IoT Sensor-based sustainable smart home management for human needs through Micro Controller

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Abstract. Smart home technology is emerging rapidly as an exciting new paradigm. Appliances inside the home can be watched over, managed, and controlled by the consumer. Additionally, the gadgets are linked together via the internet, enabling the user to remotely control features like home lighting, air conditioner, and security systems providing sustainable approach. To aid the elderly and others with disabilities, this paper's major goal is to teach consumers how to properly handle their household appliances. Thus, a smart home is being developed where the environmental conditions like air conditioner, television and lights adjust themselves with the person entering the room or even according to the weather conditions. Due to the complexity, in this paper an Microcontroller, LCD and other necessary materials in place of TV, AC and light are used to show that if a house consists of two or more people how the LCD will adjust itself and displays the standard required channel, likewise same LCD adjusts itself to the standard temperature required by the person and similarly adjusts itself according to the person entering into the room. Additionally, if it is raining outside the LCD will display a monsoon mood song, this is done using rain sensor. If these sensors are connected to the cloud, then the information related to the person entering the room is stored. This information can be accessed using your mobile.

1 Introduction

The Internet of Things (IoT) is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction [1]. In the context of smart homes, IoT refers to the use of connected

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devices to automate and control aspects of a home, such as lighting, thermostats, security systems, and appliances. Smart home devices can be controlled using a smartphone, tablet, or voice command, and they can be programmed to perform tasks based on a variety of criteria, such as time, location, or environmental conditions. Here are some of the benefits of using IoT in smart homes: Increased convenience: Smart home devices can make it easier to control your home's environment and appliances. For example, you can use a smart thermostat to adjust the temperature in your home from anywhere, or you can use a smart lock to lock or unlock your door without having to fumble with keys.

The advent of the Internet has revolutionized our way of life, transforming how people interact in various aspects, be it in their professional endeavors or social connections, by creating virtual spaces for communication and collaboration. The Internet of Things (IoT) holds the potential to further enhance this transformation by facilitating seamless communication between mobile devices and smart gadgets, thereby giving rise to the concept of pervasive or "anytime, anywhere" computing and communication.[2]

Improved security: Smart home devices can help to improve the security of your home by providing remote monitoring and control of your security system. For example, you can use a security camera to keep an eye on your home while you're away, or you can use a smart doorbell to see who's at your door without having to get up. Reduced energy consumption: Smart home devices can help you to reduce your energy consumption by automating tasks such as turning off lights when you leave home or adjusting the thermostat when you're asleep. Enhanced comfort: Smart home devices can help you to create a more comfortable environment in your home by automating tasks such as turning on the lights when you come home or adjusting the thermostat to your desired temperature. Overall, IoT has the potential to revolutionize the way we live in our homes.

It often have a central hub or control panel that allows homeowners to manage and control all the connected devices and systems in their home from a single interface. It can incorporate biometric sensors for enhanced safety and security purposes. Biometric sensors utilize unique physical or behavioral characteristics of individuals to verify their identity. Biometric sensors, such as fingerprint scanners can be integrated into smart home management systems to provide secure access control. Homeowners and authorized individuals can gain entry to the home by authenticating their biometric information, ensuring that only approved individuals can access the premises. Biometric sensors can be used to create individual profiles for different members of the household. Each person's unique biometric data can be stored and associated with their profile within the smart home management system [4-5]. This allows for personalized settings and access permissions, ensuring that each person has a tailored experience while maintaining security. As such, IoT is one of the most sustainable technologies of everyday life, and it will continue to pick up steam as more businesses realize the potential of connected devices to keep them competitive[6-7].

