IIOT PROJECT REPORT

<u>SMART HOME AUTOMATION SYSTEM</u>

Instructor: Dr. Anam Qureshi

MEMBERS	ID
Khizar Ali	K21-3329
Fatima Ali	K21-3249

1. ABSTRACT

In our modern world, automation is everywhere, from big industries to small businesses, and even our homes. Smart home automation provides comfortability, efficiency, and control over home devices. This research demonstrates a system that applies Bluetooth (BLE) protocol to connect your home devices. In our research, a smart energy efficient home automation system is proposed that can access and control the home equipment's from your room. The system integrates multiple sensors like Infrared and Passive Infrared (PIR) sensors, along with servo motor and a 4-channel relay which provides features such as automated door control and motion detection, which thereby reduces energy consumption. For this system, Arduino module is attached to the main supply unit of the home system which can be accessed through the Android application on smartphone that integrates speech recognition using Google Assistant. Thus, our research aims to develop a simple and effective approach towards home automation systems.

2. INTRODUCTION

In today's fast-paced world, homeowners seek convenience, efficiency, and control over their living spaces. A smart home automation system offers a solution by integrating technology to enhance comfort, and security. This project outlines the development of a comprehensive smart home automation system that caters to the diverse needs and preferences of homeowners.

The increasing demand for smart home solutions reflects the growing desire for seamless integration of technology into daily life. Homeowners seek a system that not only automates tasks but also provides insights, control, and peace of mind. This project aims to address these needs by developing a smart home automation system that prioritizes user experience and functionality.

3. METHODOLOGY

Smart home automation systems have gained popularity for their ability to provide convenience, enhance efficiency, and potentially reduce energy consumption [1]. These systems offer users the ability to monitor and control various aspects of their homes through a network-based controllable system [1], . By integrating hardware components, configuring software protocols, and validating system feasibility through prototype testing, users can create efficient and reliable smart home solutions tailored to their needs.

i. *Research and Requirement Gathering*
Conducted thorough research on IoT-based smart home automation systems, focusing on interoperability, security, and user experience. Analysed existing solutions and identify areas for improvement based on user feedback and market trends.

ii. *Design and Prototyping*
Designed the system architecture using IoT principles, with a central controller (Arduino Uno) connecting various sensors and actuators. Prototypes of the smart home automation system were created, incorporating IoT-enabled devices such as the Bluetooth HC-05 module, IR motion sensor, and servo motor. Utilization of user-friendly design principles to develop intuitive interfaces for controlling and monitoring the smart home devices.

iii. *Implementation Details*

Developed a software code to interface with sensors and actuators, utilizing IoT protocols like MQTT or CoAP for communication. Integration of the Bluetooth HC-05 module for wireless connectivity between devices and the central controller. Logic was implemented for sensor data processing, threshold-based control, and real-time monitoring of home automation functions.

iv. *Testing and Validation*

Comprehensive testing was conducted for smart home automation system to ensure functionality, reliability, and security. Unit test cases were written to test sensor calibration and threshold settings to ensure accurate readings and proper triggering of actions. Validate interoperability between IoT devices and compatibility with third-party platforms or services.

a. *Unit Test Cases:*

Infrared Sensor:

We define a function readIrSensor () to read the state of the infrared sensor.

We write two test cases: one to test when the sensor is active (output is HIGH) and one to test when the sensor is inactive output is LOW).

