REPORT

Problem statement

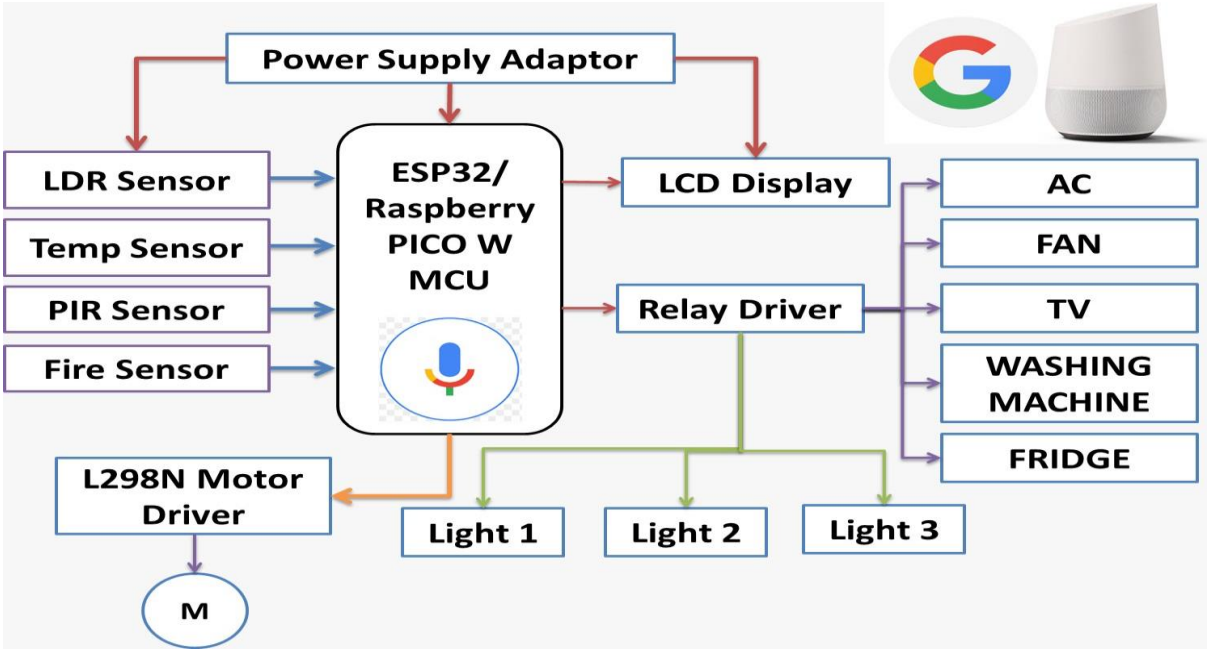
Design and suggest automation implementations for a room containing an AC, fan, lights, windows, electrical appliances, routers and a fire alert system.