2 Literature Survey

The paper proposes a system for home automation that uses Internet of Things (IoT) and touch- based controls. The system consists of a number of IoT devices, such as sensors, actuators, and a central controller. The sensors collect data about the environment, such as temperature, light, and motion. The actuators control devices in the home, such as lights, thermostats, and locks. The central controller manages the data and controls the actuators. The system is controlled using a touch-based interface. The interface allows users to control the devices in their home using simple gestures, such as tapping and swiping. The interface is also accessible to people with disabilities. The system is designed to be energy efficient. The sensors and actuators only operate when they are needed. The central controller also includes a power management module that helps to conserve energy. The system is designed

to be scalable. It can be easily expanded to add new devices or sensors. The system is also designed to be secure. It uses a variety of security measures to protect the data and prevent unauthorized access. The system has been tested in a real-world setting. The results of the test showed that the system is effective and efficient. The system is also user-friendly and accessible to people with disabilities. The paper concludes by discussing the future of the system. The authors believe that the system has the potential to revolutionize the way we live in our homes. The system can make our homes more convenient, comfortable, and secure[7-9].

This paper is about the IoT-based Smart Home Automation System is a cutting-edge technology that revolutionizes the way homes are managed and controlled. Developed by Ms. K. S. Gulghane, Dr. Mrs. S. S. Sherekar, and Dr. V.M. Thakare, this system leverages the power of the Internet of Things (IoT) to create a seamless and efficient home automation experience. Users can receive alerts and take appropriate actions in case of any security breaches or emergencies [10-12].The Smart Home Automation System using IoT, developed by Balwinder Kaur Dhaliwal, Arvinder Kaur, Muskan Bhutani, Naman Thakur, Akash Singh, and Bhavnath Jha, is a state-of- the-art technology that transforms conventional homes into intelligent and interconnected living spaces. This system harnesses the power of the Internet of Things (IoT) to create a seamless and automated home management experience. Instant notifications enable homeowners to respond promptly to security breaches or emergencies. The Smart Home Automation System using IoT offers convenience, comfort, energy efficiency, and improved security to homeowners [13-15].

This paper is about accurately detecting the presence of humans in different environments using advanced technologies like computer vision, machine learning, and sensor integration. In summary, the Human Detection System developed by Ankush Muley, and Prof. S. B. Pokharkar demonstrates a promising solution for accurately detecting human presence in diverse environments. Its integration of computer vision and machine learning technologies offers the potential to enhance security, surveillance, and interaction across a wide range of applications [16-20]. This paper is on developing a home automation system tailored specifically for individuals with physical limitations. The system utilizes hand gestures as the primary input method for controlling various home automation tasks, aiming to create an intuitive and accessible interface. The research team assessed the performance of the optimized hand gesture- based home automation system using various metrics, including accuracy, response time, and user satisfaction. The results demonstrated the system's effectiveness in providing reliable and efficient control over home automation tasks for individuals with physical limitations [21-24].

2.1.1 Traditional Person Detection:

With the help of sensors and Raspberry pi people can detect the persons who are near the door and can allow only those people whose face or touch id matches with the house members. This information can be seen from the owner’s mobile directly.

GSM BASED SMART HOME AUTOMATION:
Global System for Mobile Communication (GSM) modem is used to control home appliances such as light, conditional system, and security system via Short Message Service (SMS) text messages.
Disadvantages of Existing System:

- The traditional system can only sense who can enter into the house but cannot manipulate the devices according to the person detection.

• Similarly, the GSM also cannot change according to the person.

2.1.2 Proposed System:

Due to the complexity, in this paper an ESP32, LCD and other necessary materials in place of TV, AC and light are used to show that if a house consists of two or more people how the LCD will adjust itself and displays the standard required channel, likewise same LCD adjusts itself to the standard temperature required by the person and similarly adjusts itself according to the person entering into the room. Additional to this, if it is raining outside the LCD will be displaying a monsoon mood song, this is done using rain sensor. If these sensors are connected to the cloud then the information related to the person entering the room is stored. This information can be accessed using your mobile.
1. In this we can adjust the devices accordingly with the persons entering into the room.
2.We can also detect the rain and can also display the song when it rains.
3.We can send the information related to the person entering the home and the changes are done into the cloud.

