# SMART HOME AUTOMATION SYSTEM

**A MINI-PROJECT REPORT**

***Submitted by***


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***in partial fulfillment of the award of the degree***

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## BONAFIDE CERTIFICATE

Certified that this project **"HOME AUTOMATION SYSTEM"** is the bonafide work of **"SANGEETHA G (2116210701229), SAKTHILAKSHMI M (2116210701223)"** who carried out the projectwork under my supervision.

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**INTERNAL EXAMINER** **EXTERNAL EXAMINER**

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# ABSTRACT

This home automation project describes an interrelated system which adds to the comfort, security and usability of a house by automatic lighting, gas leak sensing, water level control and automatic water pumping. Utilizing advanced sensor technologies, the project includes four key components: the Blynk mobile application for general system management, gas sensor for leakage, ultrasonic sensor for water level, and pump for the automatic filling of water. Energy efficiency in the bedroom is achieved through remote control of the lighting system through a Blynk application. The gas sensor guarantees timely detection of leaks and generates a signal to warn against dangerous concentrations of gas. Ultrasonic sensors are used to measure the levels of water in tanks or reservoirs continuously and supply information for preventing overflow or dryness. Low water level in the tank triggers the starting of the pump; this greatly helps in managing the available water resource and reducing wastage of this precious resource. Gas and water levels are displayed and recorded by charts in the Blynk application, while the central microcontroller analyzes the results of the sensors and takes action if necessary. This project relates to the design of the integrated system and explains its advantages, showing the potential of such a system for enhancing household safety, energy efficiency, and resource use. Further, it provides solutions to problems associated with integration of home automation systems, reliability, and usability of home automation technologies, and provides a glimpse into future trends of home automation technologies. By undertaking this project, we hope to help develop smart homes and encourage greater safety and efficiency with the use of fewer resources.

# ACKNOWLEDGEMENT

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**SANGEETHA G**

**SAKTHILAKSHMI M**

# CHAPTER 1

# INTRODUCTION

The rapid advancement of technology has paved the way for smarter and more efficient living environments. Home automation systems, which integrate various electronic devices and sensors, have emerged as key enablers of this transformation. These systems are designed to enhance the comfort, convenience, safety, and efficiency of residential spaces. This project presents a home automation system that specifically includes three crucial components: automatic light control, gas leak detection using MQ2 sensor, and water level monitoring using an ultrasonic sensor.

1. **Automatic Light Control** is a significant feature that optimizes energy consumption by allowing users to remotely manage lighting through the Blynk mobile app. This system enables residents to switch lights on or off from their smartphones, providing a convenient and efficient way to control lighting without the need for physical switches. By utilizing the Blynk app, users can easily adjust lighting based on their needs, reducing energy wastage and enhancing convenience. This not only helps in minimizing unnecessary energy consumption but also adds a layer of modern convenience, making manual operation obsolete.

2. **Gas Leak Detection** is a critical safety feature in modern homes. Gas leaks pose serious risks, including potential explosions, fires, and health hazards from inhalation of toxic gases. The system integrates gas sensors that continuously monitor the air for traces of hazardous gases. Upon detection of a leak, the system can trigger alarms and notifications, enabling prompt action to mitigate the danger. Some advanced setups may even include automatic gas shutoff mechanisms to further enhance safety.

3. **Water Level Monitoring** using ultrasonic sensors addresses the efficient management of water resources. This feature is particularly useful in areas with water storage tanks or systems that require regular monitoring to prevent overflow or depletion. The ultrasonic sensor measures the water level in real-time, providing accurate data that can be used to automate refilling processes or alert homeowners to potential issues. This ensures a consistent water supply and prevents wastage, contributing to more sustainable water usage.

By integrating these components, the proposed home automation system not only improves the quality of life for residents but also enhances the safety and sustainability of the home environment. This introduction sets the stage for a detailed exploration of the system's architecture, functionality, and benefits, underscoring the transformative potential of home automation technologies in modern living spaces.

