Home Automation and Security System Using ESP32

Suhani Gupta[1], Aditi Srivastava[2], Ritika Srivastava[3], Parul Tiwari[4]

B.Tech. Scholar, ECE Department BBDITM, Lucknow, U.P.-226028,

Rajeev Singh

Assistant Professor, Department of ECE BBDITM Lucknow, U.P.-226028

***Abstract*— Contemporary society demonstrates progressive enhancement every passing day. Among the most auspicious breakthroughs in present-day technology is the implementation of home automation systems. The swift progress in technological advancements and automation has considerably simplified human existence. This undertaking involves the creation of an innovative intelligent household accompanied by an enhanced safeguarding mechanism through IoT and sensors. Users can conveniently regulate and oversee the system through web-based interfaces or smartphone applications such as the Arduino Bluetooth Control app. The principle aim of this project is to devise a cost-effective home automation and security system for smart homes, thereby guaranteeing an improved quality of life for individuals and their families, especially for elderly and disabled people.**

Keywords*— *home automation, web-based interface, Arduino Bluetooth Control, IoT, sensors.

I. INTRODUCTION

The primary focus of this research project revolves around the implementation of a robust smart home security and automation system. The concept of home automation and its emphasis on safety emerged in the late 1970s; however, as technology has advanced over time, our perceptions and expectations of home automation and its security systems have evolved significantly. When examining various home automation systems, it becomes evident that their primary objective has consistently been to offer residents efficient and convenient means of accessing their dwellings while prioritizing safety.

[1]. Home automation using the Internet of Things is much more beneficial for some reasons [2].

- Less installation cost.
- wide range control of appliances.
- Less power consumption and hence energy saving.-
- Easy to control and access able to smartphones or other devices.

In this research paper, a cost-effective smart home automation and security system is presented to significantly the quality of human life. In the contemporary era, individuals are increasingly prioritizing their home security concerns, given the alarming rise in crime rates across the globe. Domestic violence against women and children has become a crucial issue during the past few years. Manusher Jonno Foundation (MJF) is a human rights foundation of Bangladesh that has surveyed that, during the lockdown for the coronavirus pandemic a total of 4,249 women and 456 children were the victims of domestic violence in 27 selected districts of Bangladesh. them, 1,672 women and 424 children faced violence for the first time during this lockdown [3]. Crimes like kidnapping, burglary, robbery, rape, and child abuse have become a common scenario in Bangladesh. It makes us more concerned about the safety of our family. So, we have tried to find a feasible solution.

The primary objective of contemporary security systems is to detect any unauthorized entry into a residence, promptly alert the homeowner of the intrusion or attempted breach, prevent the intruder from gaining entry, and gather substantial evidence related to the incident. The swift progress of technology has revolutionized the notion of home security. Traditional lock and key mechanisms have been replaced by advanced systems encompassing cameras, diverse contact sensors, proximity sensors, and Bluetooth technology, among others. Modern households are now seamlessly connected to the internet, granting users remote control and access to their homes from any location worldwide [1]. The overarching aim of this proposed system is to construct a cost-effective automation and security solution that guarantees the protection of both our household and our loved ones.

II. OBJECTIVE

The aim is to design a prototype that establishes wireless remote control over a network of home appliances. The application is designed to run on an Android device providing features like voice command control, live streaming for security, LPG gas detection, remote control, temperature, humidity, etc. If the Wi-Fi is available, ESP32 will automatically connect with the Wi-Fi. Using day-to-day gadgets, we can utilize them for a different perspective.

III. SCOPE

The overall scope of this integrated system is to provide homeowners with a comprehensive and user-friendly home automation and security solution. It encompasses features such as remote control via voice commands, real-time video monitoring, environmental monitoring, and object detection for enhanced security measures. The system's potential for further expansion and integration with additional sensors or technologies allows for future scalability and customization to meet specific homeowner needs.

