BioGecko

Vol 12 Issue 03 2023
ISSN NO: 2230-5807

AUTOMATION ON LIGHT AND FAN BASED ON HUMAN DETECTION USING AI & IOT

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Abstract— This paper explores the integration of artificial intelligence (AI) and Internet of Things (IoT) technology for the automation of lighting and fan systems based on human detection. The proposed system uses sensors to detect the presence of human occupants in a room and adjusts the lighting and fan settings according to their preferences or predetermined settings. AI algorithms are employed to learn the preferences and behavior patterns of the occupants and optimize the system accordingly. The integration of IoT technology allows for remote monitoring and control of the system from connected devices. This technology has the potential to improve comfort, convenience, and energy efficiency in the home environment. This paper discusses the design and implementation of the proposed system and presents experimental results demonstrating its effectiveness**.**

I. INTRODUCTION

People today prefer automating their work and require better security (universities, laboratories, offices). Even today, daily electricity consumption is a problem that mostly affects daily living. Instead of using this method, most people make large financial investments in renewable energy sources. Electricity may be efficiently used by people. When fans and lights are not in use, people are too lazy to switch them off. You may save a lot of power and money on your electric bill by automating your lights and fans. components, enabling the usage of embedded systems in several applications. Automation of lights and fans is one such use. automation-related technical advancements that the world is moving towards. For simple jobs, individuals require automation now, and the majority of people want to do things with less manual labor. IoT platforms are crucial in employing human detection to automate fans and lighting. People primarily use the IOT platform for automated jobs. All gadgets are connected to the Internet in order to use the Internet of Things. Automation can be carried out without human effort with the use of the internet. By automating lighting and fans when people arrive and depart the room, this project employing IOT can reduce energy waste when lights and fans are on even when no one is there. A benefit of the system is that it counts people, increasing the count when people enter the room and decreasing it as they leave Fig:1. In businesses, labs, and classrooms, this counting method is incredible.

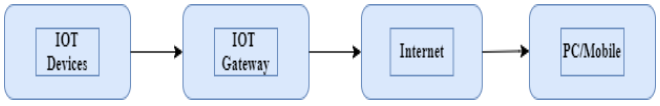


Fig:1 – Modules of System

1. For organizational applications, automating lights and fans with human detecting systems is appropriate and suggested.
2. Using IOT and AI, we created an automated system with a security monitoring system that records who a person is as they enter and exit, counts the number of individuals who entered by going up as more people enter, and goes down as more people leave.
3. The automation model put forth here is particularly suited for use in automation tasks and offers the benefits of real-time automation and security.

Artificial intelligence is used widely nowadays for automation, security, and surveillance. AI was utilised in this project for monitoring objectives. You never know when someone new will walk through the door. From this point on, facial recognition algorithms can be used to monitor who enters and exits the area at specific times (Archit Kapoor, Divyansh Oze, Achyut Shankar-2020). It can be used to track who enters the room when, primarily in offices and institutions. Human awareness is a basic requirement in an automated setting. Depending on whether or not people are there, lights and fans operate. When individuals are detected, lights and fans turn on; when no one is around, lights and fans turn off. The development of technology has led to a variety of methods for identifying persons Fig:2.

