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Smart Home Automation and Analysis Using Machine Learning

Aman Shukla[1*], Masoom Shaikh[2], Jugal Paswan[3], Siddhyant Mishra[4], Baban U. Rindhe[5]
[1,2,3,4]*Student, Department of Electronics and Telecommunication Engineering, K.C. College of Engineering and Management Studies and Research, Thane, India*
[5]*Assistant Professor, Department of Electronics and Telecommunication Engineering, K.C. College of Engineering and Management Studies and Research, Thane, India*

***Abstract*: The technologies are moving rapidly towards the automation. Now, people need more comfort and want to do all the things with less efforts and less time and the solution is automation. This research paper aims to develop and design home automation using Esp32 which have inbuild Bluetooth and Wi-Fi module. Home automation with ESP32 is a rapidly growing trend in which household appliances and systems are automated to create a more convenient and efficient living environment. Because of its built-in Wi-Fi and Bluetooth connectivity, low cost, and high versatility, the ESP32 is a powerful microcontroller that is widely used in IoT projects. Overall, home automation with ESP32 is a fun and easy way to make your home more efficient and convenient. As technology advances, ESP32-based home automation systems are expected to become more sophisticated and integrated into our daily lives.**

***Keywords*: ESP32, Wi-Fi, smart phone, home automation.**

1. Introduction

[1] Home automation is the practice of managing different home gadgets and appliances through a centralized system that can be accessed from a distance. [2] Home automation aims to make household chores easier to complete, more convenient for the user, and more efficient. Microcontrollers like the ESP32 are a common approach to build home automation. [3] Powerful microcontrollers like the ESP32 are frequently employed in IoT projects like home automation. Because it has Wi-Fi and Bluetooth built in, connecting to various devices around the house is simple. [4] The ESP32 is a viable option for both professionals and hobbyists because it is also reasonably priced and has a huge developer community. [5] Home automation is a system that monitors energy usage and predicts energy consumption, allowing users to control usages accordingly.

Home automation systems can be especially beneficial for people with disabilities because they can simplify tasks that would otherwise be difficult. The use of an ESP32 microcontroller can provide a quick and inexpensive way to implement a home automation system for disabled people. These features can be especially beneficial to people with disabilities. Voice commands allow them to control devices without using their hands, while sensors detect motion or other changes in the environment and adjust the home automation system accordingly. This can make it easier for them to navigate their home and perform daily tasks on their own.

2. Literature Survey

We have referred different international papers and journals in which we came to know that various methods were used by different authors. With the help of the previous done works from the above papers we were able to build this project. Below are some authors and their proposed methodology and their limitations.

[1] IoT Based Intelligent Domotic System Using Arduino ESP32.

This paper presents a low cost and flexible home control and environment monitoring system. It employs an embedded micro-web server in ESP32 for accessing and controlling devices and appliances remotely. To demonstrate the flexibility and effectiveness of this system, devices such as switches, power plug temperature sensor, gas sensor, motion sensor etc., have been integrated with proposed home control system. Therefore, this system has been successfully designed and implemented in real time.

[2] Research Paper for Smart Home Automation System using ESP32 with Blynk, IR Remote & Manual control Relay, IoT Project.

This paper presents an idea or a concept for home automation using ESP32 with Blynk, IR remote and manual switch to control 8relays with and without internet and monitor the real time feedback in the Blynk app. Automation of device has a wide scope for this generation as well as in forthcoming generation. In this mobile communication technology is playing a major role in the world of automation.

[3] Smart Home Monitoring System Using ESP32 Microcontrollers.

The system is designed using IoT modules and uses ESP32 microcontrollers. The chapter describes the design of the system, its hardware components, software implementation, security solutions, communication, the collecting and monitoring of processed data, as well as the quantification of costs for the production and deployment of this system.

[4] Research paper on Bluetooth based Home Automation

*Corresponding author: shuklamanju70@gmail.com

using Arduino.

The world is moving fastly towards automation. People have less time to handle any work so automation is simple way to handle any device or machine will work to our desire. This paper aim is to develop and design a home automation using Arduino with Bluetooth module. Home automation system gives a simple and reliable technology with Android application. Home appliances like fan, Bulb, AC, automatic door lock is controlled by home automation system using Arduino Uno with Bluetooth module. The paper mainly focuses on the monitor and control of smart home by Android phone and provide a security based smart home, when the people does not present at home. This paper motive is controlled home appliances in smart home with user friendly, design at low cost, simple installation

[5] Bluetooth based Home Automation using Arduino.

