

# SMART HOME AUTOMATION SYSTEM

Integration of Sensors, Actuators, and AI  
for Home Control

**BY:**

Habiba Helal Mohammed ID:22010453

Shahd Mohammed Amer ID:22010468

Rowan Kamal Fayad ID:22010340

Merihan Emad Eldeen ID:22011531

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# Project Overview

- **Smart Home Automation System:**

A system that uses technology to control and automate household appliances and systems.

Integrates various sensors, actuators, and communication protocols for monitoring and controlling devices remotely.

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- **Objective:**

To create a comprehensive smart home solution that monitors environmental factors and automates home functions using sensors, actuators, and cloud services.

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- **Core Features:**

Fire detection, door control, lighting control, and Rain control .

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- **Technologies Used:**

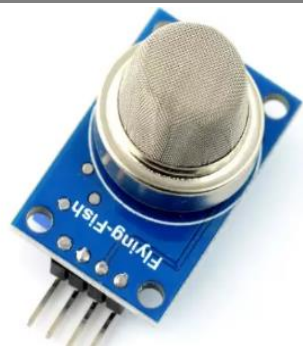
Sensors (Gas, IR, LDR, Light, Rain)

Actuators (LEDs, Servo Motors, Buzzer)

Communication Protocols (Wi-Fi, MQTT)

# Hardware Components

Gas Sensor: Fire detection



IR Sensor: Detects presence near the door.



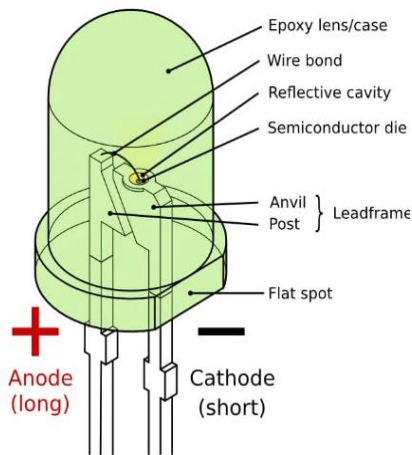
Rain Sensor: Detects rainfall.



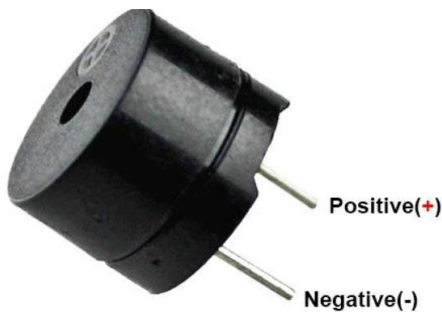
Photo Sensor: Detects day/night light.



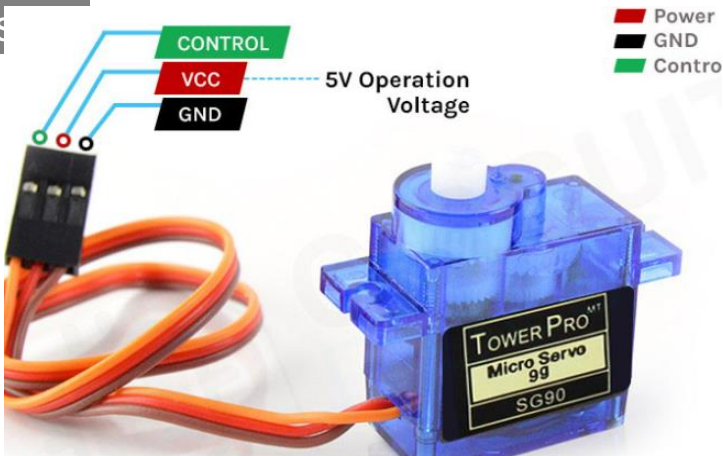
LEDs: Lighting control for rooms and garden.