# CHAPTER 2

# LITERATURE SURVEY

**[1] An overview of home automation systems:** The paper introduces Bluetooth technology for home automation, creating a smart home network without additional wiring costs. It details a system with a Host Controller (HC) on a PC and client modules communicating via Bluetooth, using the Home Automation Protocol (HAP) for data exchange. Hardware includes microcontrollers, temperature sensors, and Bluetooth interfaces, while software development involves firmware and data exchange protocols. The system's functionality is demonstrated with a room temperature control system. Future enhancements could include error detection and correction mechanisms. Overall, the paper outlines a cost-effective and efficient approach to home automation using Bluetooth technology.

**[2] Bluetooth based home automation system - N. Sriskanthan, F. Tan, A. Karande:** The paper explores the application of Bluetooth technology in home automation, creating a network of interconnected intelligent appliances. The system features a Host Controller on a PC and various client modules (home appliances) communicating via Bluetooth using the Home Automation Protocol (HAP). This setup allows for scalable, user-friendly, and cost-effective automation. Hardware includes microcontrollers and temperature sensors, while the software handles Bluetooth initialization, data exchange, and device control. Demonstrated through a temperature control system, the paper highlights Bluetooth's potential in creating efficient and interconnected home environments, with recommendations for further development.

[3] **A risk analysis of a smart home automation system:** In the near future, an estimated 90 million people will live in smart homes, enhancing security, comfort, and energy use. Many individuals, particularly in Sweden, lack knowledge and

control over their energy consumption. Smart home automation systems can provide feedback on energy use, reducing consumption by up to 20%. These systems, part of the Internet of Things (IoT), monitor and manage home environments, offering autonomous operation of devices. However, challenges such as security, privacy, and vendor lock-in persist. A common interface for managing various smart home systems has been developed, tested in Malmö, Sweden, to address these issues and enhance energy efficiency through open APIs and third-party applications.

[4] **Design-of-a-Home-Automation-System-Using-Arduino-libre:** This paper describes a low-cost, flexible home automation system using an Arduino Mega 2560 microcontroller with IP connectivity. It enables remote control and monitoring of home devices via a web application or a Bluetooth-enabled Android smartphone app. The system integrates light switches, power plugs, temperature sensors, gas sensors, and motion sensors. It features environmental monitoring and intrusion detection. The hardware module includes sensors and relay switches, while the software module comprises an Android app and a web application, both providing user-friendly interfaces for device control. Future improvements include SMS alerts and reduced wiring for installation.

**[5] Home automation system with android application:** This work presents a home automation system that enables wireless control of appliances like lights, air conditioners, electronic doors, and fans. Users can manage these devices via a web server or an Android smartphone app. The system employs a Restful API framework to control the Raspberry Pi's GPIO through HTTP requests. Both methods utilize the Restful API, but additional functionalities are needed for the Android app. A desktop PC runs the server software, and the Raspberry Pi acts as the board controller, connecting to appliances through its input and output ports.

# CHAPTER 3

## EXISTING SYSTEM

Manually controlling home systems such as lighting, gas leak detection, and water level monitoring presents numerous challenges that can significantly impact convenience, safety, and resource efficiency. Manually operating lights often results in inconvenience, as residents frequently need to switch lights on and off, which can be particularly cumbersome in large homes or for individuals with mobility issues. Additionally, this method is prone to human error, leading to lights being left on unintentionally, causing unnecessary energy consumption and increased electricity bills. Moreover, manually controlled lighting lacks optimization based on ambient conditions or occupancy, resulting in inefficient energy use. Security can also be compromised as predictable lighting patterns may signal an empty house to potential intruders.

Relying on manual detection of gas leaks is fraught with risks, as human senses are unreliable for detecting certain hazardous gases, such as carbon monoxide, which is odorless and can remain unnoticed until it poses a serious health risk. The absence of an immediate alert system further delays the response time, increasing the danger of accidents, including fires and explosions, which can be catastrophic for both property and human life.

Similarly, manual water level monitoring is inefficient and labor-intensive. It often involves inaccurate measurements and requires significant time and effort, particularly in properties with multiple water sources. This approach can lead to either water wastage or insufficient supply, with potential overflows or shortages going undetected until they cause substantial problems, such as water damage or dry tanks.