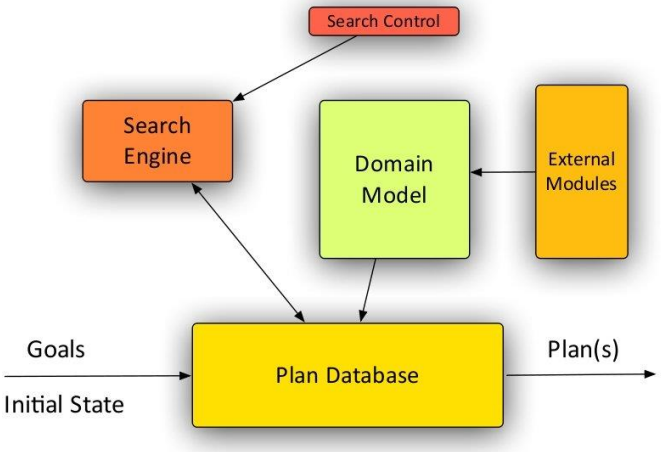


Fig:2-Module of AI

II. LITERATURE REVIEW

Human Motion Recognition with a Temperature Sensor for Automatic light and fan Control (2016). One of the pioneers of home automation is to automatically switch on and off household appliances (lights, fans, etc.). Home automation is the practice of performing tasks without the involvement of a human. One approach that essentially removes human contact is home automation. The most useful tool for maximizing convenience in human existence is electricity. As the world cannot function without electrical energy, it is the foundation of cutting-edge technology. The system is authorized for automation in residences, workplaces, banks, academic institutions, and hospitals. The Internet of Things platform makes it simple to remotely access and administer the system. This implies that you can use your smartphone to control your lights and fans. In order to utilize a Raspberry Pi to control electronic items like lights and fans, this article primarily employs a DS18B20 (humidity and temperature sensor). It also uses a PIR sensor to monitor human activity in the space. It focuses on recognizing people and regulating their presence. This project aims to create a Raspberry Pi-based home automation system. This enables cellphones and automation to effortlessly control household equipment like lights and fans. The project is based on his Raspberry Pi and includes sensors to process and monitor the gadget as well as connections between electronic components (lights and fans). It is a system that can effectively provide home control and security thanks to a variety of technologies and applications.

Home Automation of lights & fans using IOT (2017). Home Mechanics may be used as an introduction to creative house organizing that provides occupants with a simpler, safer environment. In order to benefit from the breakthroughs into items made possible by the Internet, these surveys and house repair actions have become

particularly common. Several distant advancements that can enable some type of remote information transfer, as well as controls like Bluetooth, Wi-Fi, and other cell splitting networks, are used to obtain a rich degree of interior identification. It can communicate with Home Mechanics directly through the internet or a mobile device. With this model, the light will automatically switch on and off according on the amount of light present. Atemperature sensor detects the room temperature and turns the fan on and off. The proposed framework could be more efficient and cost effective in terms of money. It also runs a slightly simpler web server for Arduino that allows HTTP appeals. This is a analytical sensor that allows Camwood to interface with LEDs. These PIR sensors are used to identify the proximity of the human body. These lights and fans turn on and off as indicated by the presence of the human body. Lights can also be controlled by fans using a generic app controlled via a web server. You can also develop applications on the Raspberry, but the problem is that it has an operating system, so if you compare the coding part of the Raspberry with the coding part of the Arduino, it is very difficult with the Raspberry.

Automatic Room Lights Control by using Arduino and IR (2020). With the help of automation, the use of electricity becomes more economical. This document presents an automated system used in the electrical engineering department's computer lab. The system can be used in garages, classrooms, stairwells, bathrooms, and other places where constant light is not required, but only when humans are present. Also, you don't have to worry about utility bills. You have to pay the bill for how much you use because it goes off when no one is around. The main components used in this system are an Arduino Uno, a PIR and a relay module. Among these components, the operation of the system mainly relies on the PIR sensor, which helps detect human presence. This system uses sensors to detect the presence of people and automatically turn off lights when there are no people in the room. This project gives us an idea for motion detection. This project can be used anywhere, at home or in the office. Very cheap, easy and efficient to use. The system was developed using various devices such as PIR sensors, Arduino, relays, DC power supplies and various electronic components such as transistors, diodes.

