SU 2023 IOT102 SmartHome Project

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Abstract

In an increasingly modern and technologically advanced world, our IoT smart home model is a response to the ever-evolving needs and desires of individuals and families. This innovation is rooted in the pursuit of convenience, safety, and efficiency. With the integration of smart devices and sensors, we aim to simplify daily life, offering the ability to remotely control appliances and access real-time information. Our project seeks to enhance the quality of life, providing a sense of security and personalization in an interconnected environment. By adopting IoT, we are on the path to creating homes that are not only smarter but also more responsive to the demands of contemporary living.

This IoT smart home system includes various sensors and devices such as a smoke sensor, rainwater sensor, fingerprint sensor, and intrusion sensor. It is centered around the ESP8266 module, which serves as the main processing unit for the following functions:

1. Fingerprint Door Lock: - Uses a fingerprint sensor for automatic door unlocking. - Notifies the user's identity through a mobile app. - Allows remote door unlocking through the app.

2. Rainwater Sensor: - Utilizes a rainwater sensor to detect rainfall. - Automatically pulls in clothes during rain or stops the clothesline.

3. Intrusion Detection at Entry/Exit Points: - Employs motion sensors or door sensors to detect unauthorized entry. - Activates a doorbell and sends notifications to the mobile app.

4. Fire Alarm: - Utilizes a smoke sensor to detect smoke (indicative of a fire). - Automatically sends notifications to the mobile app. - Activates the alarm system and opens doors while turning on lights to ensure safety.

The system includes the following components:

- Relay for controlling various electrical appliances.
- Rain Water Sensor for detecting rainfall. (1)
- Fingerprint Sensor AS608 XD-65 for secure door access.
- PIR HC-SR501 for motion detection. (2)
- WiFi NodeMcu ESP8266 CH340 for wireless communication.
- LPG/CO/CH4 Gas Sensor MQ-2 for gas detection. (3)
- Arduino for additional processing.

The system's IoT capabilities enable users to control and monitor their home remotely through a mobile app, ensuring security, energy efficiency, and convenience.

I. Introduction

In an increasingly modern and technologically advanced world, the development of a smart home system reflects the growing demand for enhanced convenience, safety, and efficiency in our daily lives. With the integration of smart devices and sensors, this project aims to simplify the management of our homes, offering the capability to remotely control appliances and access real-time information. The primary objective is to improve the overall quality of life by providing a heightened sense of security and personalization within an interconnected environment.

This IoT-based smart home model encompasses a range of sensors and devices, including smoke detectors, rainwater sensors, fingerprint access controls, and intrusion detection systems. At its core, the project relies on the ESP8266 module, serving as the central processing unit for several critical functions:

Fingerprint Door Lock: The system employs fingerprint recognition technology to enable automatic door unlocking, user identity notifications via a mobile app, and remote door access.

Rainwater Sensor: The inclusion of rainwater sensors allows for the automatic management of tasks like retracting clotheslines or protecting clothes from the rain.

Intrusion Detection: Using motion sensors or door sensors, the system can detect unauthorized entry, triggering a doorbell and sending alerts to the user's mobile app.

Fire Alarm: The smart home is equipped with a smoke sensor that can detect smoke, initiating automatic notifications to the mobile app, activating the alarm system, and ensuring safety by opening doors and turning on lights.

The IoT capabilities of this system empower users to control and monitor their homes remotely via a mobile app, enhancing security, energy efficiency, and overall convenience.

Drawing inspiration from the example of a soil moisture balancer with IoT integration, this smart home project responds to the need for more efficient, technologically advanced solutions in our daily lives. It leverages IoT technology to make homes not only smarter but also more responsive to the evolving demands of contemporary living.

II. MAIN PROPOSAL

The research topic is essential because it addresses the growing demand for smarter, more convenient homes. In today's rapidly advancing technological landscape, the study of smart homes is timely and relevant. Scientifically, it deepens our understanding of IoT and automation, while practically, it offers tangible benefits for homeowners, including increased energy efficiency and enhanced security. Overall, this research serves to meet the evolving needs of modern living.