This research paper aims to provided information about Arduino Uno, Bluetooth controller and relay module. And the information about their work is given. Along with the component of home automation, its advantage has also been discussed. The system is easy and secured for access from ant user or intruder.

[6] Interfacing of MATLAB with Arduino for Human Face Recognition Algorithm Implementation using Serial Communication.

By using Face Recognition and data communication, the state of Arduino board pin has been controlled. MATLAB programming develops a computer vision system in the real time for face detection and tracking using camera as image acquisition hardware.

[7] Smart Energy Efficient Home Automation System using IoT.

This paper presents a step-by-step procedure of a smart home automation controller. It uses IOT to convert home appliances to smart and intelligent devices, with the help of design control. To ensure, that the Wi-Fi connection do not turn off, the main controller is programmed to establish automatic connection with the available network and connected to the auto power backup.

[8] IoT Based Smart Security and Home Automation.

This paper focuses on a system that provides features of Home Automation relying on IOT to operate easily, in addition to that it includes a camera module and provides home security. The smart home consists two modules. Home automation that consists; fan light and door controller, and security module that consists; smoke sensor motion sensor and camera module.

3. System Overview

A. Project Overview

First, Home automation with ESP32 is a new technology that allows people to remotely control various aspects of their homes via a microcontroller board called ESP32.

Users can use their smartphones, tablets, or other electronic devices to control and automate home appliances and systems such as lights, air conditioning, heating, door locks, and security systems. Home automation with ESP32 offers a number of advantages, including convenience, energy efficiency, and security. Users can control their homes remotely from anywhere, at any time, and automate tasks to save time and energy. Users, for example, can programmed their thermostats to turn off when they leave the house or have their lights turn on automatically at sunset.

B. Overview of Architecture

The Android smartphone is used as a user as a user control device; end users use this to control various devices. The ESP32-WROOM-32 is a credit card sized single-board computer with an open-source platform that has a thriving community of its own, similar to that of the Arduino. It can be used in various types of projects from beginners learning how to code to project designing home automation System. In this project, ESP32-WROOM-32 is used as the master device (Fig. 1).

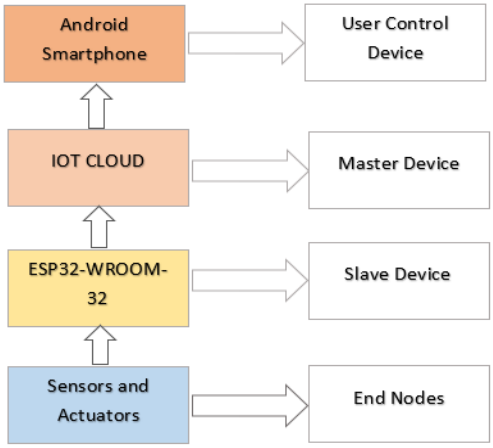

Fig. 1. System architecture

4. Proposed Method/System

A. Self-Block Diagram

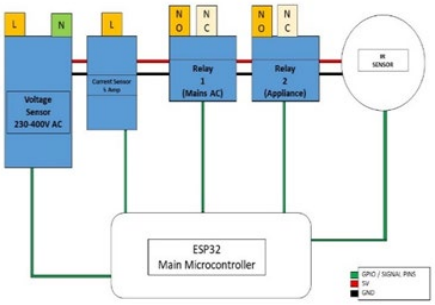

Fig. 2. Block diagram

B. Working

The project involves using an IR sensor to detect the presence of an object and turn on a relay for 10 seconds. Additionally, a voltage sensor (ZMPT10) and current sensor will be used to measure the power consumption of the AC appliance. The data collected from these sensors will be sent to Thing speak, a cloud-based platform for IoT projects, using the ESP32 microcontroller.

The main objective of this project is to save energy by only turning on the AC appliance when someone enters the room. The system is designed to be user-friendly, allowing the user to turn off the appliance remotely using a mobile app.