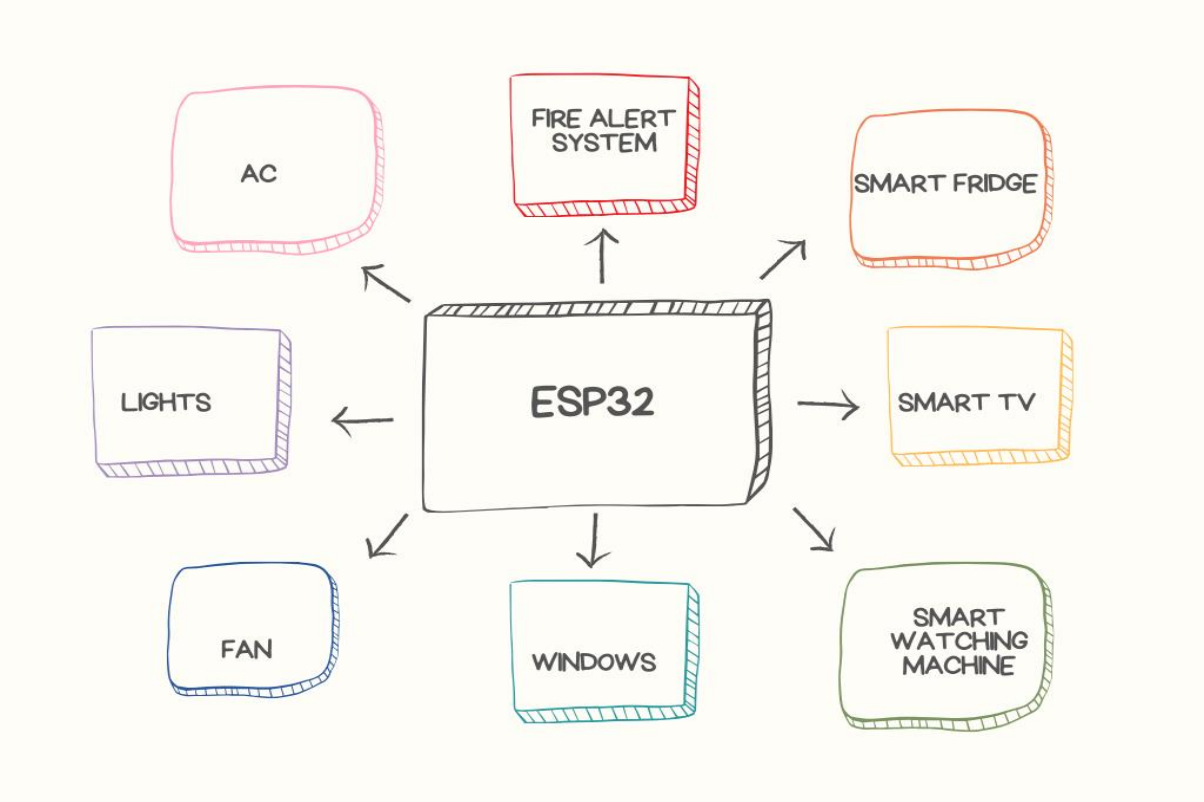
Goal : enhance efficiency and convenience, reduce carbon footprint, and increase safety through automation

Design approach :

A home automation system will monitor home attributes such as lighting, climate, entertainment systems and appliances, access control and alarm systems. This problem statement deals with room automation implementation to enhance efficiency and convenience, reduce carbon footprint and increase safety. For this problem statement we have proposed a system of room automation using IOT. Where the different home attributes and appliances are controlled using router and CPU controller used here is ESP32.

Block diagram :





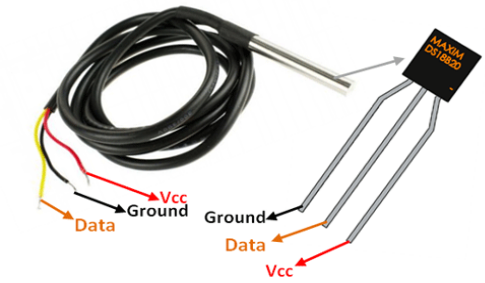
Components specifications :

1. LDR – Light Dependent Resistor / photoresistor/ photocell is a light controlled variable resistor. The resistance of a photoresistor decreases with increasing incident light intensity.

We use LDR in our room automation for window blinds, if the room is sensed very dark the LDR detects it and opens the window and vice versa.

2. Temperature sensor – DS18B20 is a popular digital temperature sensor that uses the 1-wire protocol for communication. It is manufactured by maxim integrated and is widely used in various applications for temperature

monitoring. The DS18B20 can measure temperatures in a wide range typically from -55°C to 125°C.