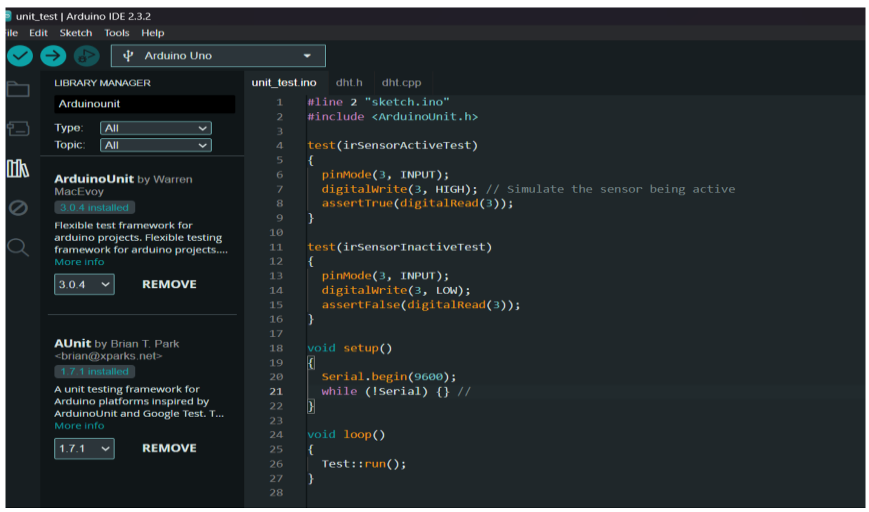


Figure 1 Test Case

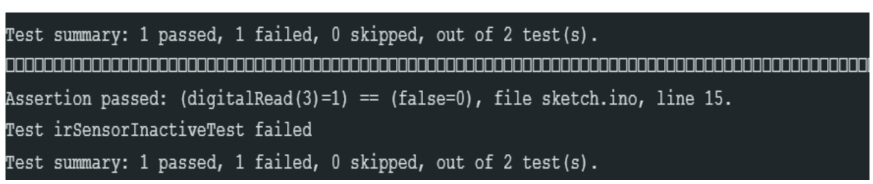


Figure 2 Output.

Humidity and Temperature dht11:

We define the acceptable ranges for temperature and humidity readings. We use hypothetical functions ‘readTemperature()’ and ‘readHumidity’ from the Dht11 library.

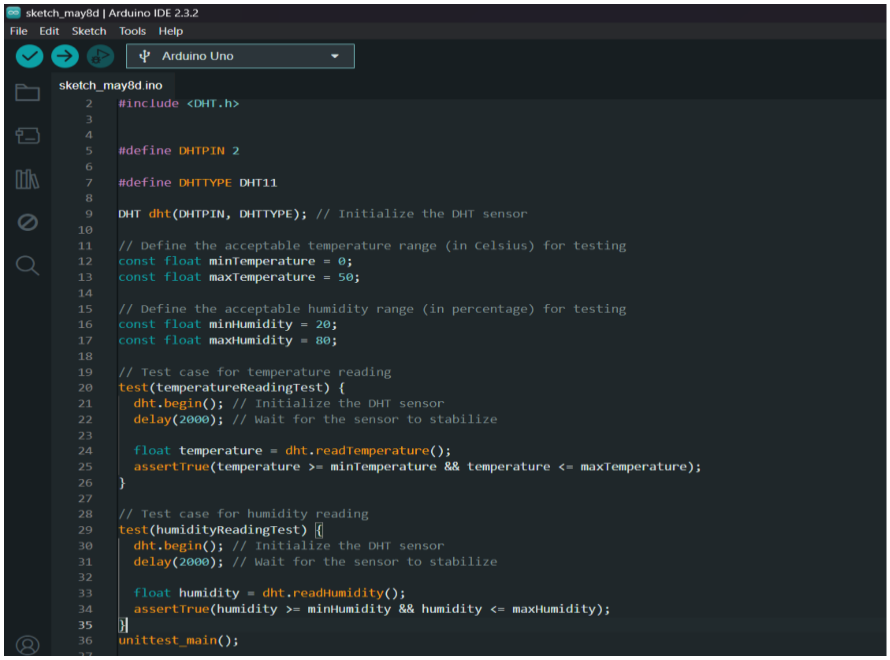


Figure 3 Test Case

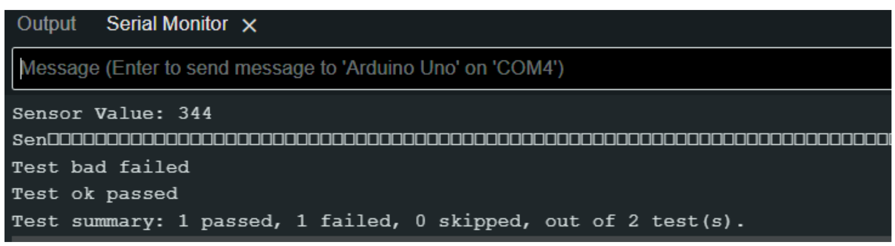


Figure 4 Output.