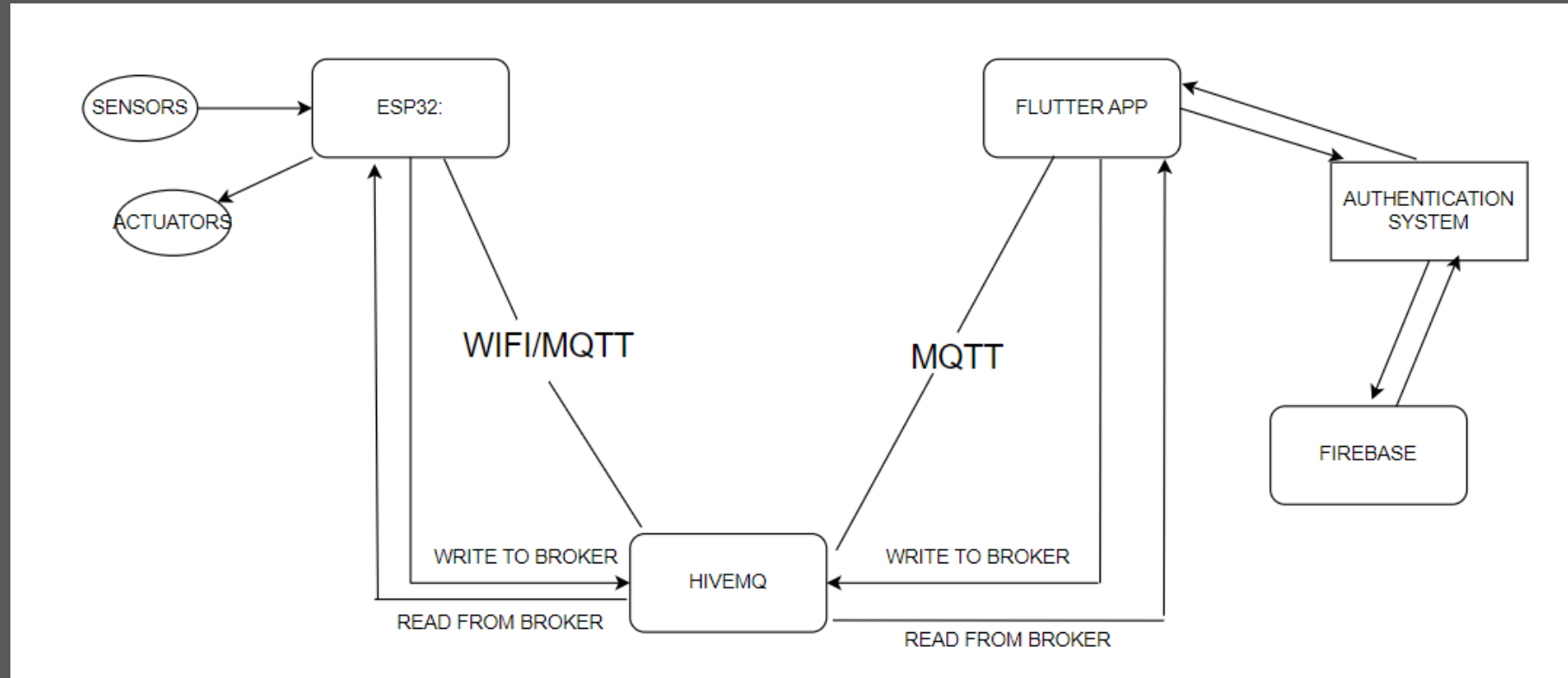
Buzzer: Alerts during fire.



Servo Motor: Door/window opening and closing



# System Architecture



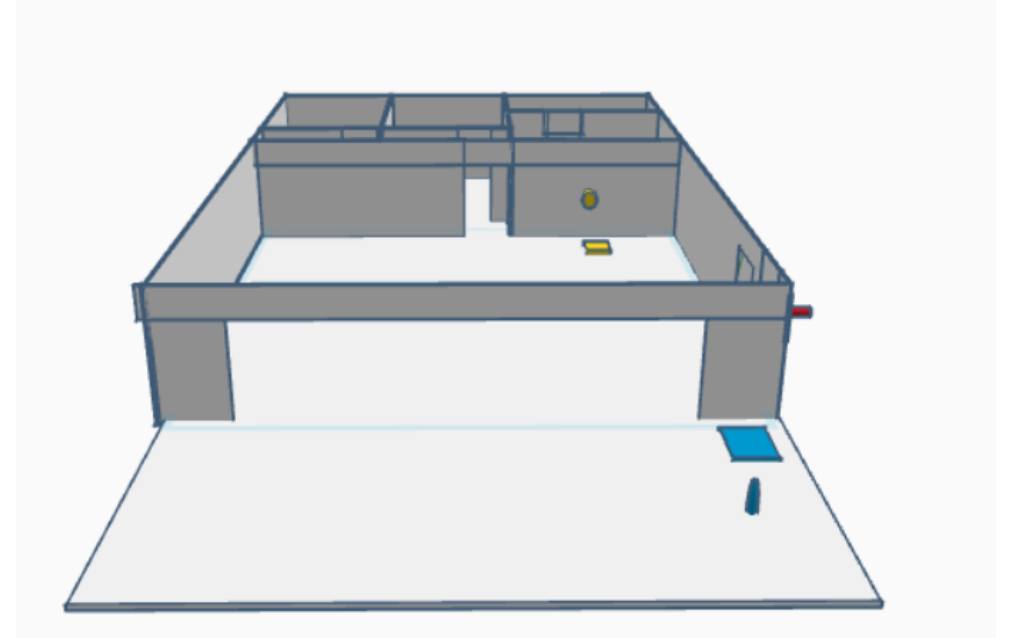
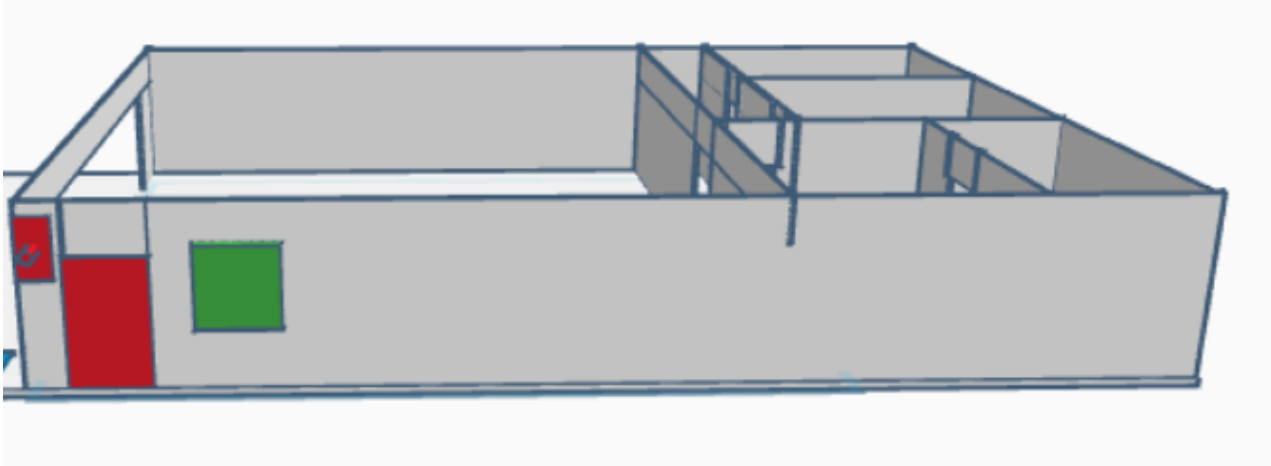
- ESP32: Central controller for sensors and actuators.
- Flutter App: Mobile app for control and monitoring. Displays real-time sensor data and controls actuators.
- Wi-Fi: Used for communication between mobile app, sensors, and actuators.
- MQTT: Messaging protocol for efficient data exchange.
- Firebase: For user authentication and real-time database.