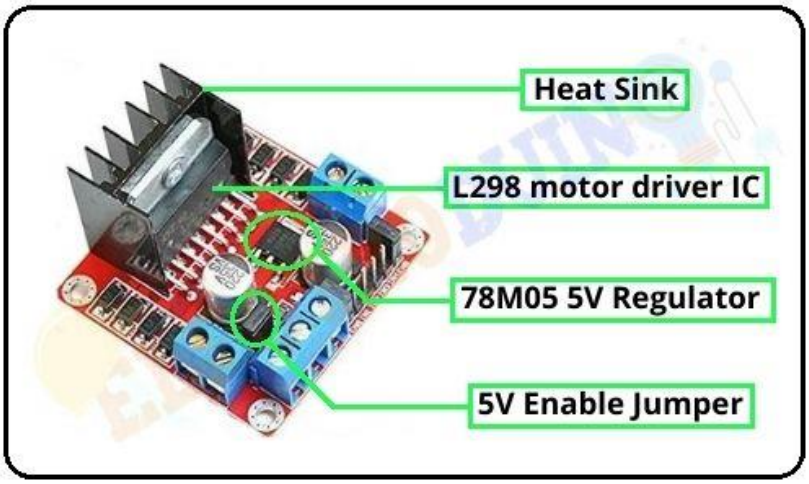


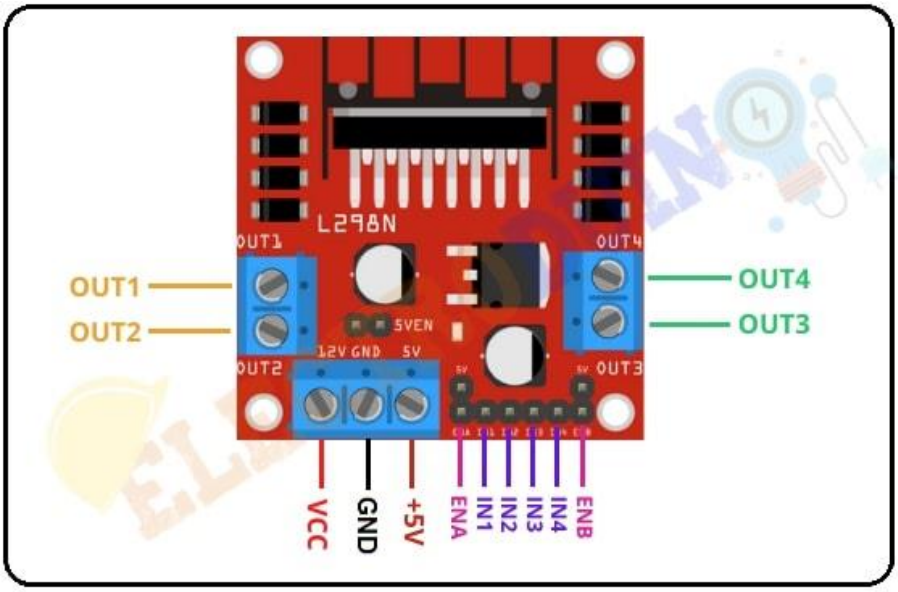
DS18B20 temperature sensor

The temperature sensor is used for automation of AC and fan in the room automation. When the temperature is between 25°C to 27°C the fan gets switched on checking whether the person is in the room through PIR sensor and if the temperature exceeds above 30°C then the AC will be switched on and the window blinds will be offed when you are switching on the AC.

3. PIR sensor – A Passive Infra-Red sensor (PIR sensor) is an electronic device that measures infrared (IR) light radiating from objects in its field of view. Apparent motion is detected when an infrared source with one temperature, such as a human, passes in front of an infrared source with another temperature, such as a wall. The PIR (Passive Infra-Red) Sensor is a pyroelectric device that detects motion by measuring changes in the infrared levels emitted by surrounding objects.

4. L298N motor driver – It is a high voltage, high current dual full bridge motor driver module for controlling DC motor and stepper motor. It can control both the speed and rotation direction of two dc motors. In this project we use this L298N motor driver to control the movement of curtains or blinds in a room. The motor driver can be utilized to control the movement of windows useful for automated ventilation systems, where windows are opened and closed based on factors like temperature, light and air quality.