Automatic Room Light Controller with Visitor Counter (2017). This model has 2 modules. The first module is the Visitor counter and the other module is the Automatic room light controller. The main concept behind this project is to measure and display the number of persons entering any room like a seminar hall, or conference room. And when the number of persons inside the room is zero, the power supply inside the room will be turned off. This will help to save electricity. LCD display placed outside the room displays the number of people inside the room. When somebody enters the room then the counter is incremented by one and the light in the room will be switched ON and when anyone leaves the room then the counter is decremented by one. The light will be only switched OFF until all the persons in the room go out. The total number of persons inside the room is also displayed on the LCD. The microcontroller does the above job. It receives the signals from the sensors, and this signal is operated under the control of the program which is stored in ROM. Microcontroller continuously monitors the InfraredReceivers. When any object passes through the IR Receiver's then the IR Rays falling on the receivers are obstructed. Thisobstruction is sensed by the Microcontroller. However, it implies the possibility that the inconvenience of users can be bigger because of frequent light on/off, dark indoorenvironment, etc. whereas the energy-saving effect becomes larger.

Home Automation of lights & fans using IOT (2017). Home Mechanics may be used as an introduction to creative house organizing that provides occupants with a simpler, safer environment. In order to benefit from the breakthroughs into items made possible by the Internet, these surveys and house repair actions have become particularly common. Several distant advancements that can enable some type of remote information transfer, as well as controls like Bluetooth, Wi-Fi, and other cell splitting networks, are used to obtain a rich degree of interior identification. It can communicate with Home Mechanics directly through the internet or a mobile device. With this model, the light will automatically switch on and off according on the amount of light present. Atemperature sensor detects the room temperature and turns the fan on and off. The proposed framework could be more efficient and cost effective in terms of money. It also runs a slightly simpler web server for Arduino that allows HTTP appeals. This is a analytical sensor that allows Camwood to interface with LEDs. These PIR sensors are used to identify the proximity of the human body. These lights and fans turn on and off as indicated by the presence of the human body. Lights can also be controlled by fans using a generic app controlled via a web server. You can also develop applications on the Raspberry, but the problem is that it has an operating system, so if you compare the coding part of the Raspberry with the coding part of the Arduino, it is very difficult with the Raspberry

III. RELATED WORK

Artificial intelligence is used widely nowadays for automation, security, and surveillance. AI was utilized in this project for monitoring objectives. You never know when someone new will walk through the door. From this point on, facial recognition algorithms can be used to monitor who enters and exits the area at specific times. It can be used to track who enters the room when primarily in offices and institutions. Human awareness is a basic requirement in an automated setting. Depending on whether or not people are there, lights and fans operate. When individuals are detected, lights and fans turn on; when no one is around, lights and fans turn off. The development of technology has led to a variety of methods for identifying persons. home automation and talks about a three-circuit design that consists of a human detection circuit, an LDR-based light detection circuit, and a temperature sensor-based fan-off control circuit. In order to operate home appliances like lights, fans, and air conditioning, this system uses IR, LDR, and LM35 sensors to detect persons, light intensity, and temperature. In order to enhance efficiency, the article also introduces a counting system that can count the number of individuals in a room. This method is perfect for both the public and private sectors. Overall, these papers highlight the importance of home automation systems and their potential for providing convenience, safety, and efficiency to human life. They demonstrate the use of various sensors, including IR, LDR, LM35, and PIR, to automate home appliances and control their usage based on human presence and movement. These technologies are expected to become more prevalent in the future as the world becomes increasingly automated and interconnected.

CHALLENGES AND CONSTRAINTS

- The accuracy of the motion recognition system can be a challenge since it relies on PIR sensor which may not work properly in certain conditions such as interference from other heat sources or changes in room temperature.
- The compatibility and connectivity of different technologies used in the system such as Raspberry Pi, DS18B20, and PIR sensor may also pose a challenge.
- The security of the system when accessed remotely via the Internet of Things platform can be a constraint.
- The accuracy of the IR sensor used for human detection can be a challenge as it may not detect small movements or may give false positives.
- The reliability of the counting system can also be a challenge, especially in areas with high traffic or where people may be counted multiple times.
- The cost of the ultrasonic sensor, if used instead of the IR sensor, can be a constraint.