IV. RELATED WORKS

Studies on home automation and security systems have been actively pursued ever since the inception of the concept. The primary aims of these investigations encompass the regulation of household appliances through diverse methodologies like Android applications, the Internet of Things (IoT), GSM technology, and remote-control mechanisms. By integrating these comprehensive systems, individuals are promptly notified in the event of any unwarranted intrusion. This process entails sending SMS alerts, capturing images, and monitoring movements within the premises. Moreover, the system empowers users to effortlessly manage home appliances through their smartphones, eliminating the need for manual operation to toggle devices ON or OFF [4]. Ongoing investigations are being conducted to elevate the capabilities of home automation and security systems over time. In 2016, Ravi Kishore Kodali, Vishal Jain, Suvadeep Bose, and Lakshmi Boppana worked on a model for smart home and security systems using the Internet of Things. The primary emphasis was placed on developing a Smart Wireless Home Security System with the capability to promptly notify homeowners via the Internet in the event of an intrusion attempt. The core microcontroller utilized for this project involved the employment of the TICC3200 Launchpad board, which enables the seamless transmission of alert messages over the Internet. [5]. K. Lova Raju, V. Chandrani, SK. Shahina Begum, M. Pravallika Devi constructed a framework for an IoT-driven Smart Home Automation and security system by utilizing the esp8266 Node MCU microcontroller. The Blynk App was implemented to enable seamless control and monitoring of home appliances through the Node MCU microcontroller. [6]. A research endeavor conducted by Vamsikrishna Patchava, Hari Babu Kandala, and P Ravi Babu introduced an innovative IoT-driven Smart Home Automation system utilizing Raspberry Pi as the central control unit. The integration of motion sensors and cameras into a web-based application enhances the system's capabilities for sensing and surveillance purposes. Raspberry Pi efficiently governs the operation of motion sensors and video cameras, bolstering the overall security and monitoring functionalities. [7]. An alternative research study proposed by G. Joga Rao, A. Vinod, N. Priyanka, and Ch. Siva Hari Kumar explored the utilization of Raspberry Pi for an integrated smart system. This comprehensive framework incorporated motion detection, camera surveillance, temperature, and humidity sensing, as well as a door lock system controlled by a single Raspberry Pi module, effectively integrating it with the Internet of Things (IoT) [8]. However, despite the growing popularity of Raspberry Pi in such applications, it is essential to acknowledge several limitations associated with its usage. These limitations include a relatively high market price, occasional boot issues, intermittent board malfunctions, and occasional camera malfunctioning resulting in blank screens [9].

A significant limitation of Raspberry Pi as an embedded system is its vulnerability to critical breakdowns, which can potentially jeopardize the entire automation system's functionality and integrity. Moreover, its relatively high market price compared to some other microcontroller options. This can be a limiting factor for individuals or projects with budget constraints. Additionally, Raspberry Pi boards may occasionally experience boot issues, which can affect the system's reliability and functionality. Another drawback is that the board may go off intermittently, leading to disruptions in the automation and security processes. Furthermore, there have been instances where the camera module connected to Raspberry Pi produces blank screens, impacting the effectiveness of video surveillance in home automation setups. The purpose of this paper is to build an embedded system that is affordable in cost and easy enough to use for the mass community and ensure security issues for the future of our family.

V. IMPLEMENTATION SETUP

A. Component Specification

1) 4-Channel Relay Module:

A quadruple-channel relay empowers the user to activate or deactivate an electrical circuit employing voltage and/or current that surpasses the Arduino's control capacity. The relay facilitates complete separation between the low-voltage (LV) circuit connected to the Arduino and the high-voltage (HV) section associated with the load. [10].

2) *ESP32 CAM:*

The ESP32 is said to be the successor of the ESP8266. This device contains wireless capabilities Wi-Fi and Bluetooth. The ESP32 comes with a dual-core processor and ESPWROOM-32 chip [11]. It has 512kB RAM and a clock frequency of up to 240MHz. [12].

3) *DHT11:*

The DHT11 Sensor, a compact and economical device, serves as a temperature and humidity measurement sensor. Featuring an incorporated thermistor, this sensor gauges the ambient air content, accurately portraying both humidity and temperature levels [13].

4) *MQ6 Gas Sensor:*

The MQ-6 sensor is employed as a gas detection device to identify and locate leaks in residential and industrial settings.

It exhibits a heightened sensitivity to gases such as LPG, propane, isobutane, and methane. With a detection range spanning approximately 200ppm to 10000ppm, this sensor effectively detects varying gas concentrations. [14].

5) ESP32 Development Board:

The Espressif Systems company developed the ESP32 chip, which imparts embedded devices with Wi-Fi connectivity and, in select models, dual-mode Bluetooth capabilities. Although ESP32 specifically denotes the chip itself, the manufacturer commonly employs the term "ESP32" to encompass modules and development boards that incorporate this chip.

6) TSOP1838 IR Receiver:

The TSOP1838 or VS1838 represents compact receiver units utilized in infrared remote-control systems. These receivers feature a PIN diode and pre-amplifier integrated into a lead frame, with the epoxy package designed to function as an infrared filter. The output signal, once demodulated, can be readily decoded by a microprocessor without the need for additional processing.