# Maquette Design and Systems Integration

## Manually Created Maquette

The maquette serves as the physical model of the smart home. It visually demonstrates the placement and functionality of various systems.

### Design



## System Integration in Maquette

### Sensor Placement:

Gas Sensor: Installed in the kitchen area for fire detection.

IR Sensor: Positioned near the main door for detecting presence.

Rain Sensor: Placed near the windows for automatic closure during rain.

Light Sensor: Installed outside for garden lighting control.

### Actuator Placement:

Servo Motors: Integrated into doors for automatic opening.

LEDs: Installed in various rooms and garden for lighting.

Buzzer: Placed near the entrance for alarm purposes.

# Rain Detection and Window Control

- **Purpose:** Automatically close windows when rain is detected.

- **Components:**

Rain Sensor: Detects rainfall.

Motor/Actuator: Closes windows.

- **Process:**

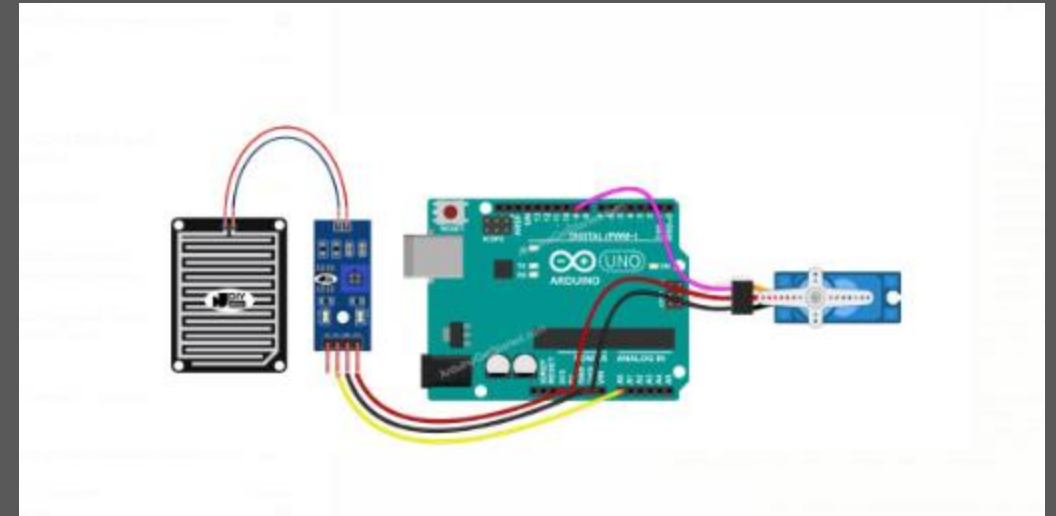
Rain sensor monitors for precipitation.

When rain is detected, the motor/actuator closes the windows.

- **Benefits:**

Protects indoor space from rain damage.

Enhances home automation and convenience.



# Fire Detection and Alarm System

- **Purpose:** Detect fires and activate an alarm.

- **Components:**

Gas Sensor: Detects the presence of gas (fire detection).

Buzzer: Emits an alarm sound when fire is detected.