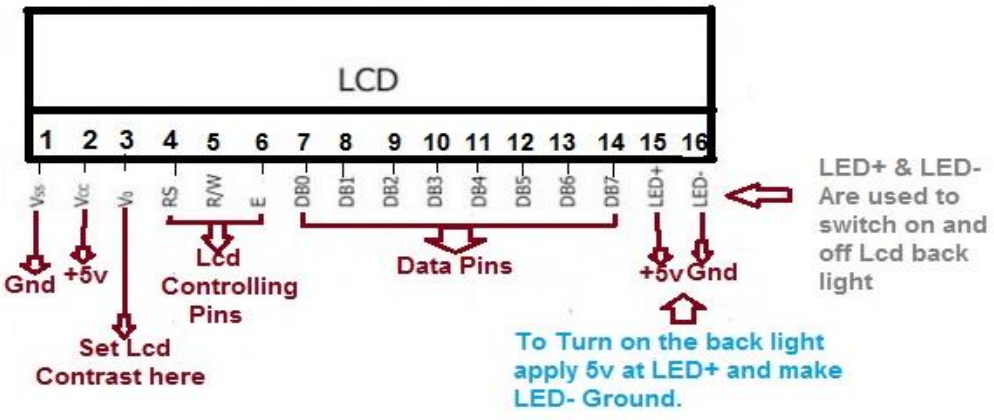


L298N Motor Driver Module pin diagram

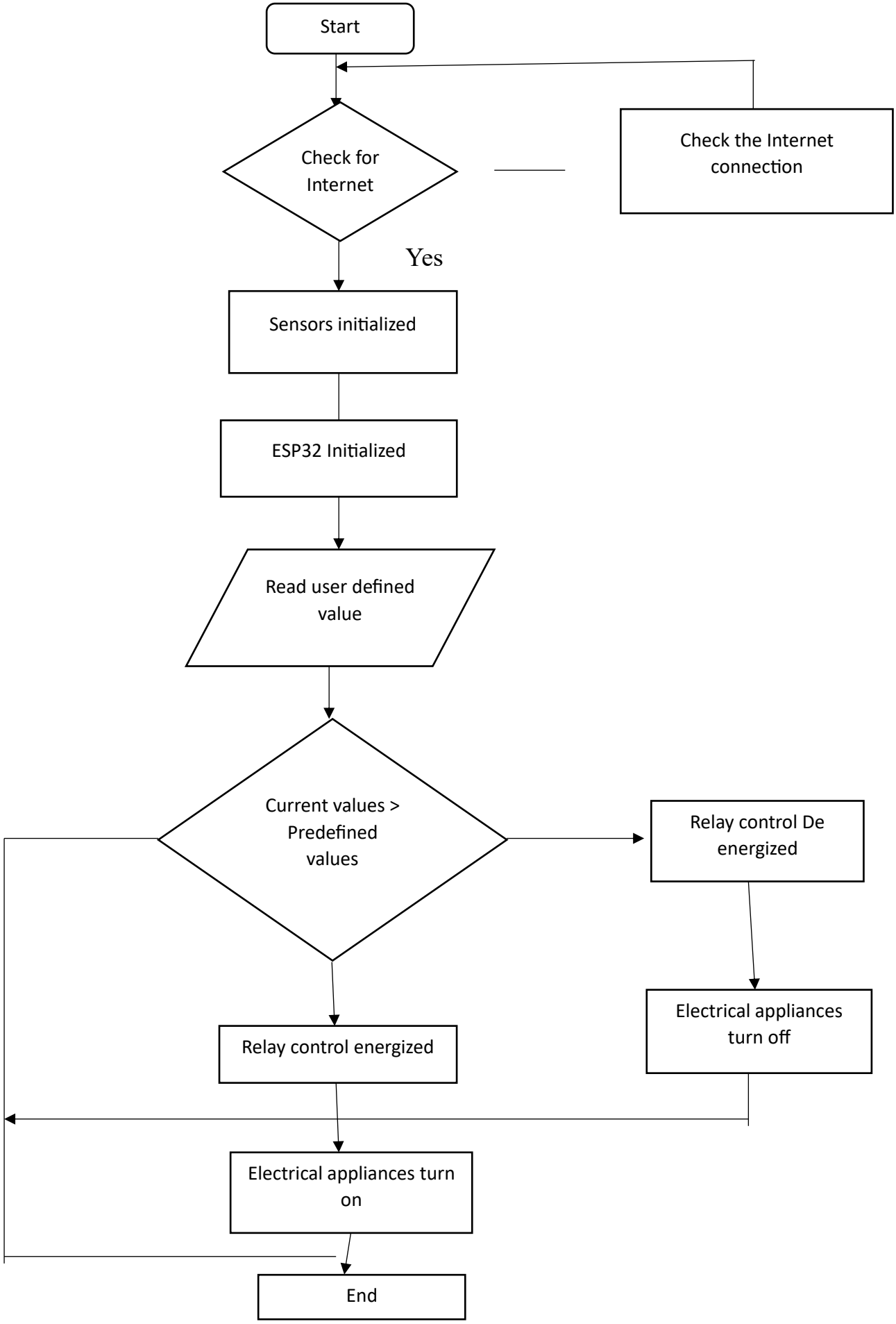
5. Gas sensor – MQ2 gas sensor operates on 5V DC and consumes approximately 800mW. It can detect LPG, Smoke, Alcohol, Propane, Hydrogen, Methane and Carbon Monoxide concentrations ranging from 200 to 10000 ppm. This sensor works on 5V DC voltage. This sensor is also used for Air quality monitoring. Used for fire alert system.