Integrating automated systems for these functions can greatly mitigate these issues. Automatic light control enhances convenience by managing lighting based on occupancy and ambient light conditions, reducing energy consumption and improving security by simulating occupancy. Automated gas leak detection provides immediate alerts and can even trigger automatic safety measures, thus significantly enhancing safety and reducing health risks. Water level monitoring using ultrasonic sensors ensures accurate, real-time data, optimizing water usage, preventing overflows and shortages, and facilitating preventive maintenance.

Overall, the adoption of home automation systems that include automatic light control, gas leak detection, and water level monitoring addresses the inefficiencies and risks associated with manual control. These systems improve the quality of life by offering greater convenience, safety, and resource management, highlighting the transformative potential of integrating advanced technologies into modern homes.

# CHAPTER 4
# PROPOSED SYSTEM

Manually controlling home systems such as lighting, gas leak detection, and water level monitoring presents numerous challenges that can significantly impact convenience, safety, and resource efficiency. Manually operating lights often results in inconvenience, as residents frequently need to switch lights on and off, which can be particularly cumbersome in large homes or for individuals with mobility issues. Additionally, this method is prone to human error, leading to lights being left on unintentionally, causing unnecess energy consumption and increased electricity bills. Moreover, manually controlled lighting lacks optimization based on ambient conditions or occupancy, resulting in inefficient energy use. Security can also be compromised as predictable lighting patterns may signal an empty house to potential intruders.

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Similarly, manual water level monitoring is inefficient and labour-intensive. It often involves inaccurate measurements and requires significant time and effort, particularly in properties with multiple water sources. This approach can lead to either water wastage or insufficient supply, with potential overflows or shortages going undetected until they cause substantial problems, such as water damage or dry tanks. Additionally, the manual operation of water pumps to refill tanks can be inefficient and prone to error, leading to either overfilling or underfilling, which further complicates water resource management.

Integrating automated systems for these functions can greatly mitigate these issues. Automatic light control enhances convenience by allowing users to manage lighting through a mobile app, reducing energy consumption and improving security by enabling unpredictable lighting patterns that simulate occupancy. Automated gas leak detection provides immediate alerts and can even trigger automatic safety measures, thus significantly enhancing safety and reducing health risks. Water level monitoring using ultrasonic sensors ensures accurate, real-time data, optimizing water usage, preventing overflows and shortages, and facilitating preventive maintenance. Furthermore, the integration of automated pump control ensures that tanks are refilled when water levels are low and stops the pump when the desired level is reached, preventing overflows, and ensuring an adequate water supply.

Overall, the adoption of home automation systems that include automatic light control, gas leak detection, water level monitoring, and automated pump control addresses the inefficiencies and risks associated with manual control. These systems improve the quality of life by offering greater convenience, safety, and resource management, highlighting the transformative potential of integrating advanced technologies into modern homes.