- **Process:**

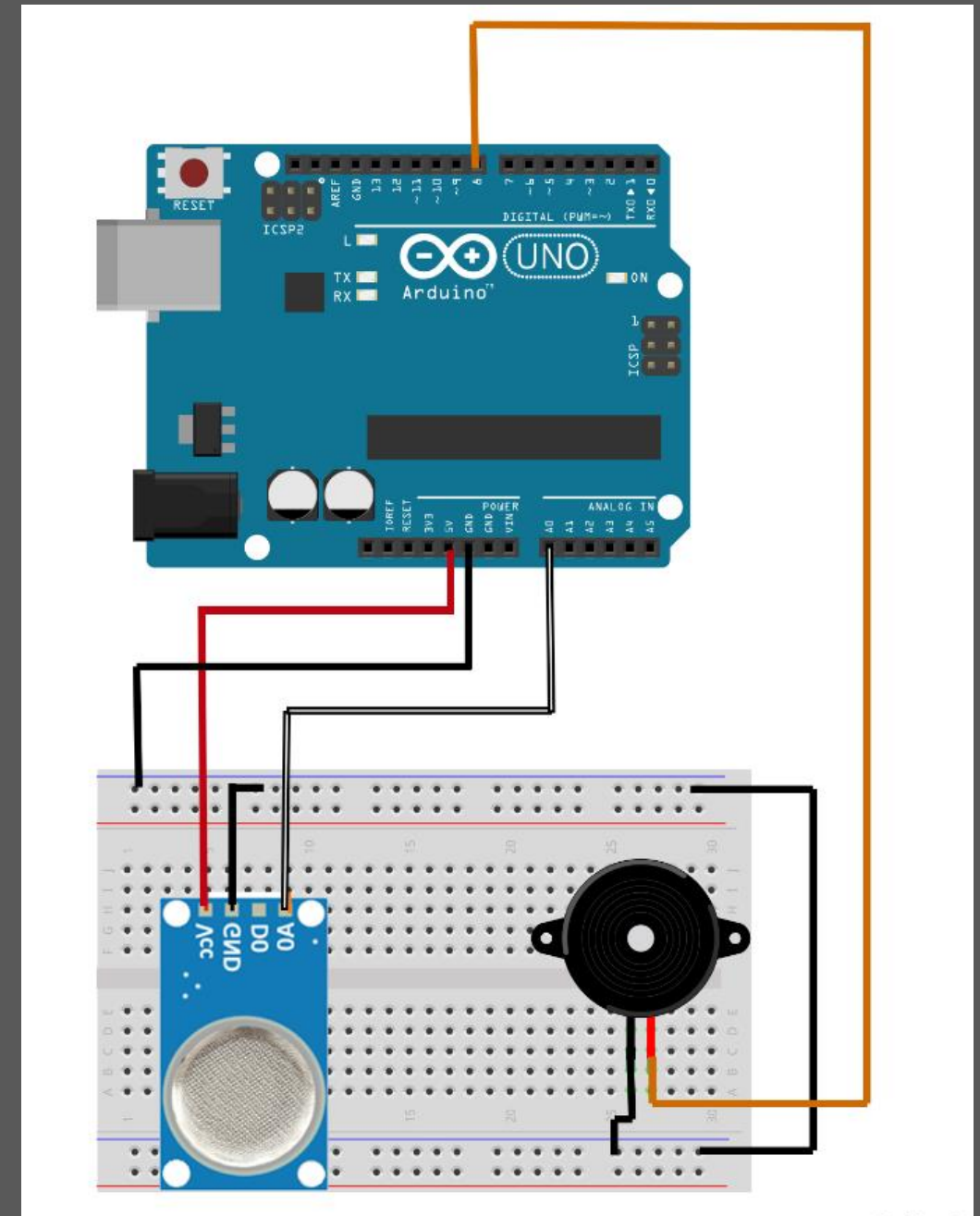
Gas sensor continuously monitors for gas levels.

If gas levels exceed a threshold, the buzzer is activated.

- **Benefits:**

Provides early warning of fire.

Increases safety and alerts occupants.