MQ2 Gas Sensor

6. LCD display – The term LCD stands for liquid crystal display. It is one kind of electronic display module used in an extensive range of applications like various circuits & devices like mobile phones, calculators, computers, TV sets, etc. These displays are mainly preferred for multi-segment light-emitting diodes and seven segments. The main benefits of using this module are inexpensive; simply programmable, animations, and there are no limitations for displaying custom characters, special and even animations, etc.



Data flow diagrams :



Automated ventilator system flowchart:

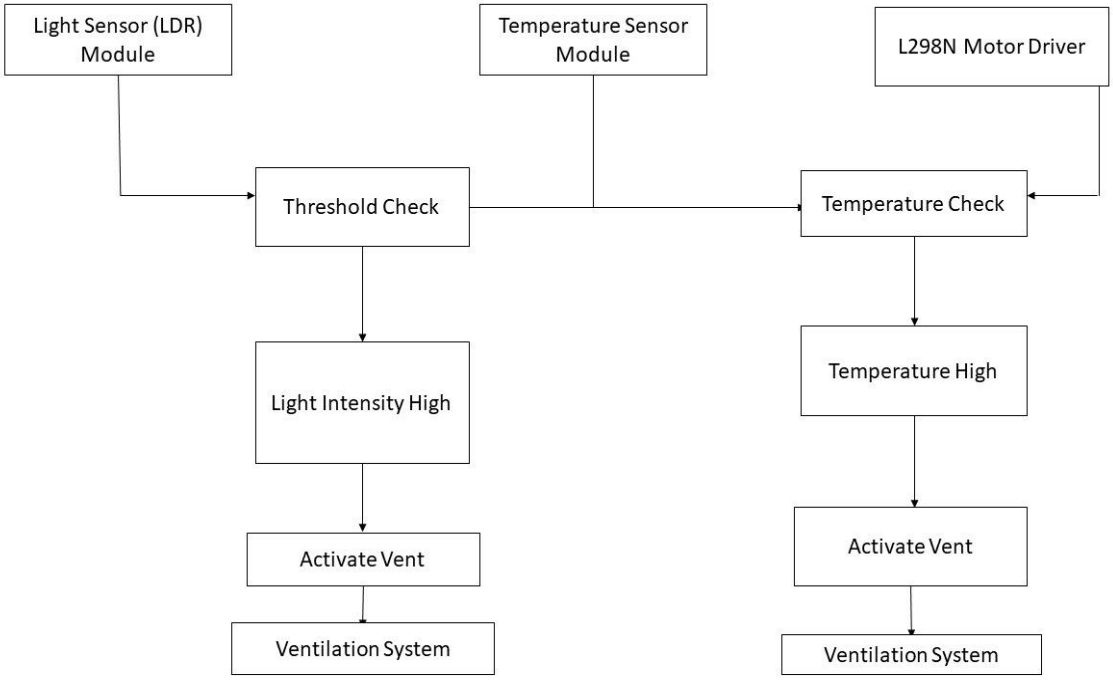
1. Initialization
   - Start
2. Read sensor data
   - Read LDR value
   - Read temperature from DS18B20
3. Analyse sensor data
   - Check light levels
   - If it's too dark(night), and the temperature is above a certain threshold
   - Proceed to ventilation control
   - If not wait for next sensor reading
4. Ventilation control
   - Activate the DC motor through the L298N motor driver
   - Adjust motor speed based on temperature
   - Run the motor or a specified duration or until a target temperature is reached
5. Post ventilation check
   - Monitor the temperature after ventilation
   - If the temperature is within the acceptable range
     Stop the motor
   - If the temperature is still high
     Continue ventilation
6. Idle state
   - Wait for next sensor reading
7. End
   - Stop