2.1.3 Research Gaps:

Security and Privacy Concerns: Security and privacy were significant concerns in smart home management. Ensuring that smart home devices and systems are resilient against cyber-attacks, unauthorized access, and data breaches remained a critical area of research. Techniques for secure communication, data encryption, and user authentication were essential. Interoperability and Standardization Energy Efficiency: Adaptability, Reliability and Fault Tolerance,Cost-effectiveness and Affordability and Integration of Artificial Intelligence

3 System Architecture

System architecture in IoT (Internet of Things) refers to the structure and organization of an IoT system, including the arrangement of its components, networks, and communication protocols. It defines how IoT devices, data, and services are interconnected to create a functional and efficient system. In IoT system architecture, there are typically multiple layers or tiers. The perception layer consists of the physical devices or sensors that collect data from the environment. These devices can include temperature sensors, motion detectors, or even wearable devices. The network layer enables communication between the devices and the central system, using protocols such as Wi-Fi, Bluetooth, or cellular networks.

An effective system architecture in IoT enables efficient data collection, analysis, and decision making, leading to improved automation, real-time monitoring, and enhanced operational efficiency. It also provides a foundation for future scalability and adaptability as the IoT ecosystem continues to evolve. The minimum hardware requirements can differ significantly based on the specific product and the sensors involved. Devices that rely on complex applications and multiple environmental inputs typically necessitate a substantial number of sensors

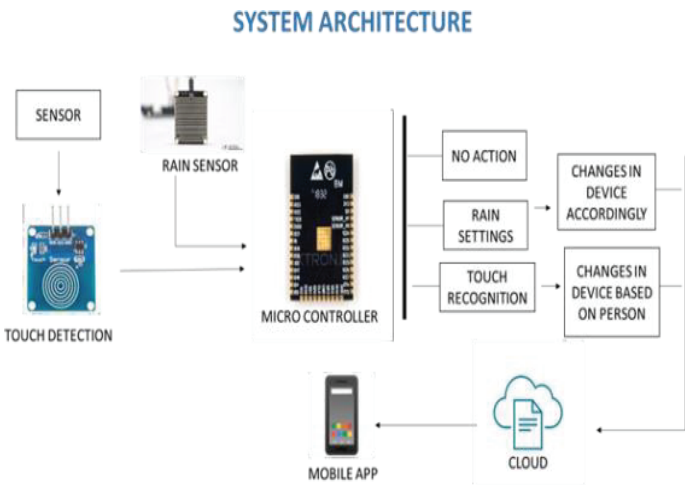

Figure 1: Architecture

3.1.1 Pin configuration:

Table1. Pin configuration

pins	DESCRIPTION
1	Ground
2	Vcc
3	Contrast Voltage
4	"R/S"_Instruction/Register Select
5	"R/W" _Read/Write LCD Registers
6	"E" Clock
7-14	Data I/O Pins

When working with an LCD display, there are several commands and functions available to control its behavior. The following commands are commonly used: lcd.begin(cols, rows): This command initializes the LCD display with the specified number of columns and rows. It prepares the display for use. lcd.clear(): This command clears the contents of the LCD display, removing any previously displayed characters or symbols. lcd.setCursor(col, row): This command sets the cursor position on the LCD display to the specified column and row. It determines where the next character or symbol will be displayed.

3.1.2 Network Infrastructure

A reliable network infrastructure is crucial for establishing connectivity between IoT devices and the central system in the paper. The selection of network technology depends on specific model requirements, ranging from wired options like Ethernet and Powerline to wireless solutions such as Wi-Fi, Wi-Fi enables cable-free connections, Bluetooth is ideal for short-range communication, Zigbee is designed for low-power devices, and LoRaWAN allows long- range communication. Regardless of the chosen technology, a reliable network infrastructure ensures seamless data transfer, remote monitoring, and control capabilities.

This facilitates real- time data collection, analysis, and management, enabling the IoT project to leverage connected devices and benefit from an interconnected ecosystem.