# Garden LEDs

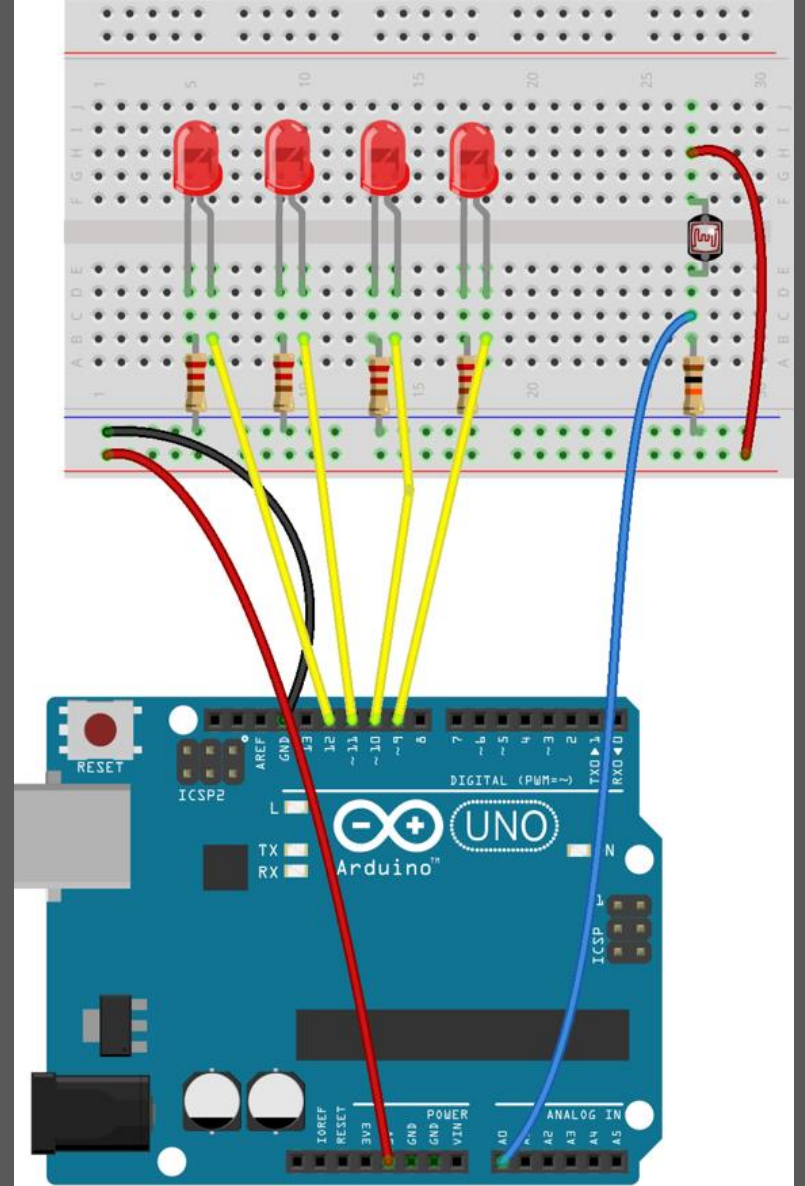
- **Components:**

## LEDs: Provide lighting for the garden.

- Light sensor measures ambient light.

- **Benefits:**

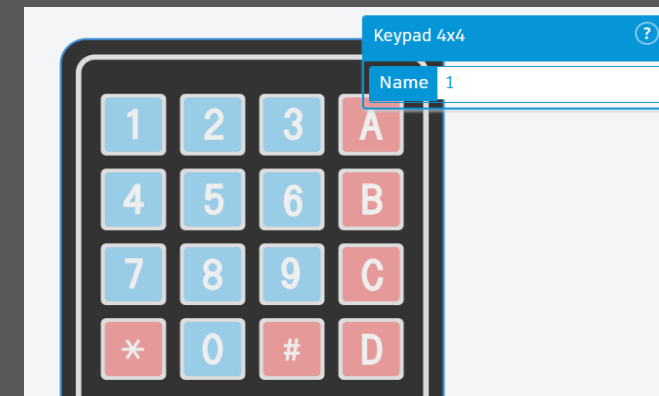
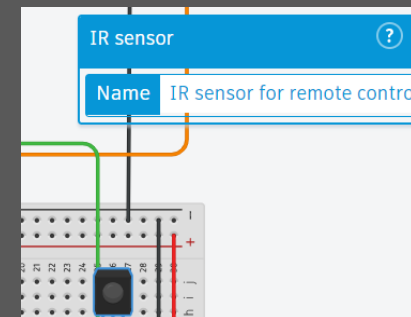
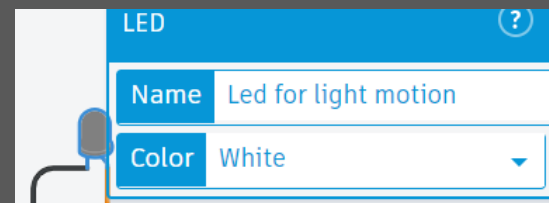
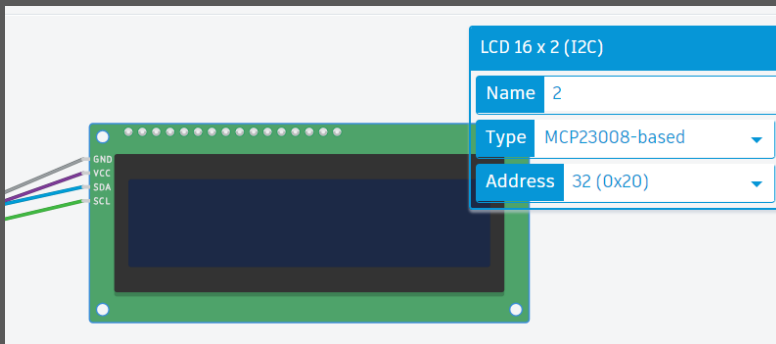
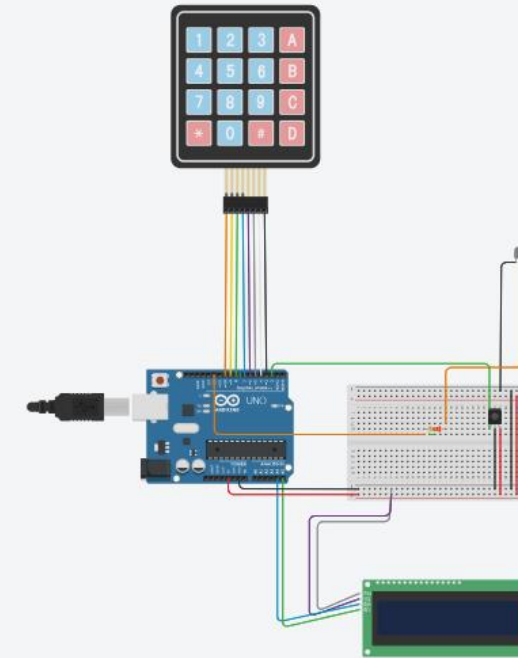
## Enhances garden aesthetics and energy efficiency.