The IR sensor will be mounted at the entrance of the room, and it will detect any object that enters the room. When the sensor detects an object, it will trigger the relay for 10 seconds, turning on the AC appliance.

Meanwhile, the voltage sensor and current sensor will measure the power consumed by the appliance. The ESP32 microcontroller will collect the data from the sensors and transmit it to the Thing speak platform over Wi-Fi.

The user can access the Thing speak platform using a mobile app and monitor the power consumption of the AC appliance. If the user wants to turn off the appliance remotely, they can do so using the app. The app will send a signal to the ESP32 microcontroller, which will turn off the relay, and the appliance will stop consuming power.

5. Implementation

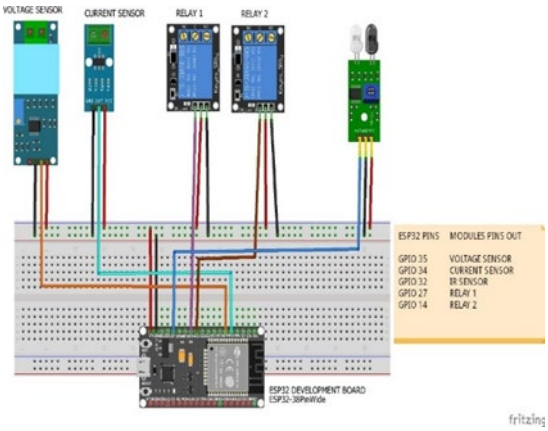

Fig. 3. Circuit diagram

A. Hardware

1) ESP32-WROOM-32

The ESP32-WROOM-32 is a robust, generic Wi-Fi + Bluetooth + Bluetooth Low Energy MCU module designed for a wide range of applications, from low-power sensor networks to the most demanding activities like voice encoding, music streaming, and MP3 decoding.

2) Voltage sensor

A voltage sensor is a sensor that measures and calculates the amount of voltage in an object. Voltage sensors can detect either AC or DC voltage levels. This sensor's input is voltage, and its output is a switch, analogue voltage signal, current signal, or audible signal.

3) IR sensor

An IR sensor, also known as an infrared sensor, is a device that detects and measures infrared radiation. Infrared radiation is a type of electromagnetic radiation with a longer wavelength than visible light that is commonly used in sensing applications due to its ability to penetrate smoke, dust, and other obscuring materials.

4) Relay module

Relay Modul is a relay interface board, it can be controlled directly by a wide range of microcontrollers such as Arduino, AVR, PIC, ARM and so on. It uses a low-level triggered control signal (3.3-5 VDC) to control the relay.

5) Current sensor

A current sensor is a sensor that measures the flow of electric current in a circuit. It is commonly used to monitor and control the flow of current in electrical systems and can be found in a wide range of devices, including power supplies and battery chargers, as well as motor control circuits and electronic appliances.

Current sensors detect the magnetic field produced by the flow of electric current through a conductor. They are typically connected in series with the current-carrying conductor, and the magnetic field generated by the current induces a voltage in the sensor, which can be measured and used to determine the current flow.

B. Software Used and Software Application

1) Machine learning working

The ability to collect and analyses data is critical in today's data-driven environment. The integration of sensors and microcontrollers has enabled the collection and processing of massive volumes of data in real time.

We can acquire insights into energy usage patterns that would have been difficult to obtain otherwise by utilizing a sensor to gather light consumption data and a microcontroller to process it. Using this data, we can forecast future months' light use and bills using a variety of machine learning algorithms.

Machine learning models utilize complex algorithms to analyze patterns in enormous data sets, allowing them to predict future events with great accuracy. We can evaluate and contrast different predictions by employing multiple machine learning models to arrive at the best accurate forecast.

With these forecasts, businesses and individuals may plan and budget for future energy bills, allowing them to save money while simultaneously decreasing their environmental effect. Overall, the integration of sensors, microcontrollers, and machine learning has revolutionized the way we manage and utilizes energy, resulting in a more efficient and sustainable future.

2) MIT app inventor

Here, our team has developed an innovative app that allows people with physical disabilities to control all of their appliances from their smartphone or tablet.

This app makes use of the ESP32 microcontroller and Wi-Fi technology to give users access to all of their connected appliances from the comfort of their mobile device.