4 Results Analysis

In this paper illustrates the intricate connections between various components, including the biometric sensor, rain sensor, and LCD display, all interconnected with the microcontroller. By integrating these elements, we create a comprehensive system that enables biometric authentication, monitors rainfall, and displays relevant information on the LCD screen. This intricate network of connections facilitates seamless communication and interaction between the different devices, enhancing the overall functionality and effectiveness of the system. The careful arrangement and configuration of these components demonstrates the attention to detail and precision required in designing a reliable and efficient smart home management solution. Upon power connection, the system initiates its startup process, transitioning into the initialization phase. During this crucial stage, all sensors and associated modules, including the biometric sensor, are activated and supplied with power. This simultaneous activation ensures that all components are prepared for operation. To provide a visual indication of the system's status, the LCD display prominently showcases the "System turned on" message, reassuring users that the system is ready for use. This informative display on the LCD screen serves as a convenient and user-friendly interface, enhancing the overall usability and accessibility of the smart home management system. The initialization phase plays a vital role in setting up the system for seamless functionality, ensuring that all components are powered up and operational, ready to deliver the desired performance and fulfill the users' needs

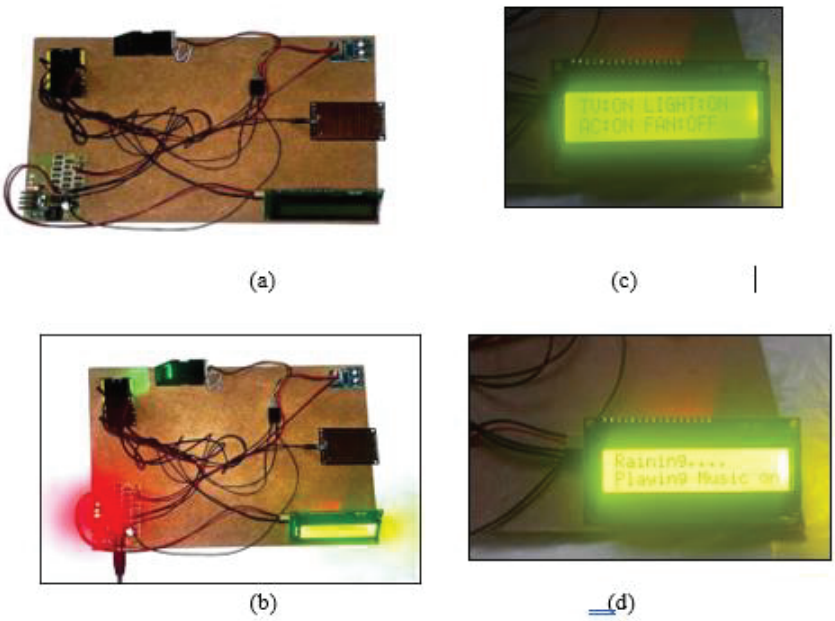

Figure 2. (a) Circuit (b) Circuit after power supply (c) LCD Display (d) Song display

5 Conclusion and Future Scope

In this study, we have introduced a sensor-based sustainable smart home management system that addresses both security concerns and personal preferences of individuals. The system offers flexibility, adapting to different user specifications. By seamlessly integrating and automating various devices, we have successfully enhanced convenience, security, and energy efficiency within the home environment, thus providing sustainability. With the ability to remotely control and monitor multiple systems, our solution simplifies daily tasks and provides homeowners with peace of mind. It highlights the immense potential of IoT technology and offers a glimpse into a future where smart homes are commonplace. As IoT continues to evolve, it has the potential to further enhance our quality of life and revolutionize our interaction with living spaces. Our proposed model has the potential for further development by incorporating additional security features such as thief detection and an alarm system. Moreover, enhancing the system to include gas leak, smoke, and fire detection would significantly bolster its capabilities, making it even more powerful than its current state. This expanded functionality would not only increase performance but also benefit a wider range of users in numerous ways. By continuously improving and refining the model, we can ensure its effectiveness in providing a safe and secure living environment while addressing the evolving needs of individuals. This ongoing development will contribute to the wider adoption and positive impact of smart home management systems in the future.

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