Home Automation Using ARM-7 Microcontroller with Improved Security

[1]Praveenkumar Babu, [2]Srinivas Reddy, [3]Vijay Kumar Ch, [4]Selvi C, [5]Ashok T and [6]Bashkaran K
[1,2,3]Dept. of Electronics and Communication Engineering, Hindustan Institute of Technology and Science Chennai, India.
[4]Dept. of Electronics and Communication Engineering, Muthayammal Engineering College (Autonomous), India.
[5,6]Dept. of Biomedical Engineering, Kongunadu College of Engineering and Technology Thottiyam, India.
[1]mbp.praveen@gmail.com, [2]19121043@student.hindustanuniv.ac.in, [3]19121047@student.hindustanuniv.ac.in,
[4]selvishankar03@gmail.com, [5]ashoksubaash@gmail.com, [6]lkbashkaran@gmail.com

Article Info
A. Haldorai et al. (eds.), *2nd International Conference on Materials Science and Sustainable Manufacturing Technology*, Advances in Computational Intelligence in Materials Science.
Doi: https://doi.org/10.53759/acims/978-9914-9946-9-8_21
©2023The Authors. Published by AnaPub Publications.
This is an open access article under the CC BY-NC-ND license. (http://creativecommons.org/licenses/by-nc-nd/4.0/)

Abstract – The Internet of Things (IoT) is a next-generation technology that enables easy remote control of home appliances and offers people a simple and convenient lifestyle. Home automation system based on ARM7 and IoT technology infrastructure (ARM7, communication devices, NodeMCU) enables remote control without human intervention. Home automation is a major advancement in technology that allows you to control lighting, security, temperature, alarms and appliances.This study presents the development of three modules that allow homeowners to remotely monitor readings with their mobile devices. The modules include dust monitoring, house light activation and gas sensors. Each module contains a microcontroller and a sensor that records the data and transmits it over the Internet, ultimately producing a report. The mobile app interprets the data and provides a readable report that homeowners can use to make future decisions.In summary, this study shows the potential of IoT and home automation systems to enable efficient and convenient control of various home appliances and devices, providing a better lifestyle for homeowners.

Keywords – Home Automation System, NodeMCU, Sensors, Smart Switches, Microcontroller, Servo Motor.

I. INTRODUCTION

The Internet of Things (IoT) has emerged as the next generation Internet, connecting various digital devices and physical objects in homes, such as smart air conditioners, refrigerators, televisions, sensors and actuators. These devices are connected to the Internet, allowing them to communicate with each other and with users through smart phones through mobile applications. The devices are equipped with sensors and ARM7 modules that allow them to collect, transmit and process data without human intervention. IoT has brought a new dimension to information and communication technologies and has become a significant progress in recent years [1], [2].

Through machine-to-machine (M2M) communication, smart devices can communicate with other connecteddevices and take actions based on the information received. Users can interact with devices to configurethem, provide instructions, or access data. The built-in sensors and components of the devices and the Internetconnection of the home network allows the devices to work independently and without human intervention [2].

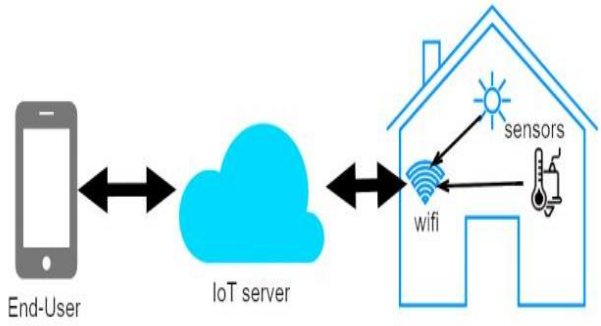

Fig 1. Home Automation System Illustrative Diagram

Home Automation System Illustrative Diagram is shown in **Fig 1.** IoT compatible smart home devices can be controlled via smartphone. Users can use their smartphones to communicate with their smart devices, such as air conditioners, to

turn them on or off remotely [3]. Device sensors are connected to an IoT platform that integrates data from different devices and applies analytics to share information with a mobile application to meet specific needs [4]. The information collected by the devices allows users to make smart decisions and save time and money [5]. The development of IoT is revolutionizing the living spaces of home builders, allowing everyone to be connected from anywhere in their home [6].