VI. METHODOLOGY

The working principle of this paper can be divided into two parts:

A. Control Relays and monitor sensor readings by various methods:

1) Arduino Bluetooth Control App:

You can use the app for control via voice command where you just need to write the commands for operating the model and then give the command via google assistant or voice. Thereby, the relays will start operating and the bulb or appliances connected to the circuit will turn ON and OFF accordingly.

2) IR Remote:

You can use any IR remote to control the appliances. If the Wi-Fi is not connected, still you can control relays with the IR remote.

B. Add-Ons:

1) ESP32CAM Blynk Motion Sensor Security Camera with Notification:

In this ESP32CAM Blynk project, a DIY Home surveillance system with ESP32 CAM, PIR motion sensor, and Blynk app is made. If any motion is detected by the PIR sensor, the ESP32CAM Motion Sensor Security Camera will send a notification to a smartphone with the photo.

Fig. 1 ESP32 CAM with motion sensor circuit.

2) Gas Leakage Detector using ESP32:

To sense the LPG Gas in Air, we will use the MQ2/MQ5 Gas Sensor. The MQ5 Gas Sensor is suitable for detecting H2, LPG, CH4, CO & Alcohol. Because of its greater Sensitivity & fast Response, Safety Alerts can be sent quickly. The MQ5 gas sensor detects the presence of various gases such as hydrogen, carbon monoxide, methane, and LPG. The sensor interacts with a gas to measure its concentration ranging from 100ppm to 3,000ppm.

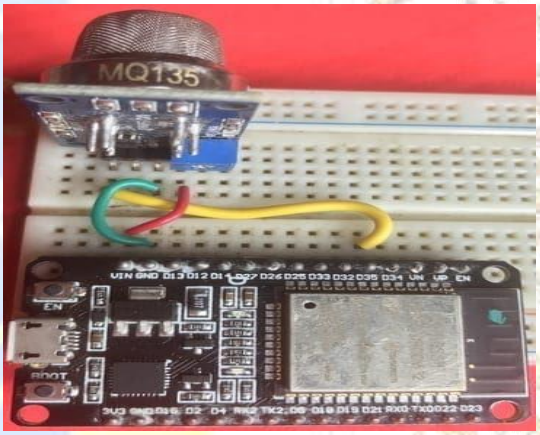

Fig. 2 MQ5 Gas Sensor with ESP32 Circuit.

VII. CIRCUIT DIAGRAM

The following diagram represents the circuit diagram of the project.

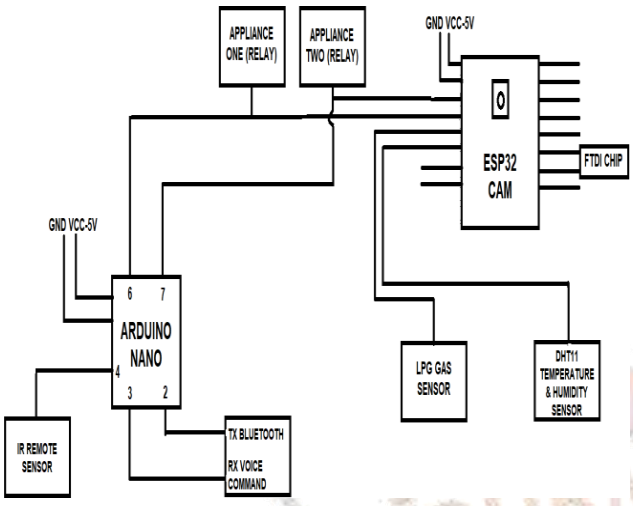

Fig. 3 Home Automation and Security System Using ESP32 circuit diagram.

VIII. HARDWARE

The following diagram is the hardware model of the project.

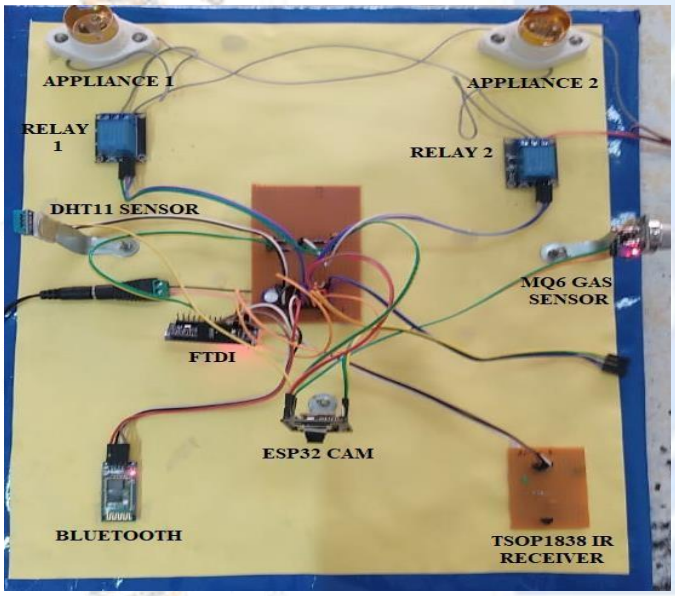

Fig. 4 Home Automation and Security System Using ESP32 hardware model.