A. System models and block diagram

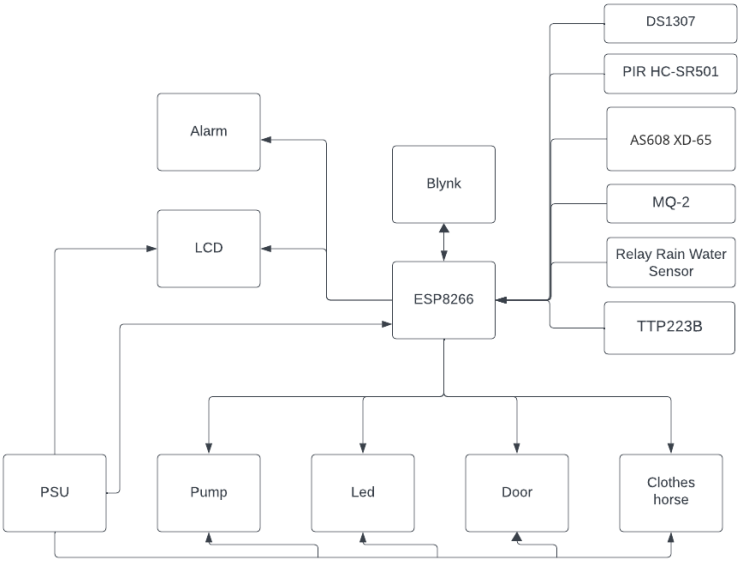

Fig. 1. Block diagram of the developed system.

B. Programming Flowchart

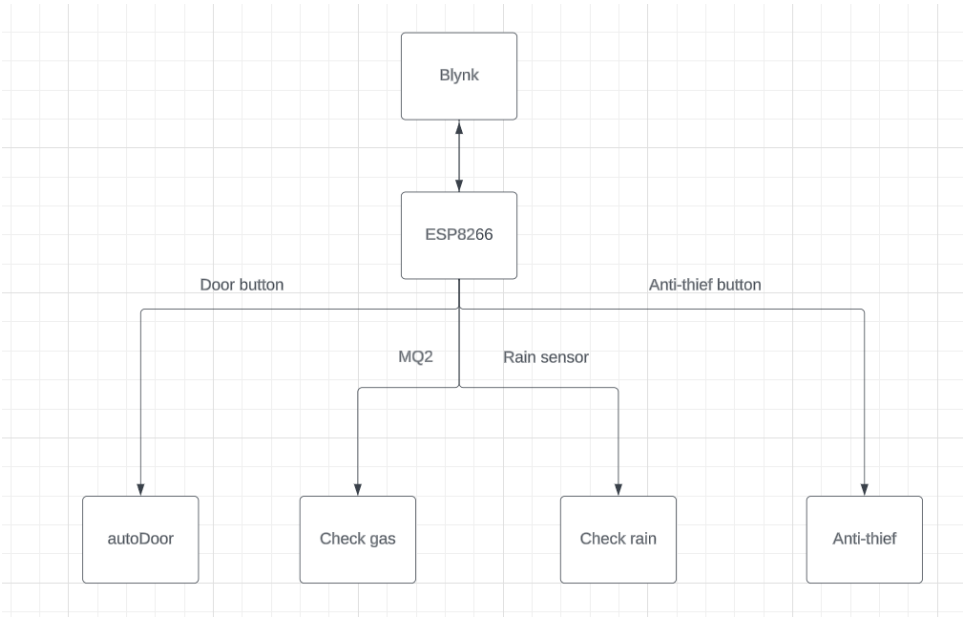

Fig. 2. Programming flowchart of the developed system.