II. SYSTEM ANALYSIS

In this existing model, the authors developed a home system to control various home appliances. The system consists of a remote control for lights, fans and other devices, as well as a computer program and Android software for the Arduino platform. Both the remote control and the Android software are open source and accessible, so the system is accessible to a wide range of users.

The proposed smart home system offers people a comfortable and convenient life because they can control and manage their home devices. The system is very reliable and easy to use, so it is the perfect solution for those who want to automate their home. By integrating various household devices into one system, the authors have created a complete solution for managing everyday devices.

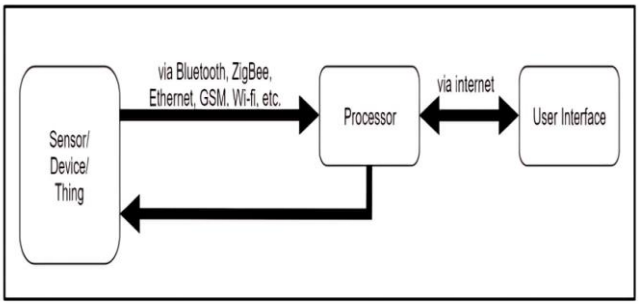

Fig 2. Schematic of Proposed Home Automation System

The proposed system is not only affordable, but also expandable, allowing you to add functions and devices as needed. With the rapid development of technology, the proposed system easily adapts to new and emerging devices, which makes it a future-proof solution for home automation. Schematic of Proposed Home Automation System is shown in **Fig 2**.

In short, the offered smart home system represents an important contribution in the field of home automation, offering an affordable, reliable and easy-to-use solution to control and manage home devices.

III. LITERATURE SURVEY

A real-time home automation system has been developed that is efficient both in efficiency and technology [1]. This system is able to automatically change the state of the devices according to the user's behaviour. The system creates a log file that can be used to track user behaviour, such as device drive time. This log file can be used as input to apply machine learning algorithms to the system. Machine learning algorithms can help the system learn how the user uses devices in the home and automatically change the state of the devices accordingly. This can potentially save energy and make the system more efficient.

The main goal of this paper was to develop a home automation system which is cost-effective and has a wide range of applications [11]. The HAS uses a server to monitor and control devices through an Internet connection, which provides greater flexibility. The system can be installed in a house is very useful for people with disabilities to control their devices. The system can also be used for industrial purposes to remotely control the entire industrial system using a domain website.

This article presents a flexible and simple structure for monitoring and automating a solar house on the EmonCMS platform, which collects information from sensor nodes based on the principle of IoT and can be used to control house devices [3]. A NodeMCU with ESP2866 was used as the main processing unit to collect and process data from sensors and control switches. system can also be enhanced with advanced artificial intelligence to make it smarter and more adaptive, allowing it to grow and evolve over time. This model represents a complete smart home monitoring and automation system based on Internet of Things technology.

This work offers a simple and cost-effective solution for home automation using ESP8266 chips and Raspberry Pi boards [4]. The proposed qToggle system is flexible and easy to use, which enables more flexible web design. The QToggle system aims to be a complete smart home prototype with multiple functions such as automation, control, monitoring and security. The system is designed for continuous development and improvement over time, making it a flexible and adaptable solution for home automation.

The work introduces the home automation system which uses connectivity systems and data sources such as sensors and actuators to enable multiple home automation applications [5]. A user-friendly smartphone web-based application has been developed to allow users to control a wide range of smartphone-connected devices. The system is adaptive and useful for consumers and people with disabilities, and future work will include adding additional features such as video surveillance. HAS is designed to be computationally efficient and effective.