Using MIT App Inventor, our team created a user-friendly application for controlling various household appliances. Users can use this app to easily turn on/off their devices, set timers, and customize schedules based on their preferences. The app integrates seamlessly with multiple smart home devices, allowing users to manage all of their appliances from a single interface. It also provides real-time energy usage monitoring,

assisting users in lowering their electricity bills and contributing to a greener environment. Overall, our application is a dependable and convenient solution for managing home appliances, improving users comfort and convenience.

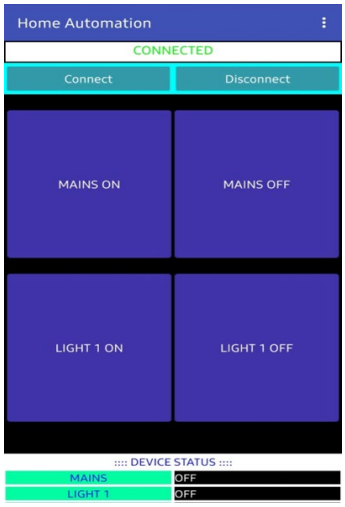

Fig. 4. App (on MIT app inventor)

6. Results

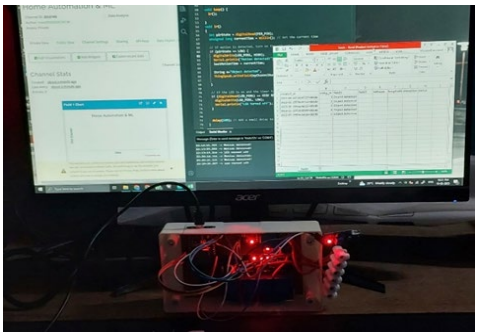

Fig. 5.

Our project on home automation with ESP32 and machine learning was a huge success. We are pleased to inform you that our system has numerous applications for every appliance in your home. The voltage sensor, which can accurately monitor the amount of electricity used in a given month, is one of our project's most notable features. It can also track overall current consumption and store it in an Excel sheet for monitoring purposes.

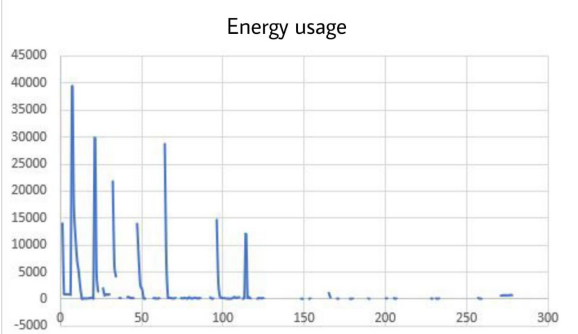

Fig. 6. Energy usage

Our project on home automation with ESP32 and machine learning was a success, with the voltage sensor being the most notable feature. It can accurately monitor electricity usage and store it in an Excel sheet for monitoring purposes.

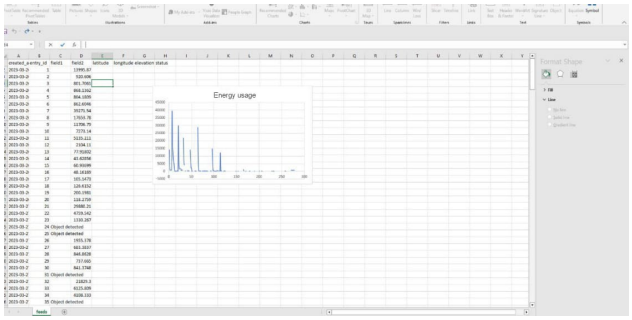

Fig. 7.

We collect data from the sensor via a microcontroller and use it to predict future light consumption and bills for upcoming months using multiple machine learning models.