# CHAPTER 5

# PROJECT DESCRIPTION

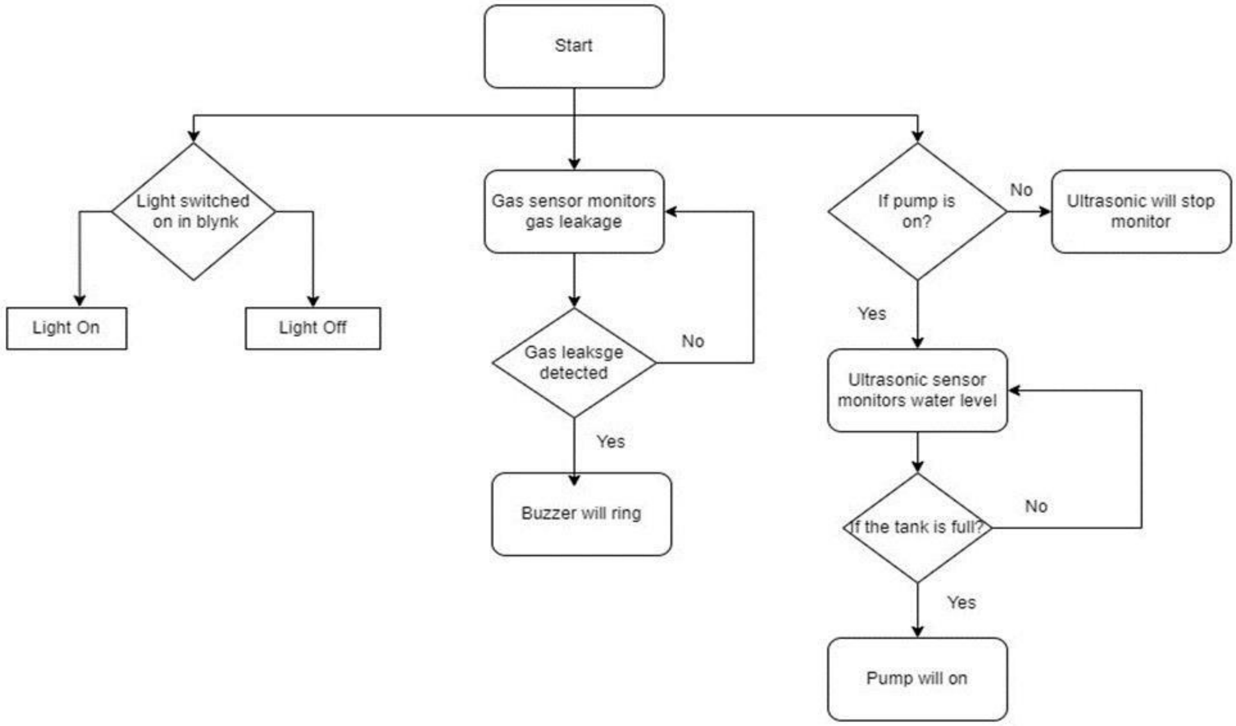



Fig 5.1 PROCESS FLOW DIAGRAM

## 1. Lighting Control Module

The lighting control module leverages the Blynk mobile app to provide residents with remote control over their home lighting system. By using the app, users can easily switch lights on or off from their smartphones, reducing the need for physical switches and enhancing convenience, especially in large homes or for individuals with mobility issues. This module eliminates the inconvenience of manually operating lights, thereby minimizing human error, such as leaving lights on unintentionally, which leads to unnecessary energy consumption and increased electricity bills. Additionally, the system allows for the scheduling of lighting patterns, which can improve home security by simulating occupancy, deterring potential intruders.

2. **Gas Leak Detection Module**

The gas leak detection module incorporates an MQ-2 gas sensor to identify the presence of hazardous gases like carbon monoxide. This sensor is integrated with the Blynk app, providing real-time alerts to residents in case of a gas leak. Additionally, a buzzer is activated when a gas leak is detected, providing an immediate audible warning to alert occupants of the danger. Unlike manual detection, which is unreliable and can result in delayed responses, this automated system ensures immediate notification and can trigger safety measures to mitigate risks. This module significantly enhances home safety by reducing the likelihood of accidents, including fires and explosions, thereby protecting both property and human life. The immediate alerts allow for quick evacuation and prompt action to rectify the leak, ensuring a safer living environment.

3. **Water Level Monitoring Module**

The water level monitoring module employs an ultrasonic sensor to continuously monitor the water levels in tanks or reservoirs. The data collected by the sensor is transmitted to the ESP32 microcontroller, which processes the information and updates the Blynk app in real-time. This setup provides residents with accurate and up-to-date information on water levels, preventing both overflow and dry conditions. Manual water level monitoring is often inaccurate and labor-intensive, but this automated solution offers precise measurements with minimal effort. The module ensures efficient water resource management, reducing wastage and ensuring a consistent water supply.

4. **Automated Pump Control Module**

Complementing the water level monitoring module, the automated pump control module manages the refilling of water tanks using a relay to control the pump. When the ultrasonic sensor detects that the water level is low, the system automatically activates the pump via the relay to refill the tank. Once the desired water level is reached, the pump is switched off to prevent overflow. This automated control minimizes the risks associated with manual pump operation, such as overfilling or underfilling, and ensures optimal water usage. By preventing wastage and maintaining adequate water levels, this module contributes significantly to the efficient management of water resources within the home.

5. **Central Microcontroller and Integration Module**

At the heart of the system is the ESP32 microcontroller, which integrates all the modules and processes the data from various sensors. The ESP32 acts as the brain of the system, executing commands and ensuring smooth operation of all automated functions. It communicates with the Blynk app to provide users with real-time updates and alerts, facilitating seamless interaction with the system. This central integration ensures that all modules work together harmoniously, enhancing overall system reliability and performance.