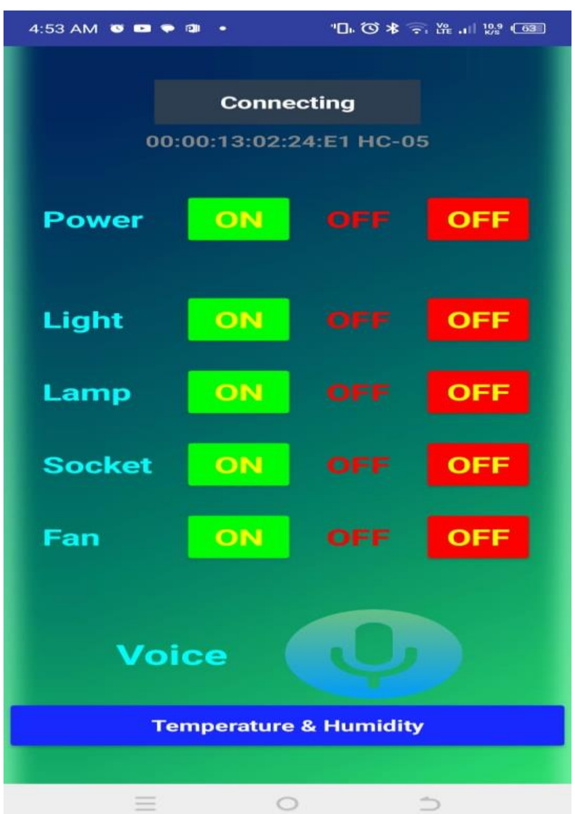
v. *Software Development*

Code constructed to control various home automation devices based on sensor readings and user inputs. For example, turn on/off lights.

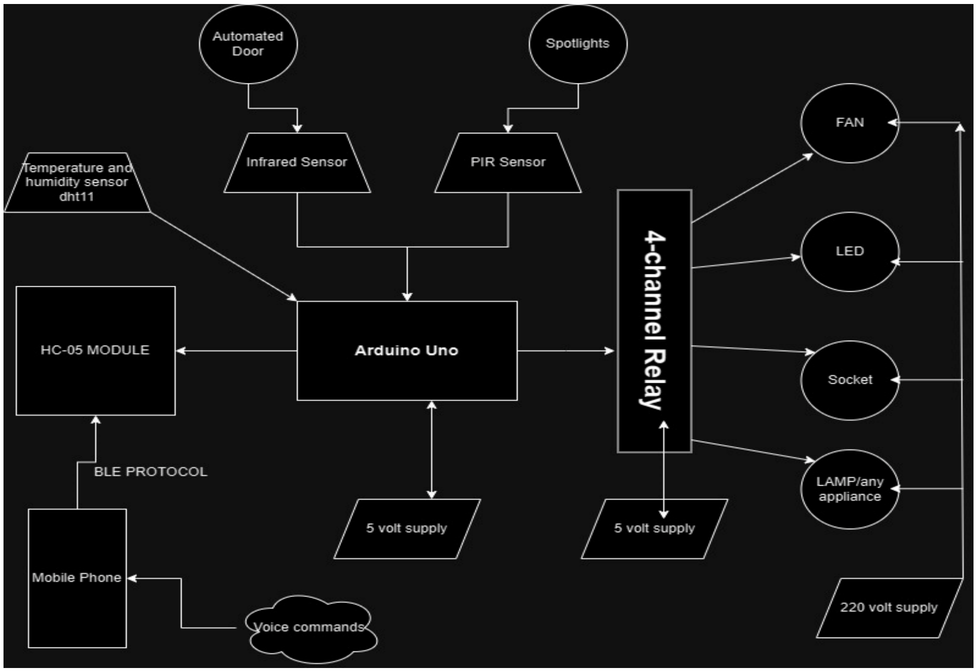
Developed code to establish communication between the central controller (e.g., Arduino) and peripheral devices using Bluetooth protocol. Designed and developed a user interface (UI) for controlling and monitoring the home automation system. We created a mobile app using MIT App inventor. Implemented voice control functionality using platforms like Amazon Alexa or Google Assistant. Relevant code to interpret voice commands and execute corresponding actions.