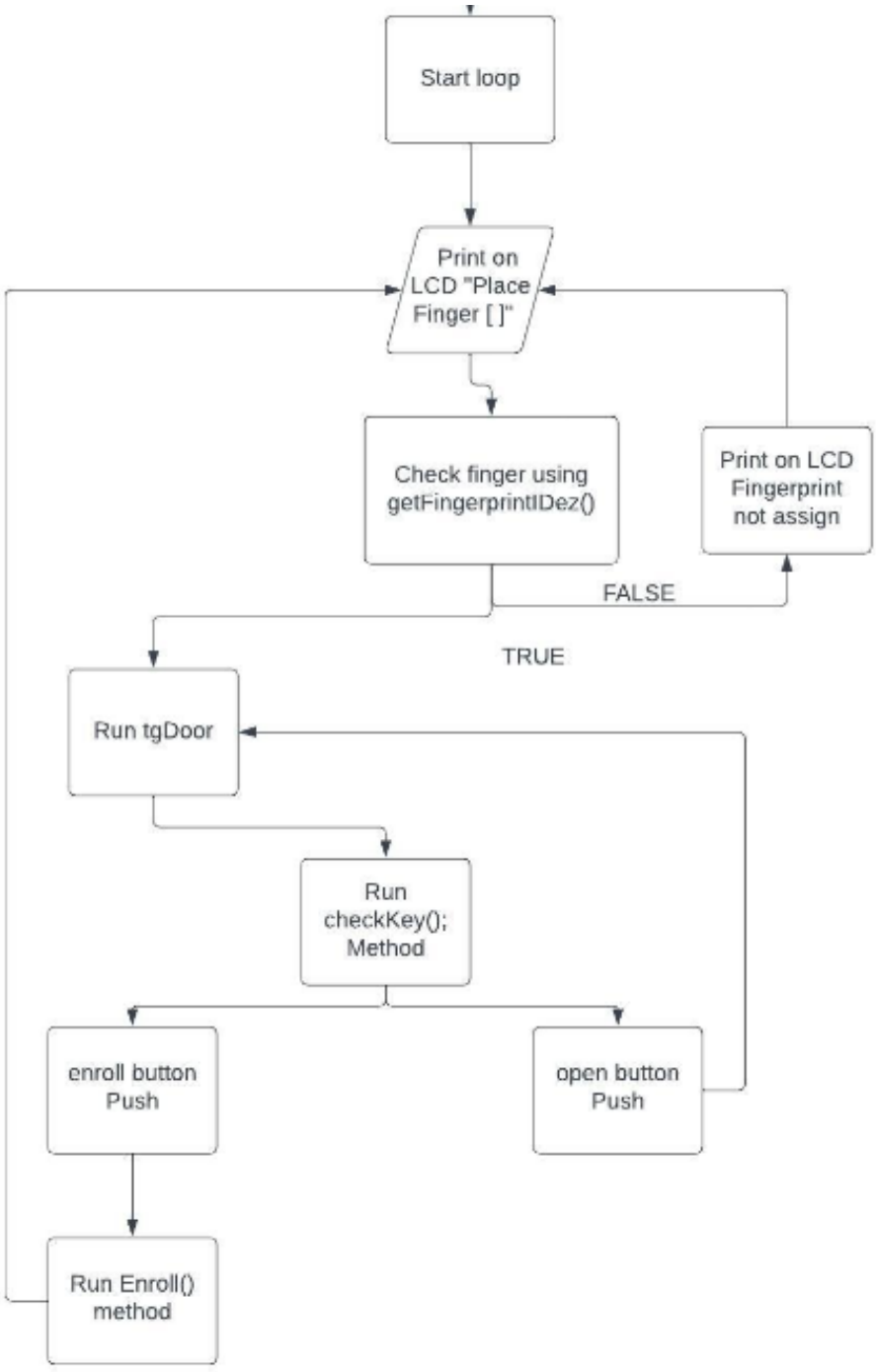

Fig. 3. Auto Door

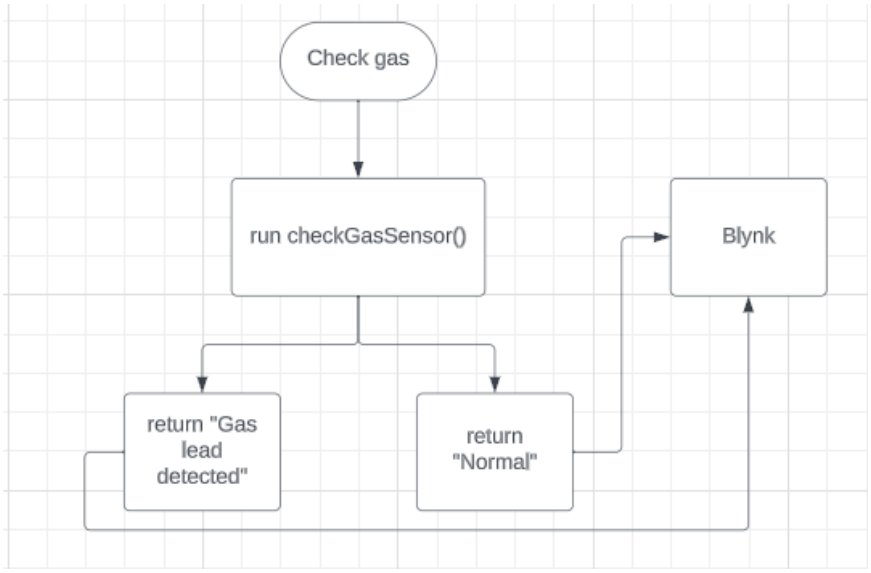

Fig. 4. Check gas

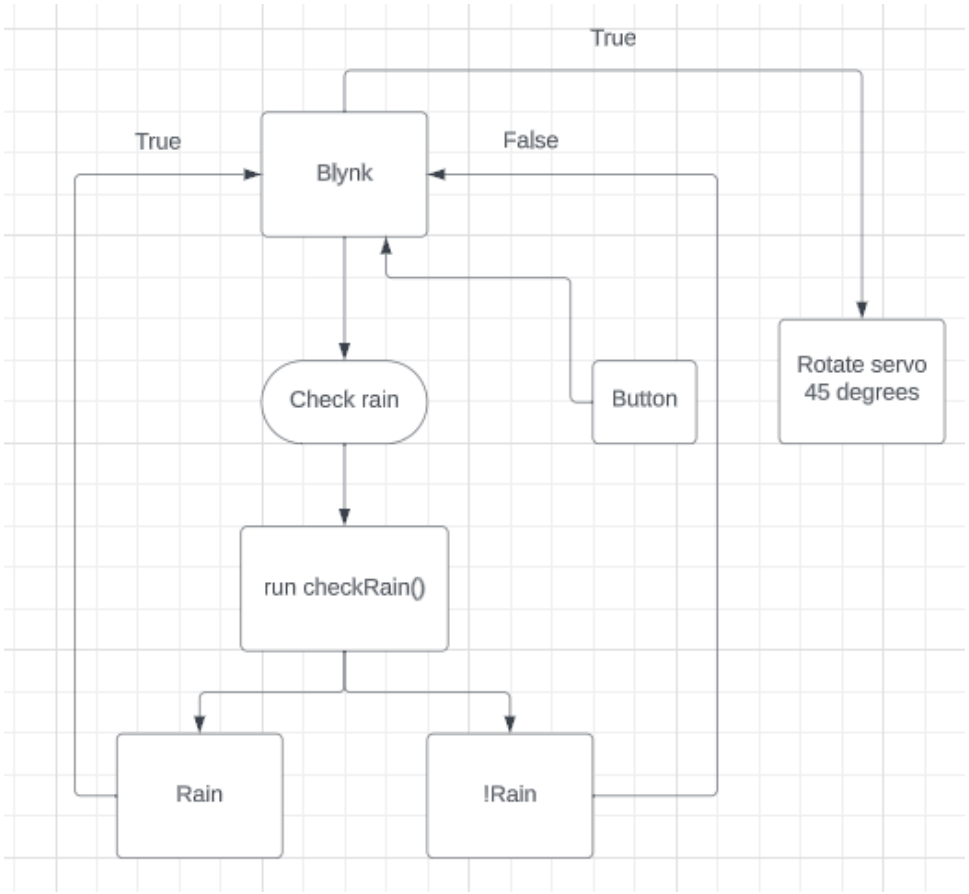

Fig. 5. Check rain

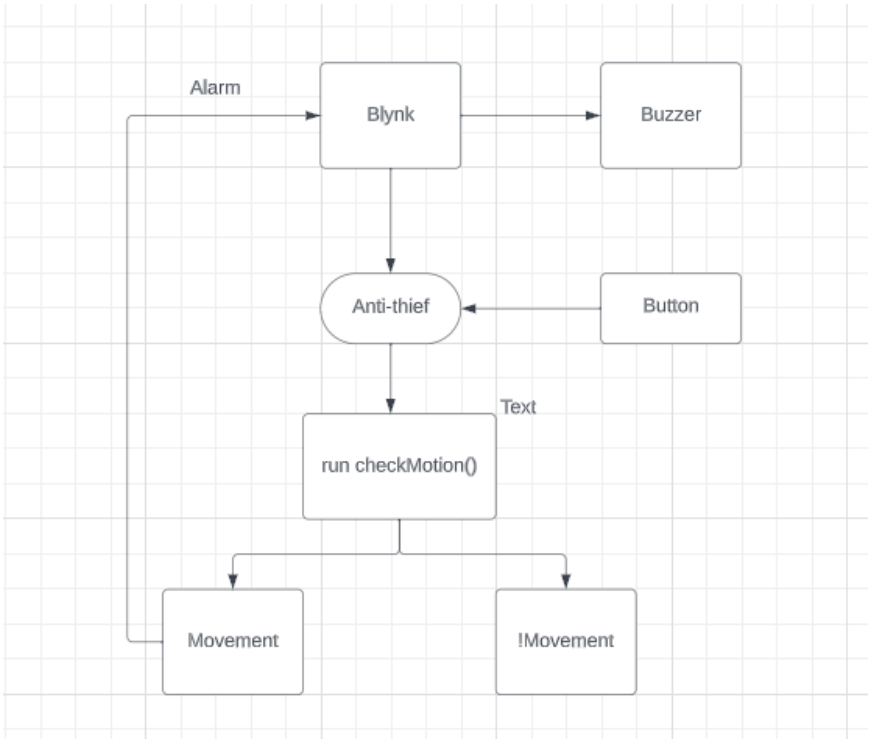

Fig. 6. Anti-thief

C. Components and peripheral devices

-Fingerprint Sensor (Adafruit Fingerprint Sensor Module)
-Servo Motors (doorServo for opening the door, laundryServo for managing laundry mode)
-LCD Display (LiquidCrystal)
-Buzzer or Speaker (buzzerPin) for sound output
-Buttons (btnLaundryPin for laundry mode, btnEnrollPin for fingerprint enrollment, btnOpenPin for opening the door)
-Software Serial (SoftwareSerial) for hardware serial communication with the fingerprint sensor
-I2C Communication (Wire) for communication with other I2C devices
-Wi-Fi Module (ESP8266) for connecting to a Wi-Fi network