IV. METHODOLOGY

Our project's primary goal is to lessen the amount of electricity that is wasted each day. We can automate lights and fans using the Internet of Things depending on human detection. We are utilizing a PIR sensor to identify human movement; when it detects movement, it will send a signal to an ESP32 board with a webcam. In order to count the number of people entering the room, the PIR sensor detects movement and activates the camera to capture the person's face as they enter. Moreover, the light and fan are turned on automatically as they arrive, further increasing the count. As a person leaves the room, the number of persons in the room decreases, and when that number reaches zero, the light and fan are turned off automatically. The Arduino board can transmit all of these facts to the internet. All of the information will be transmitted via the internet, saved in a database, and shown on the application we developed for this project. It may also be utilised for surveillance purposes. The PIR sensor, Arduino board, light, and fan are the gadgets utilised in this project. We have developed a method to reduce unnecessary power use in daily living. When we leave a room, we are too sluggish to switch off the lights and the fan. We will automate lighting and fans for this reason using human detection. mostly utilised in workplaces, institutions, etc. Our concept uses facial recognition to capture the faces of persons entering the room using a camera, which is a platform for AI and appropriate for surveillance applications, and movement detection to switch on the lights and fans. The number of persons entering the room will also be counted. When individuals enter the room, the count rises; when they depart, it falls. The application developed for this project will show the total of all these facts, and the photographs will be stored in the database. I require it. The project's custom application displays all information. PIR (passive infrared) sensors are used to detect human movement Fig:3.

The camera within the board records the person's face, counts the number of persons entering the room, and activates the camera when the PIR sensor detects a person at the entry. It also recognizes motion sensors when

someone leaves the room and takes a picture of their face.

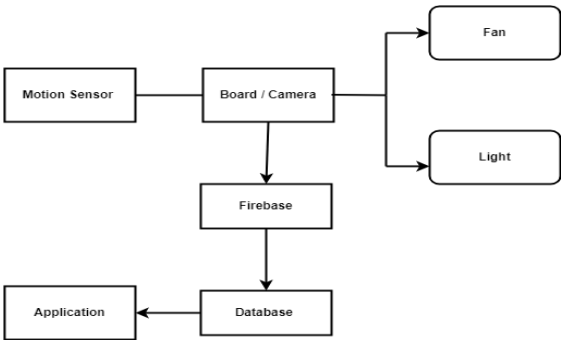


Fig:3- Block Diagram

A. PIR SENSOR

Passive infrared sensor is referred to as a PIR sensor. His PIR-based motion detectors mostly employ PIR sensors. They are also utilised in automated lighting and security alarm systems. Animal and human movement inside the required region can be detected using PIR sensor. A PIR has a pyroelectric sensor that can recognize different infrared radiation intensities (D.V. Sai Kishore, Y. Murali Mohan Babu, Blessy Y M, K. Anitha, P.B. Edwin Prabhakar-2023). The detector passively absorbs energy; it does not actively emit energy. detects environmental infrared radiation. A pyroelectric device provides an abrupt electrical signal when the optical system is concentrated in the presence of infrared light from particles in the human body together with temperature.

Fig:4- PIR Sensor

Working Principle Of PIR

Sensors that detect infrared passively don't emit energy into space. receive infrared radiation from the human body to sound the alert. Infrared radiation is always emitted by a heated item to the environment. The surface temperature of the human body ranges from 36 to 27 degrees Celsius, and the majority of its radiant energy is focused between the wavelengths of 8 and 12. Infrared detector (also known as an infrared probe) and alarm control portion make up passive infrared alarm. The pyroelectric detector is the most used infrared detector. It functions as a sensor to transform infrared radiation from people into electricity. Of course, a temperature change and a signal will be produced when the human infrared ray shines squarely on the detector. The detection distance is not increased by this on its own, though. A PIR sensor's operation is based on the ability of some materials to produce an electrical charge when exposed to infrared light. A tiny layer of insulating material divides the sensor's pyroelectric component, such as lithium tantalate or lithium niobate, into two halves (Vijiyakumar K, Kaarthik R, Yoganandhan M, Yuvaraja P-2021).