a. Start Screen

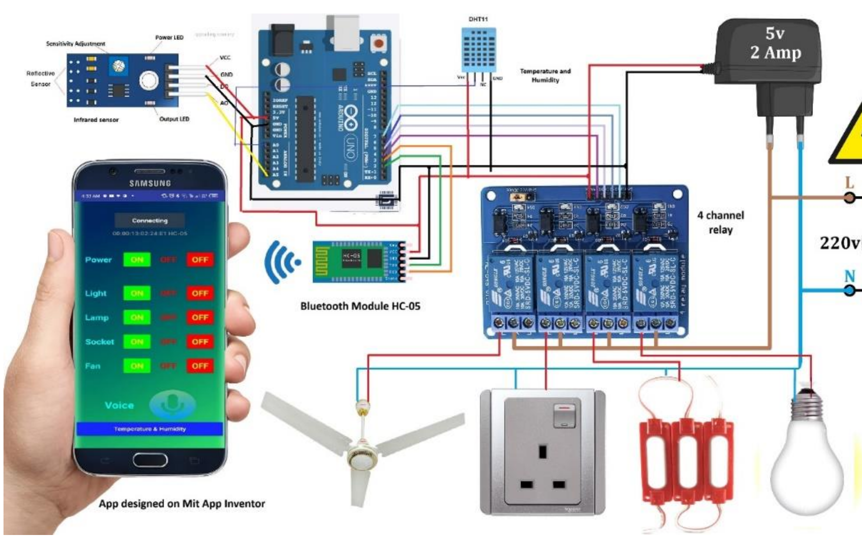
b. Main Screen (control screen)



vi. Block Diagram



vii. Circuit Diagram



viii. Data transmission and Visualization

Upon gathering sensor data from the smart home automation system, implemented a mechanism to store this data into .csv (Comma Separated Values) file.
Utilized Power BI, a powerful business analytics tool by Microsoft, for visualizing the collected sensor data from the .csv files.

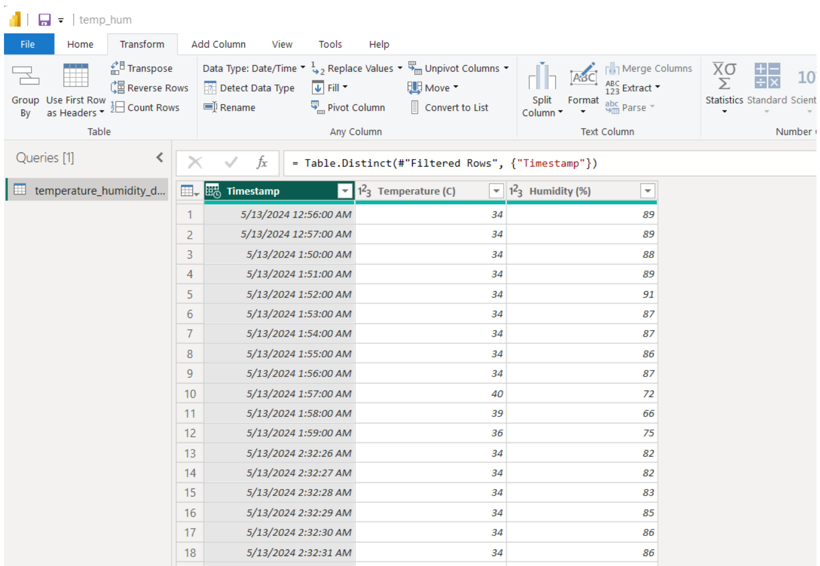


Figure 5 CSV file.