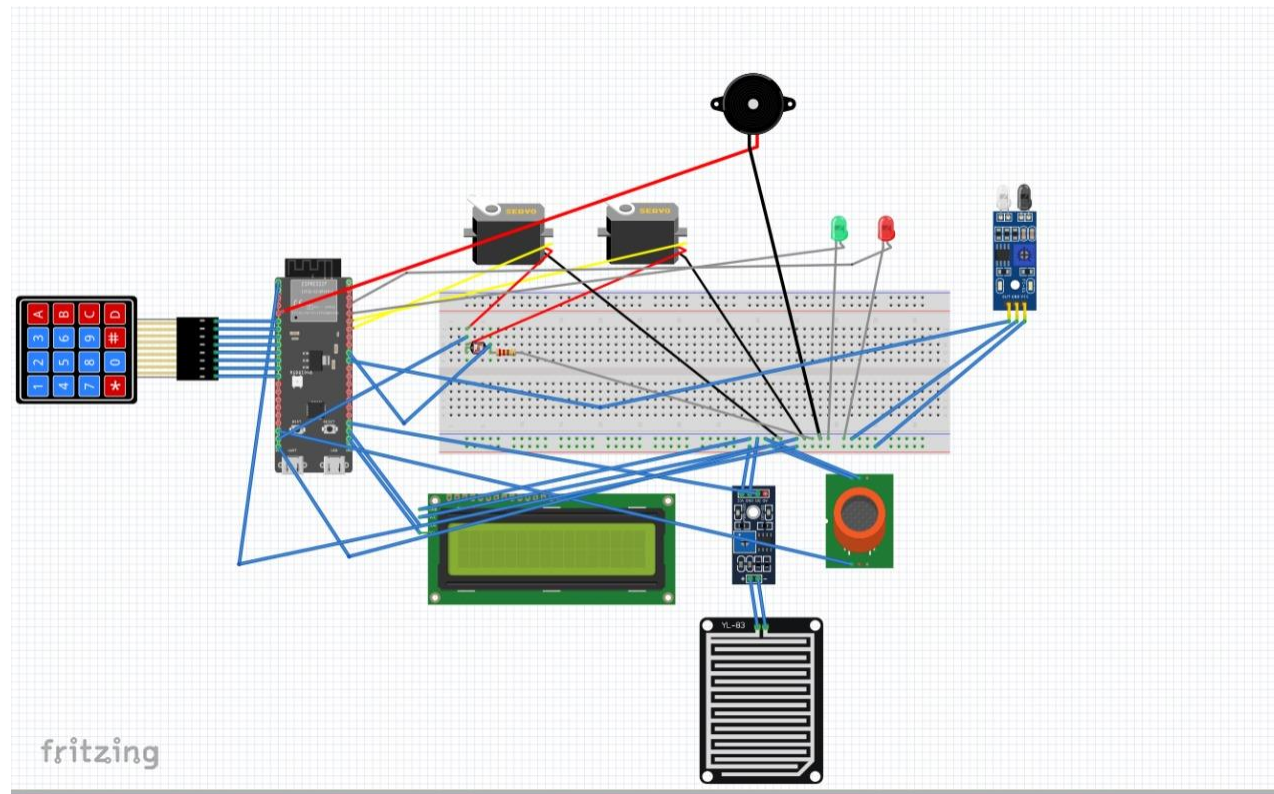
## Smart Door Access and Control

- **Purpose:** Control door access with a password and automatically open the door when an IR sensor detects a person.
- **Components:**  
Keypad: For password input.  
IR Sensor: Detects presence at the door.  
Servo Motor: Opens or closes the door.
- **Process:**  
User inputs password via keypad.  
If the password is correct, the servo motor opens the door.  
The IR sensor detects the presence and facilitates automatic door operation.
- **Benefits:**  
Secure access control.  
Automated door operation for convenience.



The circuit design ensures seamless interaction between the ESP32 and environmental sensors, providing a robust foundation for home automation.

With the flexibility of the Fritzing Simulator, testing and refining the system becomes both efficient and precise, allowing for smooth transitions to physical hardware deployment.