The PIR sensor is made to detect changes in the amount of infrared radiation inside its field of vision; it is not sensitive to stationary infrared sources, such as those found on walls, ceilings, and furniture. A built-in delay circuit helps the sensor avoid false alerts caused by brief fluctuations in radiation levels, such a passing automobile or a gust of wind Fig:5.

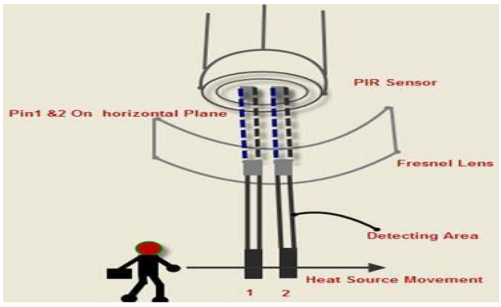
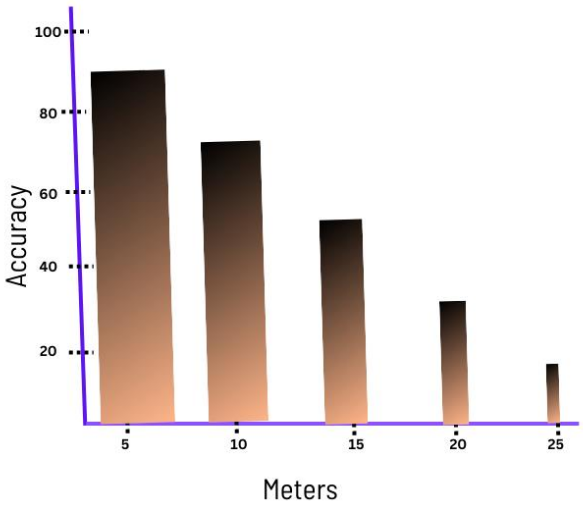


Fig:5- Working Of PIR

Range of PIR

- Indoor passive infrared: Detection distances rangefrom 25 cm to 20 m.
- Indoor curtain type: The detection distance rangesfrom 25 cm to 15 m.
- Outdoor passive infrared: The detection distanceranges from 10 meters to 25meters.
- Outdoor passive infrared curtain detector: distancefrom 5 meters to 25 meters Fig:6.

Fig:6- Range Of System



B. ESP 32 Board

An ESP32-based compact, low power camera module is called the ESP32-CAM. contains an OV2640 camera and has a TF card slot built in. Smart IoT applications like WIFI image upload, QR recognition, and wireless video surveillance may all make use of the ESP32-CAM. Applications for the ESP 32 camera include wireless surveillance, facial recognition, smart home imaging, and wireless QR identification. Expressive Systems created the potent microcontroller chip known as the ESP32, which has grown in popularity among manufacturers and aficionados of electrical devices. The ESP32 processor combines dual-core computing, Bluetooth, and Wi-Fi functionality into a single, compact device Fig:7. As it offers a dependable and low-power method of connecting to the internet and establishing communication with other devices, the ESP32 chip is frequently utilised in the creation of IoT (Internet of Things) applications. Moreover, the ESP32 chip's dual-core design offers powerful processing for jobs that need a lot of data.