IV. METHODOLOGY

Sensing: The first step in home automation is sensing the environment. This can be done using various sensors such as temperature, motion. These sensors are connected to an ARM7 microcontroller.

Data acquisition: After the sensors have detected the environment, the ARM7 microcontroller needs to acquire the data. The microcontroller processes the sensor data to determine the state of the environment.

Decision making: Based on the data received, the ARM7 microcontroller decides whether to turn on or off the devices connected to it. For example, if the temperature sensor detects that the room is too hot, the microcontroller can start the air conditioner/fan.

Device Control: Once a decision is made, the ARM7 microcontroller sends a signal to the devices to turn them on or off. This can be done with relays connected to the microcontroller.

User interface: The user interface is used to communicate with the home automation system. This can be done using a variety of devices, such as a smartphone, tablet or computer. The user can control the devices connected to the ARM7 microcontroller through the user interface.

Communication: The ARM7 microcontroller can communicate with other devices through various communication protocols such as Bluetooth, Wi-Fi or Zigbee. In this way, the user can control the devices remotely.

Monitoring: The ARM7 microcontroller is connected to the pc via usb port to help the user to monitor.

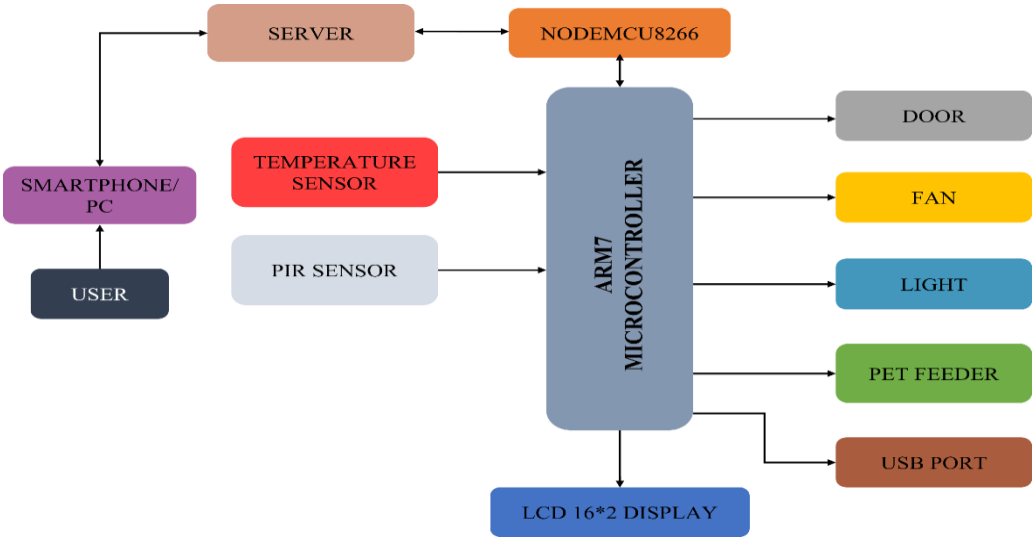

Fig 3. Block Diagram of Proposed Model.

V. WORKING MODEL

Block Diagram of Proposed Model is shown in **Fig 3.** Home automation systems aim to automate and simplify various tasks in the home, such as controlling lights, fans and temperature. The components you listed can be used in a home automation system using an ARM7 LPC2148 microcontroller as the brain of the system. Here is a brief description of how the components are working together.

ARM7 LPC2148 Microcontroller: This microcontroller is the central unit of the home automation system. it is responsible for managing and coordinating the various parts of the system. A microcontroller receives inputs from various sensors and controls output devices such as servo motors, LEDs and fans. NodeMCU ESP8266: This is a Wi-Fi module that can be used to connect the home automation system to the Internet. In this way, various devices of the system can be controlled remotely by smartphone or computer. The NodeMCU ESP8266 can also be used to send notifications to the user about certain events, such as when the temperature rises above a certain threshold.