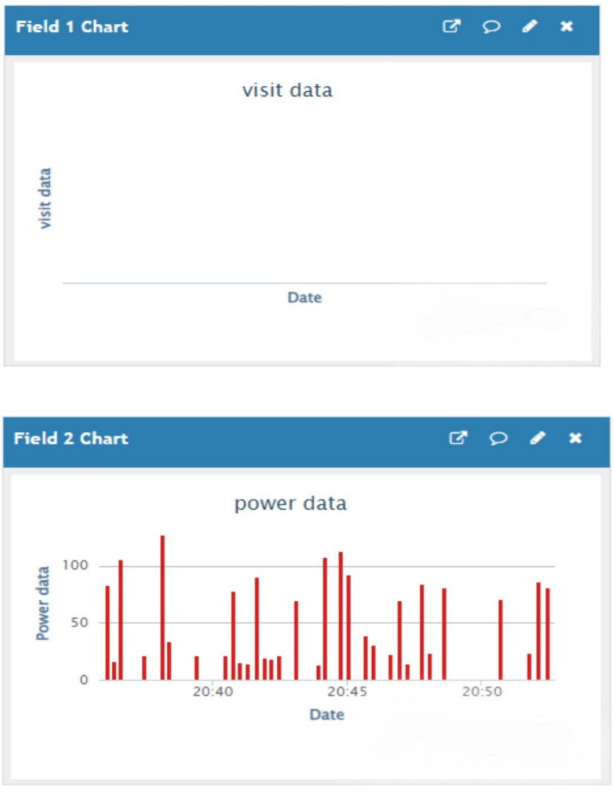

Fig. 8. power consumption graph and data visit graph

Using this data, we can forecast future months' light use and bills using a variety of machine learning algorithms.

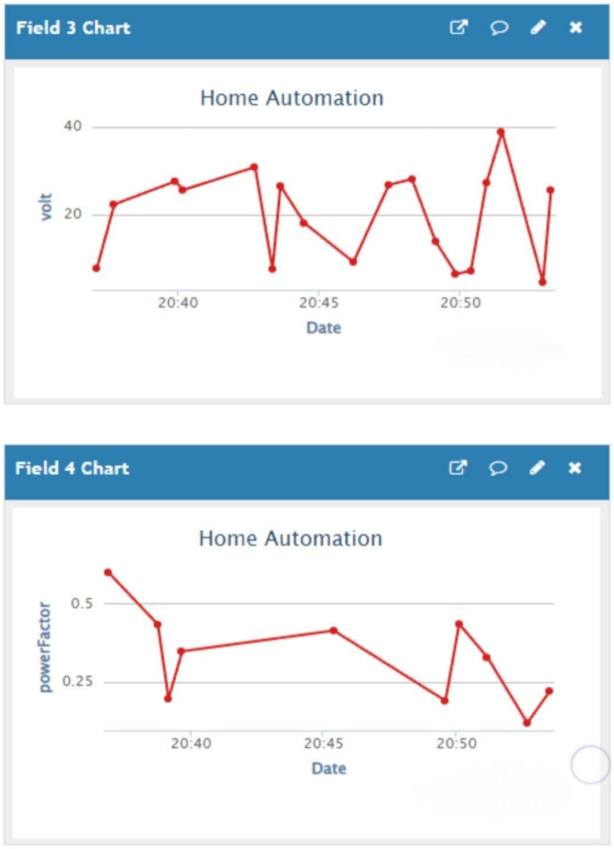

Fig. 9. Volt and power factor graph

7. Conclusion

The home robotization system has been experimentally proven to work satisfied by connecting appliances to it and the operation were successfully controlled from a wireless mobile device. We learned numerous chops similar as soldering wiring the circuit and other tools that we use for this design and was suitable to work together as a platoon during this design likewise, Home robotization grounded on ESP32 and machine literacy has a promising future because it has the implicit to bring new situations of intelligence and robotization to our homes. The home robotization system has been experimentally demonstrated to perform well by connecting appliances to it, and the operation has been successfully controlled from a wireless mobile device. We learnt colorful chops, similar as soldering, wiring the circuit, and using other outfit for this design, and we were suitable to work as a platoon throughout this design. likewise, home robotization grounded on ESP32 and machine literacy has a promising future since it has the capability to bring new situations of intelligence and robotization to our homes. Home robotization systems can learn a home's energy consumption patterns and optimize energy operation using machine literacy algorithms. This could affect in substantial energy savings and lower mileage bills. Machine literacy algorithms can be used to prognosticate when a device or appliance will fail, allowing homeowners to take preventative measures to avoid expensive repairs. The ESP32 can be used to cover bias and notify druggies when conservation is needed.

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