6. **User Interface Module**

The user interface module, powered by the Blynk mobile app, serves as the primary point of interaction between the residents and the home automation system. The app displays data from the gas leak detection, water level monitoring, and pump control modules, providing users with comprehensive control and oversight. The app also stores data in the form of charts, enabling users to analyze trends and optimize their resource usage over time.

# CHAPTER – 6

# SYSTEM DESIGN

## 6.1 ARCHITECTURE DIAGRAM

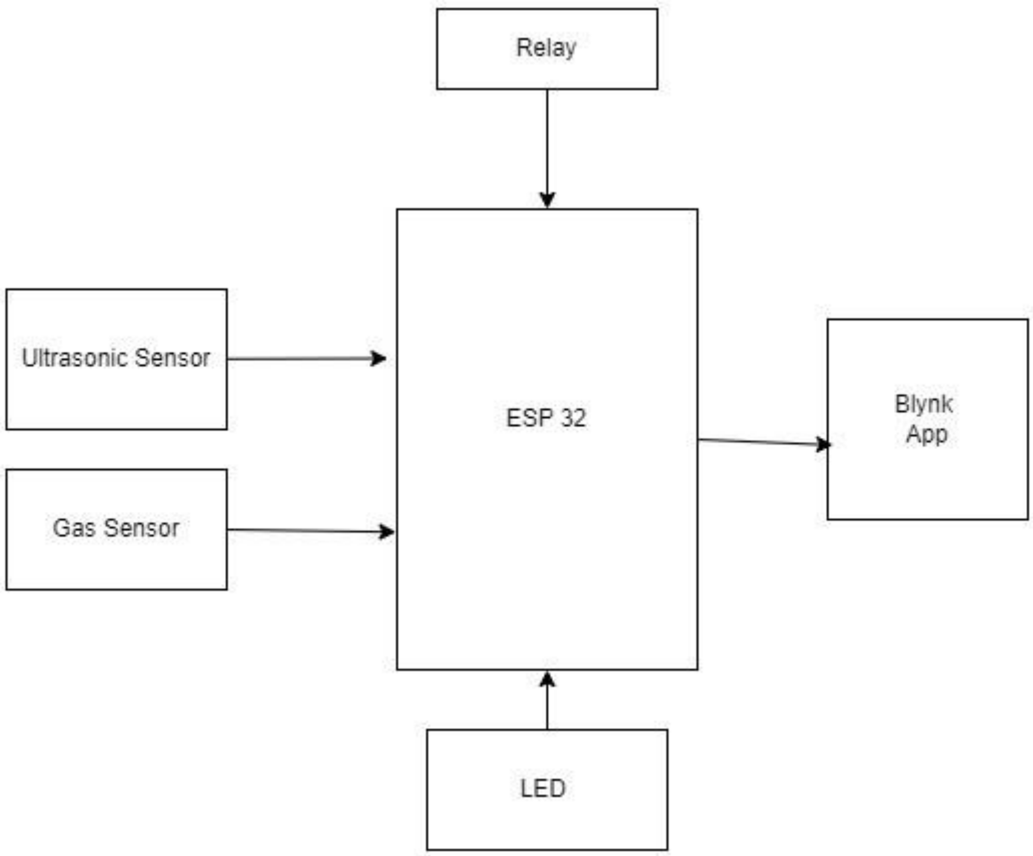



Fig 6.1 ARCHITECTURE DIAGRAM

The water level monitoring system described is designed for both safety and automation, integrating several components and features to ensure efficient and secure operation. Key components of the system include the Blynk App, gas sensor, ultrasonic sensor, pump, buzzer, and relay. The Blynk App acts as the user interface, enabling remote monitoring and alert reception via a smartphone. The gas sensor is responsible for detecting flammable or toxic gases such as methane or propane, ensuring safety by providing early warnings of potential hazards. The ultrasonic sensor measures the distance to the water surface by emitting sound waves and calculating the time it takes for the echo to return, enabling precise water level measurement.