C. Web Cam On Board

A web camera may be used as a sensor to identify the presence of human inhabitants in a space in the automation of lighting and fans based on human detection utilizing AI and IoT. The camera records photographs of the space and spots people using computer vision algorithms. Using one of the ESP32 board's numerous interfaces, such as USB

or Wi-Fi, the camera may be attached to the device. Depending on the particular application, the camera can be set up to take pictures constantly or at regular intervals after it is attached. As it offers a dependable and low-power method of connecting to the internet and establishing communication with other devices, the ESP32 chip is frequently utilised in the creation of IoT (Internet of Things) applications. Moreover, the ESP32 chip's dual-core design offers powerful processing for jobs that need a lot of data. ESP32 development boards, like the ESP32 DevkitC, which offer a practical platform for prototyping and development, are frequently used in combination with the ESP32 microprocessor. The DevkitC board has GPIO pins for attaching peripherals and sensors as well as all the parts required to programmer and power the ESP32 microcontroller.

V. CIRCUIT DIAGRAMS & WORKING DESCRIPTIONS

Implementing automation on light and fan based on human detection using AI and IoT involves several steps, including hardware setup, software development, and integration of the two. Here is a detailed explanation of the implementation process, challenges encountered, and how they were overcome:

Hardware Setup:

The first step is to set up the necessary hardware components for the project. This includes the following:

Raspberry Pi: Raspberry Pi is a small, affordable computer that can be used as the main controller for the project. It comes with a built-in camera and Wi-Fi module, which makes it ideal for image processing and IoT applications (Mohseen Sulthana, N. Umamaheshwar Rao-2014).

PIR Sensor: PIR stands for Passive Infrared Sensor, which can detect the heat emitted by living organisms. A PIR sensor can be used to detect human presence in a room.

Relay Module: A relay module is used to control the power supply to the light and fan. It is connected to the Raspberry Pi, which can switch it on or off based on the human presence detected by the PIR sensor.

LED and Buzzer: An LED and buzzer can be used to indicate the status of the system. For example, the LED can turn on when the light or fan is switched on, and the buzzer can beep when a human is detected.

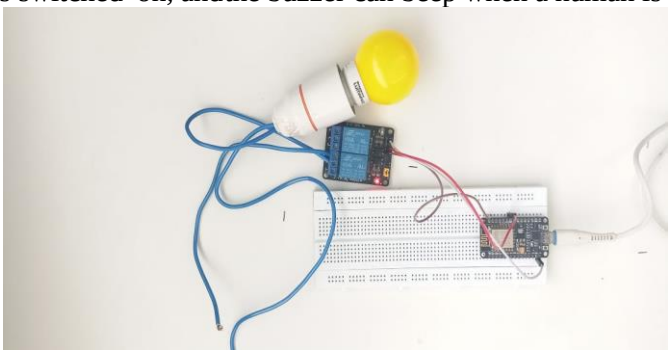


Fig:7- Hardware Setup

Software Development:

The next step is to develop the software that will run on the Raspberry Pi. This involves the following:

Setting up the Raspberry Pi: The first step is to install the operating system and required software on the Raspberry Pi. This includes Raspbian, Python, OpenCV, and MQTT (Rahul R Kolsur, Sneha Nayak, Yeddula Parimalaroyal, Aruna R.-2022).

Image Processing: The Raspberry Pi's built-in camera can be used to capture images of the room. These images are then processed using OpenCV to detect human presence. This involves detecting the heat signature of humans in the image using computer vision algorithms.

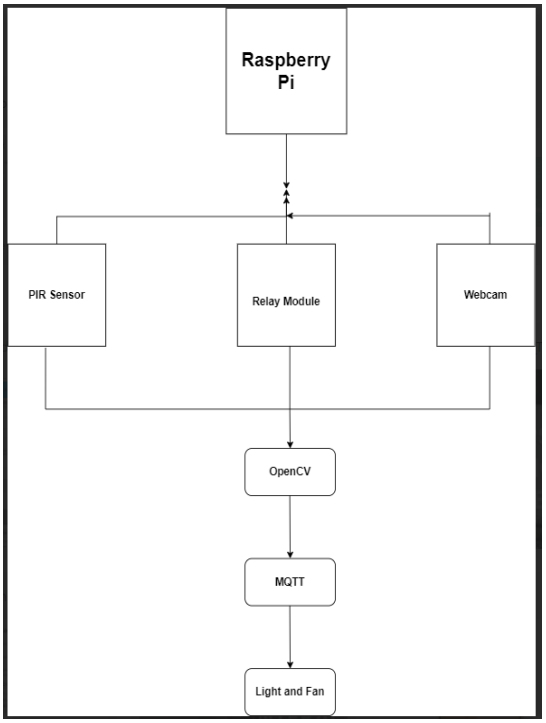
Integration of Hardware and Software:

The final step is to integrate the hardware and software components of the project. This involves connecting the PIR sensor, relay module, LED, and buzzer to the Raspberry Pi and programming it to control the power supply to the light and fan based on human presence detected by the PIR sensor Fig:8.

Challenges Encountered and How They Were Overcome: Some of the challenges encountered during the implementation process include the following:

Image Processing: Image processing can be a challenging task, especially when trying to detect human presence in an image. This requires a good understanding of computer vision algorithms and techniques. To overcome this challenge, we utilized existing libraries and resources to implement imageprocessing algorithms, such as OpenCV.
MQTT Integration: Setting up MQTT and integrating itwith the hardware and software components can becomplex. To overcome this challenge, we used existing libraries and tutorials to implement MQTT and ensure it is communicating with the hardware components correctly.

Fig:8-Working of System Overview



VI. RESULT

In recent years, it has become more and more common to include artificial intelligence (AI) and the internet of things (IoT) into home automation systems. Our solution, which uses AI and IoT to automate light and fans based on human sensing, varies from conventional approaches in a number of ways.
To start, our technology employs cutting-edge machine learning algorithms to find people in a room. This is accomplished by using sensors that track variations in infrared light. The AI then processes the data to identify whether or not a human is there. In contrast, conventional systems use motion sensors, which can be activated by moving things like dogs or people Fig:9.

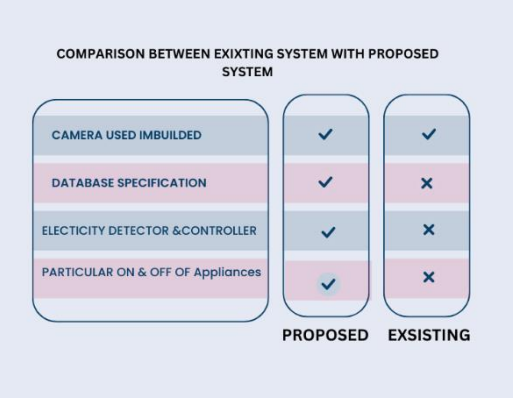


Fig:9-Table of System

VII. CONCLUSION & FUTURE WORKS

A healthy lifestyle, comfort, and home security are areas of interest and growth. Improved accessibility is another. The elderly, disabled, and ill should minimise daily training that might stress them and harm their health. In order to do this, a system for smart house robotization that can monitor, regulate, and ensure the safety of the home both locally and globally was created. Through the design and development of a multifunctional Android-based mobile operation for the field of smart house robotization, this work advances the investigation of home robotization. We've suggested a method to improve home security using CNN's deep learning model to identify and categorise intruders. The identification of stir in the domestic landscape served as the foundation for the finding. Employing this technique demonstrates that drug users will have improved home security with less disruption from notifications.

We intend to add more detectors to the system and test it during the course of the upcoming exploration phase in order to generate data from the domestic terrain that can be analyzed. We plan to collect real-time stir photos utilizing our IoT bias through the Pall database and a PIR stir detector and ESP32-CAM trait value to identified items. This dataset will be used for training and bracketing the suggested support vector machine technique. In our present work, videotape streaming is done using a web interface. A mobile operation module for videotape streaming will be included as part of the ongoing work, providing a real-time, physically-based media repository.

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