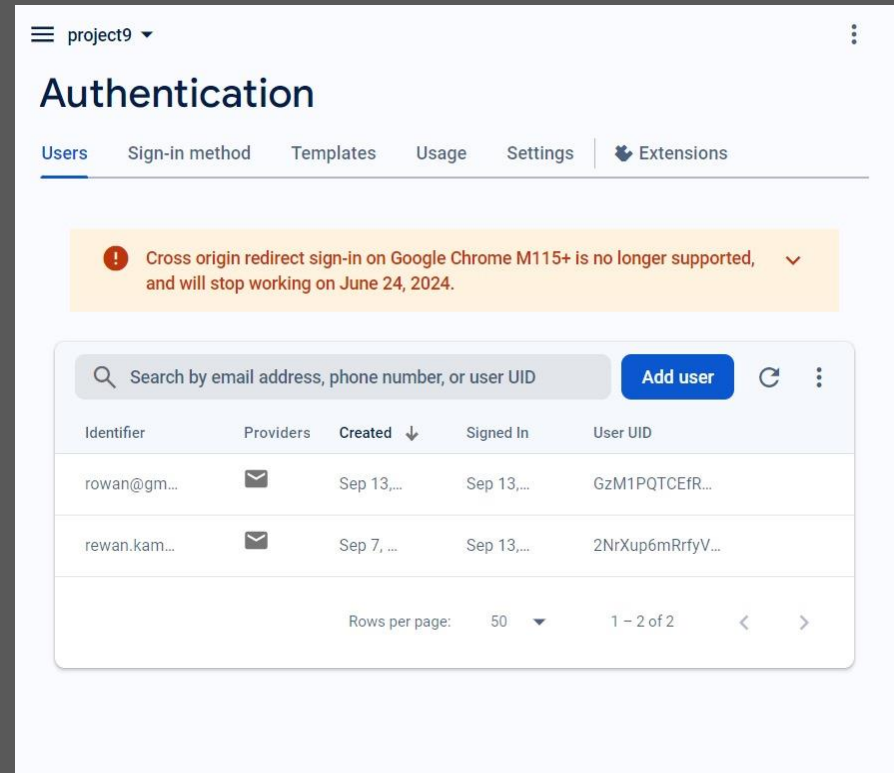
## Firebase Authentication:

- Integrated Firebase for secure login and signup functionality in the Flutter app.




## Firestore Database

- Firestore Database is used to store and retrieve sensor data in real-time.
- The database syncs data across all clients instantly
- Real-time data storage and retrieval for sensors and actuators.



## Secure login using email and password

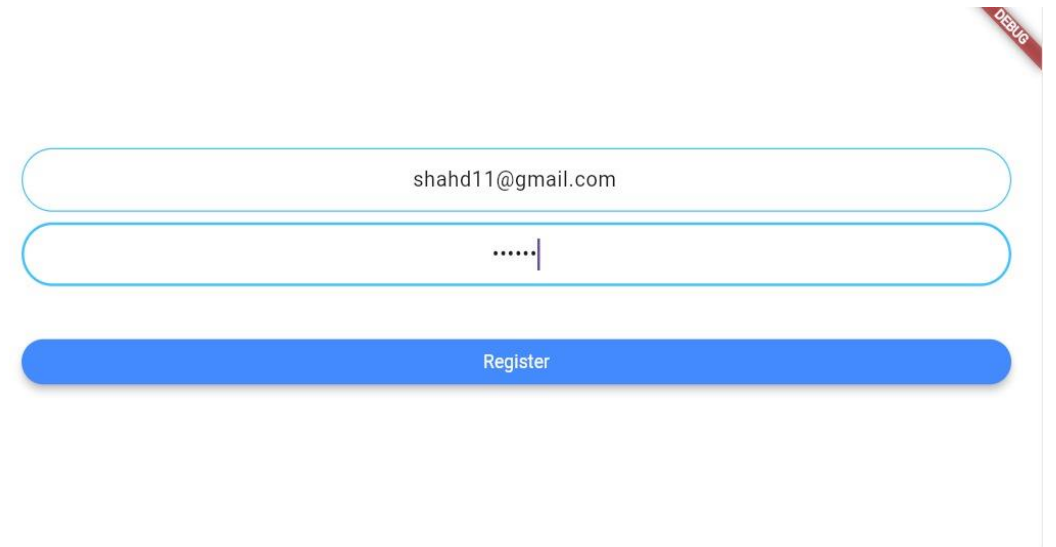
Firebase Authentication is used to manage user logins securely within the app.  
The login page enables users to enter their credentials (email and password) for access.



A UI mockup of a login form. It features two input fields: the top one contains the email 'shahd11@gmail.com' and the bottom one contains a masked password '.....'. Below the inputs is a blue button labeled 'Log In'. A red 'DEBUG' label is in the top right corner.

## Secure account creation with email and password

The sign-up page allows new users to create an account within the app.  
Inputs: Email, Password, and optional profile details.



A UI mockup of a registration form. It features two input fields: the top one contains the email 'shahd11@gmail.com' and the bottom one contains a masked password '.....'. Below the inputs is a blue button labeled 'Register'. A red 'DEBUG' label is in the top right corner.

# Flutter/Dart Mobile Application

- IoT-based Home Automation System using MQTT and Flutter:

This app controls home appliances (LEDs) and monitors environmental conditions like rain and fire detection.