The electric pump fills the water tank, while the buzzer serves as an audible alarm to alert users in case of gas leakage. The relay is used to control the pump's operation, turning it on and off as needed. The system operates through a series of steps. Upon powering up, an indicator light may illuminate to show the system is operational. The gas sensor continuously monitors for gas leaks, and if a leak is detected, the buzzer sounds a loud, continuous alarm to notify of potential danger. Meanwhile, the ultrasonic sensor emits ultrasonic waves that travel through the air, reflect off the water surface, and return to the sensor. The time taken for the round trip is used to calculate the distance between the sensor and the water.

The system then evaluates the water level by comparing the measured distance to pre-programmed thresholds that define the "full" and "empty" levels of the tank. If the tank is full, indicated by the water surface being close to the sensor, the system automatically shuts off the pump to prevent overflow. Conversely, if the tank is not full, the system initiates the filling process by turning on the pump, which draws water into the tank. This entire process, from gas detection to water level measurement and pump control, is continuous, ensuring constant monitoring and adjustment as needed.

Additionally, the Blynk app can provide real-time displays of the water level and allow users to set the pump on or off remotely, as well as receive alerts for critical situations like low water levels or potential gas leaks. The automation aspect eliminates the need for manual monitoring, reducing the risk of human error, and ensures the tank is filled automatically without overflowing.

