDs

In this figure we can be able to detect the presence of human with the help of LEDs, which will turn on whenever there is human presence, otherwise the lights will not indicate.

7. CONCLUSION

The proposed methodology can be implemented in real time and is reliable in automatic controlling of lights without any human intervention The proposed methodology can be implemented in real time and is reliable in automatic controlling of lights without any human intervention. And because of the usage of image processing technique, a visual representation can also be captured and it can be further used for security purposes and this video can also be accessed by a remote computer. This approach requires cameras to be installed in the rooms where the mechanism is to be implemented if any existing camera based surveillance is not already implemented. Using existing cameras greatly reduces the hardware cost required for implementation.

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