Built using Flutter for the frontend and MQTT protocol for communication with the ESP32 microcontroller.

## MQTT Communication







How it Works:

- The app communicates with the ESP32 device using the MQTT protocol.
  - Topics are used for each control function (e.g., /room\_led, /garden\_led, /rain\_status, /fire\_status).
1. Real-time control and monitoring of home automation systems.
  2. Easily scalable to include more sensors and devices.
  3. Future improvements could include more sophisticated UI elements and adding more sensors.

## HIVEMQ BROKER REDING DISPLAY

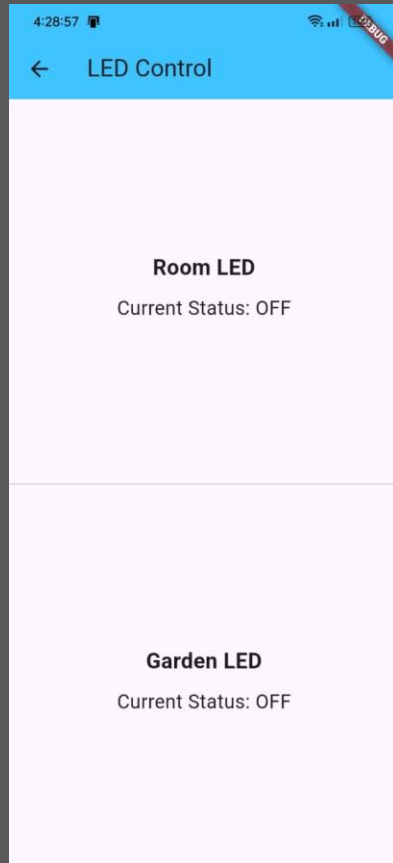
**Messages** 14286

Send and see messages that are published to the topics you are subscribed to. If you cannot see any messages, make sure you are subscribed to the correct topics. You can always subscribe to the ( # ) wildcard to receive all messages.

MESSAGE	TOPIC	QoS
You	Topic	
151	 home/sensors/gas	0
OFF	 home/control/buzzer	0
OPEN	 home/sensors/rain	0
OFF	 home/sensors/ir	0
3421	 home/sensors/ldr	

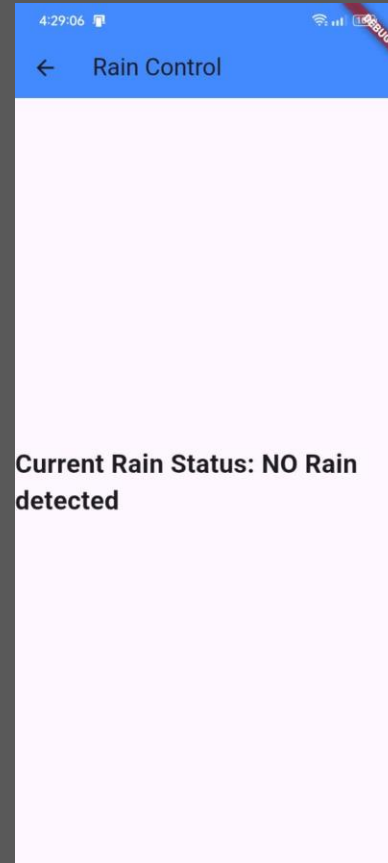
## LED Control:

- Room LED: Toggle ON/OFF control
- Garden LED: Toggle ON/OFF control
- Displays the current status of each LED in real time (e.g., ON/OFF).



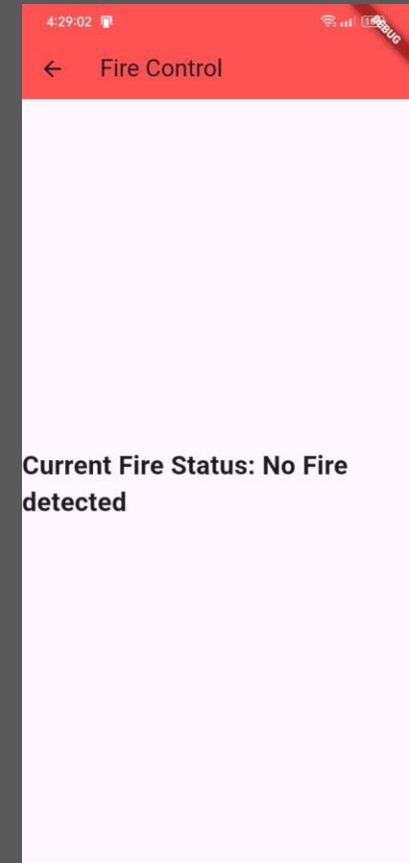
## Rain Control:

- Monitors weather conditions and detects rain.
- Displays current rain status (e.g., "No Rain Detected").
- Ideal for automating outdoor systems like irrigation.



## Fire Control:

- Monitors for potential fire hazards in the environment.
- Displays current fire status (e.g., "No Fire Detected").
- Helps with early detection of fires for safety.



**Thank you for your attention!**  
**Any questions?**