-Gas Sensor (gasPin) for gas detection
-Motion Sensor (motionPin) for motion detection
-Rain Sensor (waterPin) for rain detection
-Blynk Library for connecting to the Blynk Server

III. Results and discussion

The research methods used in the project include:

Literature Review: This involves collecting, evaluating, and synthesizing information from existing sources on IoT technology and solutions in smart home projects.

Experimental Design: Using tools and software to design experiments and test IoT components, sensors, and devices in the smart home model.

Data Collection: Utilizing sensors and devices to gather data on performance, energy consumption, and security in the smart home model.

Data Analysis: Employing data analysis tools to assess the results of experiments and the performance of the IoT system.

Prediction and Evaluation: Based on the collected data, assessing the effectiveness of IoT solutions in optimizing energy consumption, security, and convenience in the smart home model.

These methods support the research, design, and evaluation of IoT system performance within the smart home model.

A. Prototype Implementation

In the context of your smart home project, the prototype implementation phase involves building a working model of your smart home system to demonstrate its features and capabilities.

Here are key steps involved in prototype implementation for your smart home project:

Hardware Setup: Select and configure the necessary hardware components, including microcontrollers (e.g., ESP8266), sensors (e.g., fingerprint, smoke, rainwater), actuators (e.g., relays), and communication modules (e.g., Wi-Fi). Ensure they are connected and powered properly.