## 6.2 CIRCUIT DIAGRAM

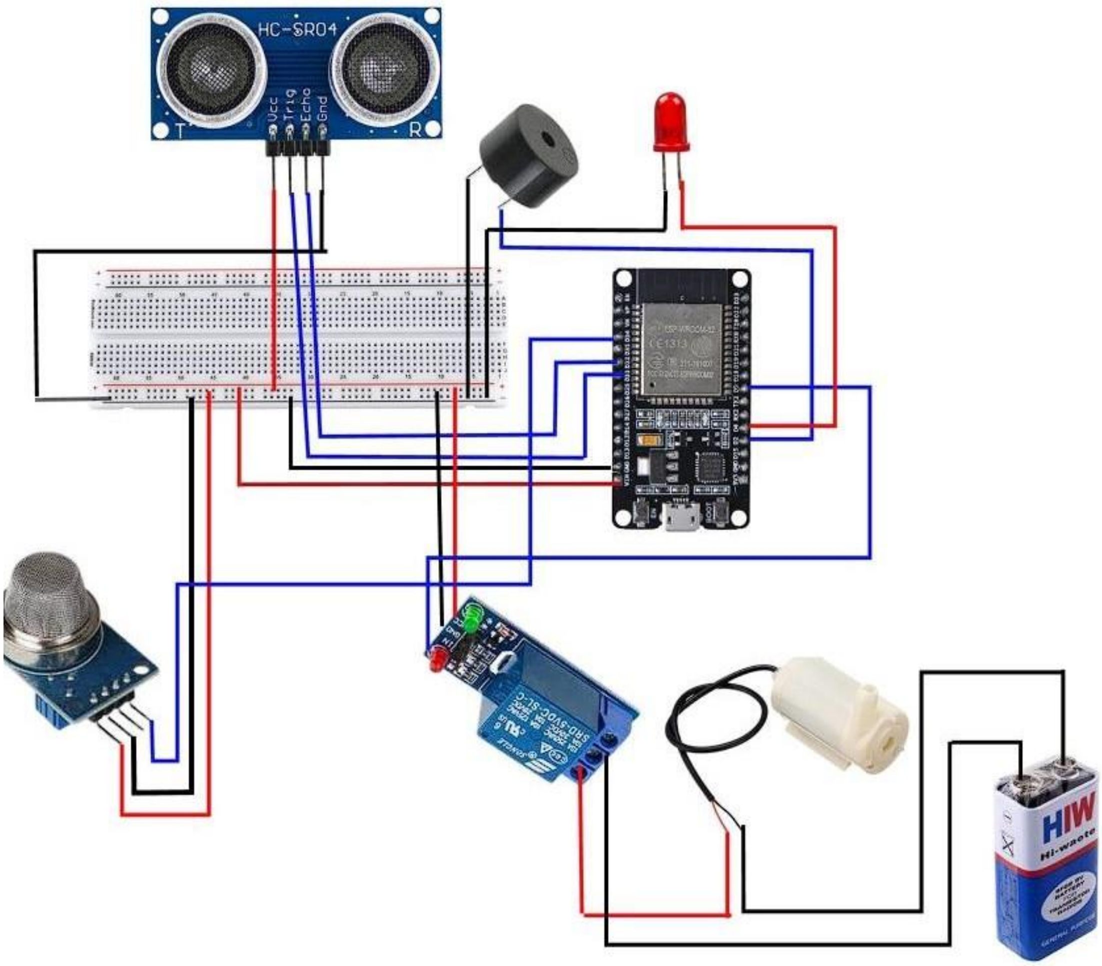



Fig 6.2 CIRCUIT DIAGRAM

## 6.3 HARDWARE REQUIREMENTS:

### HARDWARE COMPONENTS:

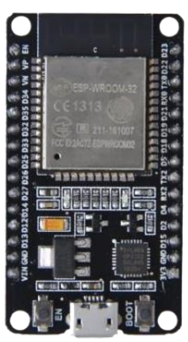
- Esp 32
- Ultrasonic Censor

- Gas Sensor
- LED
- Jumper Wires
- Pump
- Laptop
- USBMouse
- Data Cable

### 6.4 SOFTWARE COMPONENTS:

- Arduino IDE

**ESP 32:**



ESP32 is a series of low-cost, low-power system on a chip microcontroller with integrated Wi-Fi and dual-mode Bluetooth. The ESP32 features a powerful dual-core Xtensa LX6 microprocessor, providing robust computational capabilities suitable for demanding applications. It has numerous General Purpose Input/Output (GPIO) pins for connecting sensors, LEDs, and other peripherals.

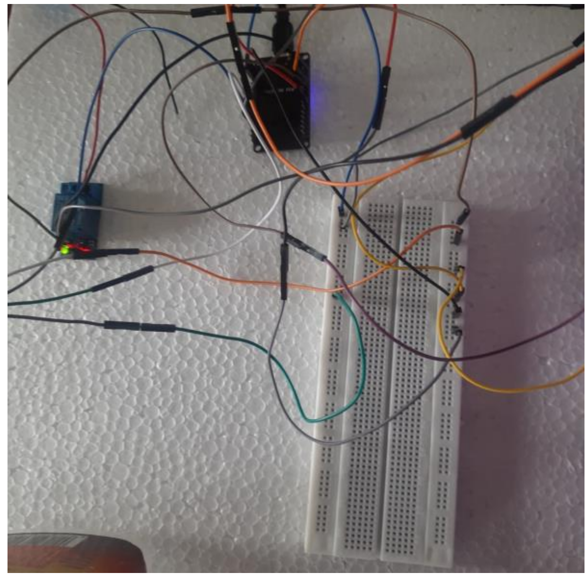
**ULTRASONIC SENSOR:**

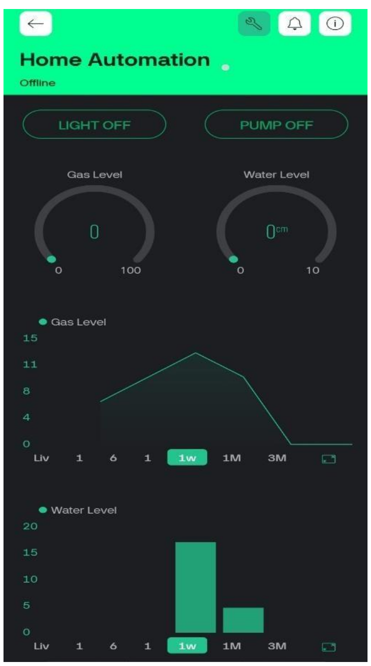

Ultrsonic sensors have two piezo electric crystals called transmitter and receiver. The transmitter emits the ultrasonic waves. When the ultrasonic waves hits an object it returns back and received by the receiver. We can calculate the distance between the ultrasonic sensor and the object by using the formula. Distance = ( Speed * Time) / 2

**MQ2 SENSOR:**

The MQ-2 sensor is capable of detecting multiple gases including LPG (liquefied petroleum gas), methane, alcohol, hydrogen, propane, carbon monoxide, and smoke. The sensor operates based on a tin dioxide ($SnO_2$) semiconductor layer that has low conductivity in clean air. When the target gases are present, they reduce the resistance of the $SnO_2$ layer, increasing conductivity. The sensor outputs an analog voltage that varies with the concentration of the detected gas.