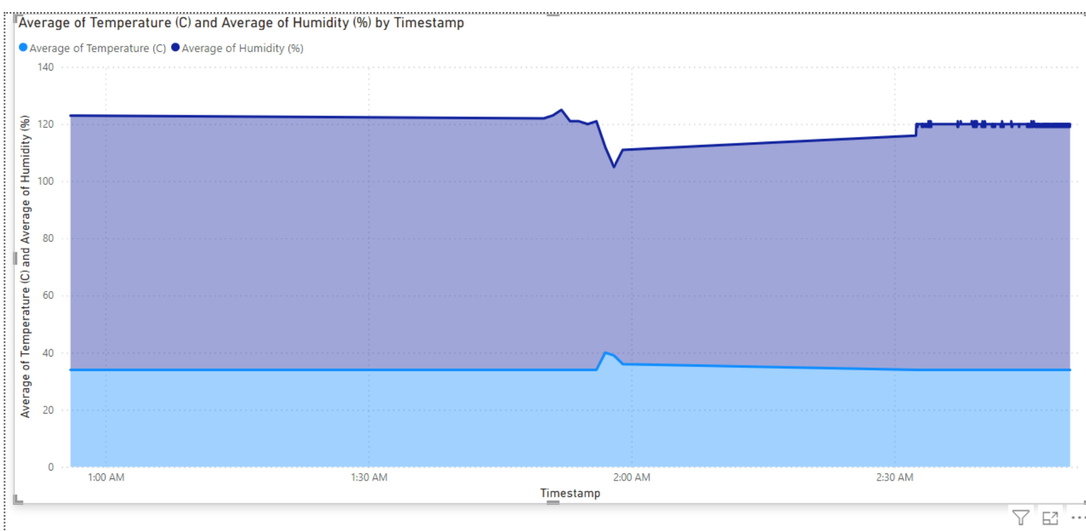


Figure 6 Area Chart on Power Bi

In summary, setting up a home automation system involves integrating hardware components, configuring software protocols such as MQTT, and validating system feasibility through prototype testing. By following a structured approach guided by insights from various sources, users can create efficient and reliable smart home solutions tailored to their needs.

4. RESULTS AND DISCUSSIONS

The smart home automation system, incorporating a diverse array of sensors including motion, temperature, and infrared sensors, alongside actuators such as LED bulbs and an exhaust fan, showcased significant advancements in modernizing residential living environments. The integration of Bluetooth Low Energy (BLE) technology, alongside a comprehensive array of sensors and actuators, has propelled the smart home automation system to the forefront of modern residential living. By harnessing the power of BLE connectivity and leveraging a range of hardware components, including the Bluetooth HC-05 module and Arduino Uno microcontroller, the system has achieved remarkable advancements in enhancing home management and convenience.

Through seamless communication between the BLE-enabled mobile application, developed using MIT App Inventor, and the smart home system, users can effortlessly control and monitor various aspects of their living environment. The integration of motion, temperature, and infrared sensors enables the system to intelligently respond to changes in the home environment, promoting energy efficiency and comfort.
For instance, the motion sensors facilitate automatic activation and deactivation of lighting systems, optimizing energy usage while providing occupants with convenience and security.

With its user-friendly interface and intuitive functionalities, the smart home automation system has the potential to revolutionize traditional home management practices, ushering in a new era of connected and sustainable living. By leveraging BLE technology and a robust hardware infrastructure, the system exemplifies the future of residential automation, offering homeowners unprecedented control, comfort, and peace of mind.

5. CHALLENGES AND FUTURE WORK

In our smart home automation project, several challenges were encountered, primarily related to hardware selection, integration, and resource constraints. The following highlights the challenges faced and outlines potential areas for future improvement and development.

i. *Hardware Sensitivity and Reliability*
The sensitivity and reliability of hardware components posed significant challenges in the smart home automation system.
Issues such as component failures, compatibility issues, and intermittent connectivity impacted the system's performance and reliability.

ii. *Limited Resources and Budget Constraints*
The project faced limitations in terms of resources and budget constraints, which affected the procurement of quality components and equipment. Future projects should explore strategies to

optimize resource allocation, seek alternative funding sources, or leverage partnerships with industry stakeholders to mitigate budget constraints.

iii. *Frequent Replacements and Adjustments*

Due to hardware sensitivity and reliability issues, frequent replacements and adjustments were necessary, disrupting control functionalities. The need for constant maintenance and troubleshooting detracted from the project's efficiency and effectiveness.

Future efforts should focus on implementing robust testing procedures and preventive maintenance strategies to minimize downtime and enhance system stability.

iv. *Future Directions and Recommended Work*

Due to hardware sensitivity and reliability issues, frequent replacements and adjustments were necessary, disrupting control functionalities. The need for constant maintenance and troubleshooting detracted from the project's efficiency and effectiveness.

Future efforts should focus on implementing robust testing procedures and preventive maintenance strategies to minimize downtime and enhance system stability.