Automated lighting system flowchart:

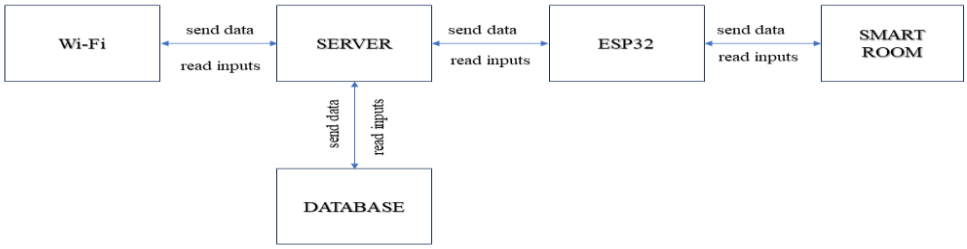
1. Initialize ESP32 and components
2. Connect to Wi-Fi
   - Establish a wi-fi connection to enable communication between the ESP32 and Google assistant service
3. Configure relay driver
   - Set up the relay driver to connect the lights connected to it.
4. Configure PIR sensor
   - Configure the PIR sensor to detect motion in its vicinity.

5. Google Assistant Integration
6. Main program loop
    - Enter the main loop where the ESP32 continuously monitors the PIR sensor for motion.
    - If motion is detected, control the relay to turn on the lights.
    - Communicate with Google Assistant to enable voice-controlled commands for turning on/off the lights.
7. End

Execution approach of automated ventilator system :



Execution approach :



SPECIAL FEATURES/ ADVANTAGES OF DESIGN :

Room automation using ESP32, a low-cost, low-power microcontroller with built-in Wi-Fi and Bluetooth capabilities, offers several advantages. Here are some of the key benefits: Cost-Effective Solution, Wireless Connectivity, Scalability, Remote Control and Monitoring, Energy Efficiency, Customization and Flexibility, Sensor Integration, Compatibility with IoT Ecosystems, Open Source.

room automation using ESP32 offers a cost-effective, wireless, and highly customizable solution with support for remote control and monitoring, making it suitable for a wide range of applications.