# CHAPTER 7
# OUTPUT






The Blynk application shows the gas level and water level. If there is presence of gas leakage, the buzzer will ring and notification will be sent to the application. We can also control the light from this app.

# CHAPTER 8

# CONCLUSION AND FUTURE WORK

In conclusion, the proposed home automation system powered by the ESP32 microcontroller offers a holistic solution for modern homeowners seeking enhanced convenience, safety, and resource efficiency. Through remote control via a mobile app, the system simplifies lighting management, reducing energy wastage and adapting to user preferences seamlessly. The integration of sensors for water level monitoring and gas leak detection adds layers of proactive safety and resource management, preventing potential hazards and promoting sustainable practices.

Looking ahead, the system's potential for future enhancements, such as voice assistant integration, advanced analytics, and scalability, promises even greater functionality and customization. By continuously evolving and incorporating fail-safe measures, renewable energy integration, and user-friendly interfaces, the system stands poised to meet the evolving needs of smart homes and contribute to a more sustainable and intelligent living environment for users. Ultimately, this home automation solution represents a step towards smarter, safer, and more efficient homes, enhancing quality of life while reducing environmental impact.

## APPENDIX

homeAutomation.cpp

```
#define BLYNK_TEMPLATE_ID "TMPL358S56nvi"
#define BLYNK_TEMPLATE_NAME "Home Automation"
#define BLYNK_PRINT Serial



#include <WiFi.h>
#include <WiFiClient.h>
#include <BlynkSimpleEsp32.h>

char auth[] = "2Ee_rmUV3s8ktY8nOlwTjrhjeTLkfsTG";
char ssid[] = "OPPO A31";
char pass[] = "sangoppoa31";

#define gasSensor 34
#define buzzer 2
#define light 4
#define trigger 33
#define echo 32
#define relay 5

#define tankHeight 14

void gasSensorMonitor()
{
  int gasLevel = analogRead(gasSensor);
```

```
  gasLevel = map(gasLevel,0,4095,0,100);
  Serial.print("Gas Level: ");
  Serial.println(gasLevel);
  Blynk.virtualWrite(V7, gasLevel);

  if(gasLevel>=50){
    digitalWrite(buzzer,HIGH);
    Blynk.logEvent("gas_leakage","Alert! Gas leak detected in the kitchen. Turn off the gas cylinder immediately. Avoid using electrical devices. Ventilate the area. Stay safe!");
  }
  else{
    digitalWrite(buzzer,LOW);
  }
}

void waterLevelMonitor()
{
  long duration;
  int distance;
  const int thresholdDistance = 2;
  digitalWrite(trigger, LOW);
  delayMicroseconds(2);
  digitalWrite(trigger, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigger, LOW);
  duration = pulseIn(echo, HIGH);
```

```
  distance = duration * 0.034 / 2;
  Blynk.virtualWrite(V0, tankHeight - distance);
  Serial.print("Distance: ");
  Serial.print(distance);
  Serial.println(" cm");
  if (distance <= thresholdDistance) {
    digitalWrite(relay, HIGH);
    Blynk.virtualWrite(V2, 1);
    Serial.println("Water level high: Pump OFF");
  } else {
    digitalWrite(relay, LOW);
    Blynk.virtualWrite(V2, 0);
    Serial.println("Water level low: Pump ON");
  }
  delay(2000);
}

void setup() {
  Serial.begin(115200);
  Blynk.begin(auth, ssid, pass);
  pinMode(buzzer,OUTPUT);
  pinMode(light,OUTPUT);
  pinMode(echo,INPUT);
  pinMode(trigger,OUTPUT);
  pinMode(relay,OUTPUT);
  digitalWrite(relay,HIGH);
}
```

```
void loop() {
  Blynk.run();
  gasSensorMonitor();
  waterLevelMonitor();
  delay(1000);
}

BLYNK_WRITE(V1){
  bool value = param.asInt();
  if(value==0){
  digitalWrite(light,LOW);
  }
  else{
    digitalWrite(light,HIGH);
  }
}

BLYNK_WRITE(V2){
  bool value = param.asInt();
  if(value==0){
  digitalWrite(relay,LOW);
  }
  else{
    digitalWrite(relay,HIGH);
  }
}
```

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