Servo motors: Servo motors can be used to control the movement of various devices in the home automation system, such as opening and closing doors. A microcontroller can be programmed to send a signal to servo motors to move them to a certain position. Temperature sensor: The temperature sensor can be used to monitor the temperatures of different rooms in the house. A microcontroller can be programmed to startfans or an air conditioner when the temperature rises above a certain threshold.Login Web Portal is shown in fig 4 and Configuration of Switches in Web Portal is shown in **Fig 5**.

PIR sensor: The PIR sensor can be used to detect people in the room. This can be useful to open the door automatically when someone enters the room. The microcontroller can be programmed to empty the room as to close the door. In short, the ARM7 LPC2148 microcontroller acts as a central unit that controls and coordinates the various components of the home automation system. The NodeMCU ESP8266 can be used to connect the system to the Internet, allowing remote control and notifications. Servo motors, temperature sensor, IR sensor, LED lights and fans control all

the different home automation devices.Experimental Setup is shown in **Fig 6** and Sensors and Switches Monitoring is shown in **Fig 7**.

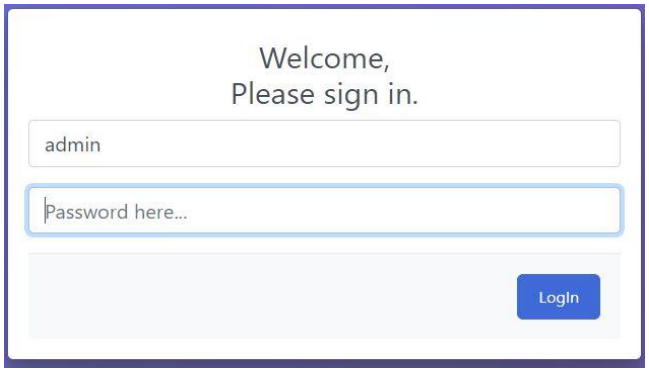

Fig 4. Login Web Portal

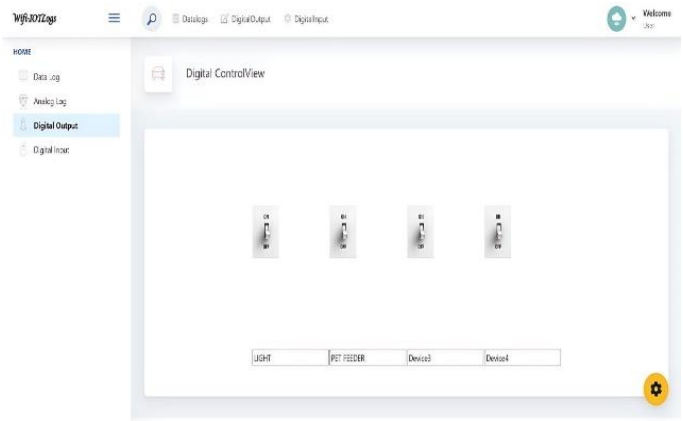

Fig 5. Configuration of Switches in Web Portal

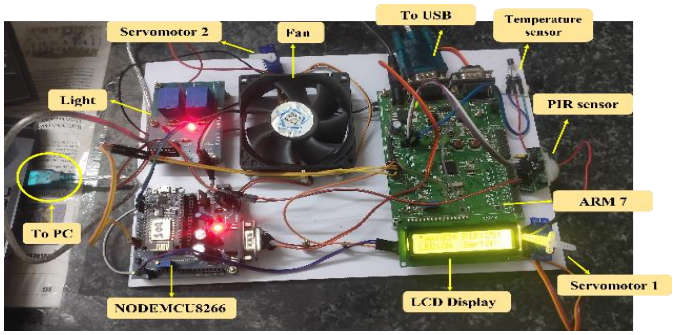

Fig 6. Experimental Setup

Fig 7. Sensors and Switches Monitoring

VI. CONCLUSION

This paper presented a simple and effective design for smart home automation systems based on ARM7 microcontrollers offer a very flexible and adaptable solution to automate different parts of the home. Because these systems can control multiple devices and sensors and communicate with other systems and networks, they can provide homeowners with greater comfort, convenience and energy efficiency. However, the design and implementation of such systems can be complex, and factors such as system security, user interfaces, and compatibility with existing infrastructure must be carefully considered. However, with proper design and implementation, home automation systems based on ARM7 microcontrollers can provide significant benefits to homeowners and improve their overall quality of life.