JUSTIFICATIONS FOR EACH AUTOMATION CHOICE :

AC (Air Conditioner): Automation of the AC allows for energy efficiency and comfort. Smart thermostats can learn user preferences, adjust temperatures based on occupancy, and optimize settings for energy savings. Remote control ensures that users can turn on/off or adjust the AC settings even when not physically present.

Fan:

Justification: Smart fans can be controlled based on room temperature, occupancy, and time of day. This contributes to energy saving & enhancing user comfort.

Lights:

Justification: Lighting automation improves energy efficiency and convenience. Motion sensors can turn lights on or off based on occupancy.

Windows:

Justification: Automated windows contribute to natural ventilation and temperature control. Sensors can detect environmental conditions and automatically open or close windows. Integration with weather forecasts and indoor temperature sensors ensures optimal ventilation and comfort.

Electrical Appliances:

Justification: Automation of electrical appliances, such as TVs, watching machine and kitchen devices, enhances energy efficiency and safety. Integration with occupancy sensors ensures that appliances are turned off when the room is unoccupied.

Routers:

Justification: Automated network monitoring can enhance security and troubleshoot connectivity issues.

Fire Alert System:

Justification: Automating the fire alert system is critical for safety. Smoke detectors and fire alarms can be integrated into a smart home system to trigger

notifications, alarms, and even emergency services in case of a fire. This can significantly reduce response time and mitigate potential damage.

Potential benefits and impact.

Energy Efficiency:

Benefits: Automation can optimize the usage of electrical appliances, lights, and HVAC systems based on occupancy, time of day, and environmental conditions. This leads to reduced energy consumption and lower utility bills.

Impact: Energy-efficient practices contribute to environmental sustainability and can make the room eco-friendlier.

Comfort and Convenience:

Benefits: Automation allows for personalized and convenient control of the room environment. Users can adjust the temperature, lighting, and other settings with ease. Smart thermostats and fans enhance comfort by adapting to user preferences.

Impact: Improved comfort and convenience create a more pleasant and user-friendly living or working space.

Safety:

Benefits: Integration of a fire alert system ensures early detection of potential fire hazards, enabling timely evacuation or intervention. Smart plugs and outlets can prevent electrical overloads, reducing the risk of electrical fires.

Impact: Enhanced safety features contribute to a secure living or working environment, protecting occupants and property.

Remote Accessibility:

Benefits: Automation systems with remote control capabilities allow users to monitor and control the room's components from anywhere with an internet

connection. This is especially useful for adjusting settings or checking on the status of devices when not physically present.

Impact: Remote accessibility enhances flexibility and convenience, providing users with greater control over their living or working spaces.

Optimized Ventilation:

Benefits: Automated windows and ventilation systems can optimize airflow based on environmental conditions. This contributes to better air quality and a healthier indoor environment.

Impact: Improved ventilation supports occupant well-being and comfort, reducing the likelihood of issues related to poor air quality.

Network Optimization:

Benefits: Automation of routers and network monitoring tools can optimize internet bandwidth, enhance security, and provide a more reliable network connection.

Impact: A well-optimized network supports seamless connectivity, faster internet speeds, and a more stable online experience for users.

Time and Resource Savings:

Benefits: Automation reduces the need for manual intervention in adjusting settings or turning devices on/off. Scheduling and automation rules save time and resources by streamlining routine tasks.

Impact: Increased efficiency and time savings contribute to improved productivity and a more relaxed living or working environment.

Any assumptions or considerations :

Compatibility of Devices:

Assumption: All devices (AC, fan, lights, electrical appliances, etc.) are assumed to be compatible with the chosen automation system. Compatibility issues can arise if devices use different communication protocols or if some devices are not designed for integration with smart home systems.

Power Supply and Stability:

Consideration: The reliability of the power supply is crucial. Automation systems, especially those controlling safety-critical devices like fire alert systems, need a stable and uninterrupted power source. Considerations should be made for backup power solutions in case of power outages.