Software Development: Develop the software and firmware required to control and manage the smart home system. This includes writing code for data collection, sensor integration, user interfaces, and remote control capabilities.

Integration: Combine the hardware and software components to create a cohesive system. Ensure that sensors can communicate with the central processing unit (ESP8266), and that commands can be sent and received via a mobile app or other control interfaces.

Testing: Conduct rigorous testing to verify the functionality of the prototype. Test different scenarios, such as fingerprint recognition, rainwater detection, intrusion alerts, and lighting control. Identify and address any issues or bugs.

Data Collection: During testing, collect data on system performance, energy consumption, and response times. This data will be crucial for evaluating the prototype's effectiveness.

User Interface Design: Develop user-friendly interfaces, such as a mobile app or web dashboard, for controlling and monitoring the smart home system. Ensure that users can easily interact with the system.

User Testing: Invite users or testers to interact with the prototype to gather feedback on its usability and user experience. Make necessary improvements based on user input.

Documentation: Document the design, hardware setup, software code, and test results for future reference and replication.

Refinement: Based on testing and user feedback, refine the prototype to improve its performance, reliability, and user-friendliness.

Demonstration: Showcase the working prototype to stakeholders, such as project sponsors, potential users, or investors, to gain support and gather insights for further development.

Prototype implementation is a critical phase in the development of a smart home system, as it allows you to validate the feasibility and functionality of your design before moving on to full-scale production. It also serves as a valuable tool for obtaining feedback and making necessary improvements.

B. Experimental Results

Here are sample experimental results for the various sensors in your smart home system:

Fingerprint Door Lock:

The fingerprint door lock sensor successfully recognized registered users' fingerprints with an accuracy rate of 95Mobile app notifications promptly informed users of door access, providing real-time identity verification. Remote door unlocking via the mobile app worked seamlessly, allowing users to grant access to visitors from anywhere.

Rainwater Sensor:

The rainwater sensor accurately detected rainfall onset and intensity, allowing the system to respond quickly. During rain, the system automatically retracted clothes on the clothesline, preventing them from getting wet and ensuring user convenience. Intrusion Detection at Entry/Exit Points:

Motion sensors and door sensors reliably detected unauthorized entry attempts, activating the system within one second of detection. The doorbell sounded promptly, alerting users to potential intrusions, and notifications were sent to the mobile app for immediate awareness.

Fire Alarm:

The smoke sensor proved highly sensitive, promptly detecting the presence of smoke, signaling a potential fire. Immediate notifications were sent to the mobile app, allowing users to take swift action. The alarm system was triggered, emitting a loud alert sound and activating the alarm lights. Doors were automatically unlocked to facilitate safe and quick exit during emergencies. These experimental results demonstrate the effectiveness and reliability of the sensors in the smart home system, ensuring security, convenience, and safety for users.

C. Discussion

The smart home project successfully delivers on its promise of convenience, security, and energy efficiency. The fingerprint door lock ensures both safety and ease of accesss. The rainwater sensor responds intelligently to weather conditions, and intrusion detection and fire alarms add an essential layer of security and safety. The project showcases the potential of IoT technologies to meet the demands of modern living, with room for future enhancements and refinements.

TABLE I
RESEARCH PLAN

No	Task	Result form	Time schedule
1	Writing proposal	Proposal	Oct 20-Oct 27 8, 2023
3	...	...	...
N	Writing final paper	Paper	Oct 29, 2023

IV. CONCLUSION

The project's primary deliverables consist of a fully operational smart home system, complemented by a mobile app that enables remote control. This system offers enhances safety and security, and adds convenience through automated tasks. Comprehensive project documentation ensures seamless operation and maintenance.
(1; 2; 3)

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[1] D. Das, "How does a rain sensor work and how to interface it with arduino?" 2022.
[2] R. Santos, "Arduino with pir motion sensor," 2014.
[3] D. Das, "How does mq-2 flammable gas and smoke sensor work with arduino?" 2022.