IX. CONCLUSION

The system exhibits a high degree of dependability and offers seamless control capabilities. The primary objective of this endeavor is to achieve automation of everyday household appliances while establishing a robust security framework for residential settings. The project holds the potential for future enhancements through the integration of diverse sensor technologies and the incorporation of more efficient home appliances. Given the ubiquitous usage of smartphones, these user-centric systems can benefit a broad spectrum of individuals, contributing to the overall welfare of the population. The experimental model was made according to the circuit diagram and results were as expected. Both the remote and voice control mode methodologies were successfully achieved. The Arduino Bluetooth Control app was also successful in displaying the status of every appliance.

X. FUTURE SCOPE

The scope of this project can be expanded to many areas by not restricting to only homes but too small offices. It can be enhanced by using ML-AI, enabling cloud connectivity for remote access, advancing security using facial recognition and encryption, optimizing energy consumption, etc.

ACKNOWLEDGMENT

The realization of this research endeavor owes its existence to the invaluable contributions and unwavering support from numerous individuals and organizations. We extend our heartfelt gratitude to all those who played a vital role in the triumph of this undertaking. Our profound appreciation goes to Mr. Rajiv Singh Sir, our esteemed mentor, whose profound guidance, and unwavering support left an indelible mark on the trajectory of this research. His astute perspectives and domain expertise were pivotal in shaping the course of this project. Furthermore, we express our sincere thanks to all the study participants who graciously dedicated their time, shared their experiences, and provided invaluable insights. Their enthusiastic involvement with our research proved indispensable, and we deeply appreciate their active participation.

REFERENCES

[1] A. C. J. A. R. Malekian, "Smart Home Automation Security: A Literature Review," *Smart Computing Review, vol. 5, no. 4,* vol. 5, no. 4, pp. 269-285, 2015.

[2] U. A. U. I. I. A. Umer Ijaz, "IOT Based Home Security and Automation System," *NFC-IEFR JOURNAL OF ENGINEERING AND SCIENTIFIC RESEARCH,* vol. 04, pp. 58-63, December 2016.

[3] A. Alif, "MJF: 4,249 women subjected to domestic violence during the lockdown," Dhaka Tribune, 2020.

[4] R. S. K. J. Surinder Kaur, "HOME AUTOMATION AND SECURITY SYSTEM," *Advanced Computational Intelligence: An International Journal (ACII),* vol. 3, no. 3, pp. 17-23, July 2016.

[5] V. J. S. B. A. L. B. Ravi Kishore Kodali, "IoT Based Smart Security and Home Automation," 2016.

[6] V. C. S. B. P. D. K. Lova Raju, "Home Automation and Security System with Node using Internet of Things," 2019.

[7] V. Patchava, H. B. Kandala and P. R. Babu, "A Smart Home Automation technique with Raspberry Pi using IoT," in *2015 International Conference on Smart Sensors and Systems (IC-SSS)*, 2015.

[8] A. V. P. S. H. K. G. Joga Rao, "IOT Based Web Controlled Home Automation Using Raspberry PI," *International Journal of Scientific Research in Science, Engineering (IJSRSET),* vol. 6, no. 2, pp. 229234, 2019.

[9] C. Digest, "https://circuitdigest.com/article/top-10-common-issueswhile- using-raspberry-pi".

[10] "Home Automation Using Arduino Uno," vol. 6, no. 2, pp. 41-42, February 2017.

[11] "https://www.espressif.com/en/products/hardware/esp32/overview".

[12] P. P. B. A. Uma Pujaria, "Internet of Things based Integrated Smart Home Automation," in *International Conference on Communication and Information Processing (ICCIP-2020).*

[13] B. S. D. K. V. J. N. Y. V. S. P. R. K. N. V. Pamarthi Kanakaraja, "Home Automation and Security using Raspberry Pi and Whatsapp," *International Journal of Engineering and Advanced Technology (IJEAT),* vol. 9, no. 2, pp. 3678-3682, December 2019.

[14] A. S. D. Omkar Kashid, "Arduino-based Gas Leakage Detection for Living Security," *International Research Journal of Engineering and Technology (IRJET),* 2020.