References

[1] H. K. Singh, S. Verma, S. Pal and K. Pandey, "A step towards Home Automation using IOT," 2019 Twelfth International Conference on Contemporary Computing (IC3), 2019, pp. 1-5, doi: 10.1109/IC3.2019.8844945.

[2] [2] M. M. Islam, M. N. Farook, S. M. G. Mostafa and Y. Arafat, "Design and Implementation of an IoT Based Home Automation," 2019 1st International Conference on Advances in Science, Engineering and Robotics Technology (ICASERT), 2019, pp. 1-5, doi: 10.1109/ICASERT.2019.8934606.

[3] M. Al-Kuwari, A. Ramadan, Y. Ismael, L. Al-Sughair, A. Gastli and M. Benammar, "Smart-home automation using IoT-based sensing and monitoring platform," 2018 IEEE 12th International Conference on Compatibility, Power Electronics and Power Engineering (CPE-POWERENG 2018), Doha, Qatar, 2018, pp. 1-6, doi: 10.1109/CPE.2018.8372548.

[4] Stolojescu-Crisan C, Crisan C, Butunoi B-P. An IoT-Based Smart Home Automation System. Sensors. 2021; 21(11):3784. https://doi.org/10.3390/s21113784.

[5] Khan, M.A.; Ahmad, I.; Nordin, A.N.; Ahmed, A.E.-S.; Mewada, H.; Daradkeh, Y.I.; Rasheed, S.; Eldin, E.T.; Shafiq, M. Smart Android Based Home Automation System Using Internet of Things (IoT). Sustainability 2022, 14, 10717. https://doi.org/10.3390/su141710717

[6] Thamaraimanalan, T., Mohankumar, M., Dhanasekaran, S., &Anandakumar, H. (2021). Experimental analysis of intelligent vehicle monitoring system using Internet of Things (IoT). EAI Endorsed Transactions on Energy Web, 8(36).

[7] A. P. Nirmala, V. Asha, P. Chandra, H. Priya and S. Raj, "IoT based Secure Smart Home Automation System," 2022 IEEE Delhi Section Conference (DELCON), New Delhi, India, 2022, pp. 1-7, doi: 10.1109/DELCON54057.2022.9753086.

[8] B. Mustafa, M. W. Iqbal, M. Saeed, A. R. Shafqat, H. Sajjad and M. R. Naqvi, "IOT Based Low-Cost Smart Home Automation System," 2021 3rd International Congress on Human-Computer Interaction, Optimization and Robotic Applications (HORA), Ankara, Turkey, 2021, pp. 1-6, doi: 10.1109/HORA52670.2021.946127.

[9] Venkatraman, S.; Overmars, A.; Thong, M. Smart Home Automation—Use Cases of a Secure and Integrated Voice-Control System. Systems 2021, 9, 77. https://doi.org/10.3390/systems9040077.

[10] J. Jaihar, N. Lingayat, P. S. Vijaybhai, G. Venkatesh and K. P. Upla, "Smart Home Automation Using Machine Learning Algorithms," 2020 International Conference for Emerging Technology (INCET), Belgaum, India, 2020, pp. 1-4, doi: 10.1109/INCET49848.2020.9154007.

[11] Babu, P., Parthasarathy, E, "Reconfigurable FPGA Architectures: A Survey and Applications," J. Inst. Eng. India Ser. B (Springer), 2020. https://doi.org/10.1007/s40031-020-00508-y.