MY PROJECT

This project focuses on energy efficiency, cost optimization, and intelligent energy management in a smart home environment using IoT technologies. The system leverages components such as the Arduino Mega 2560, ESP32, PZEM-004T energy meter, DHT11 (temperature and humidity sensor), LDR, water level sensors, 5V relays, RTC module, and other supporting electronics like voltage divider circuits.

The core functionality of the project revolves around smart source switching between solar and grid power. The Arduino Mega acts as the central controller for in-house automation, continuously monitoring time-of-day tariffs (peak, off-peak, and normal hours) and the availability of solar power. During peak or off-peak hours, if solar power is available, the system automatically switches the entire home to solar energy and also charges the battery for later use. In contrast, during periods without solar availability, the system intelligently decides whether to use grid power based on current tariffs and battery levels—charging the battery during off-peak hours and using it during expensive peak periods. This cycle is repeated continuously to ensure optimal energy usage and reduced electricity costs.

Another major feature is water level monitoring and automated pump control. The system checks the water level in the tank and, when possible, schedules pump operation during peak solar availability to reduce grid usage. If water levels drop during non-solar hours, the system assesses whether the remaining water is sufficient until the next solar cycle. If not, it activates the pump using grid power to ensure uninterrupted water availability. This logic ensures efficient water management without compromising energy goals.

The Arduino Mega also automates various home functions such as air conditioning, outdoor lighting, and other key appliances, all tuned to operate within energy-efficient schedules. The data and status of all automated devices are transferred via serial communication to the ESP32, which acts as a communication bridge to the cloud.

The ESP32 is responsible for real-time monitoring and control, interfacing directly with other household appliances via relays and transmitting all sensor data and automation status to a Blynk dashboard through MQTT and the internet. The dashboard provides users with a detailed interface showing appliance status, current power source (grid or solar), pump operation status, and more. It also allows users to remotely control appliances that are not fully automated via toggle switches on the dashboard.

In summary, this project presents a comprehensive IoT-based Smart Home Automation System that intelligently manages energy sources, schedules appliance usage, optimizes electricity cost, and gives users centralized real-time monitoring and control. It is a scalable, energy-efficient solution that integrates renewable energy with automation for a smarter and more sustainable home.

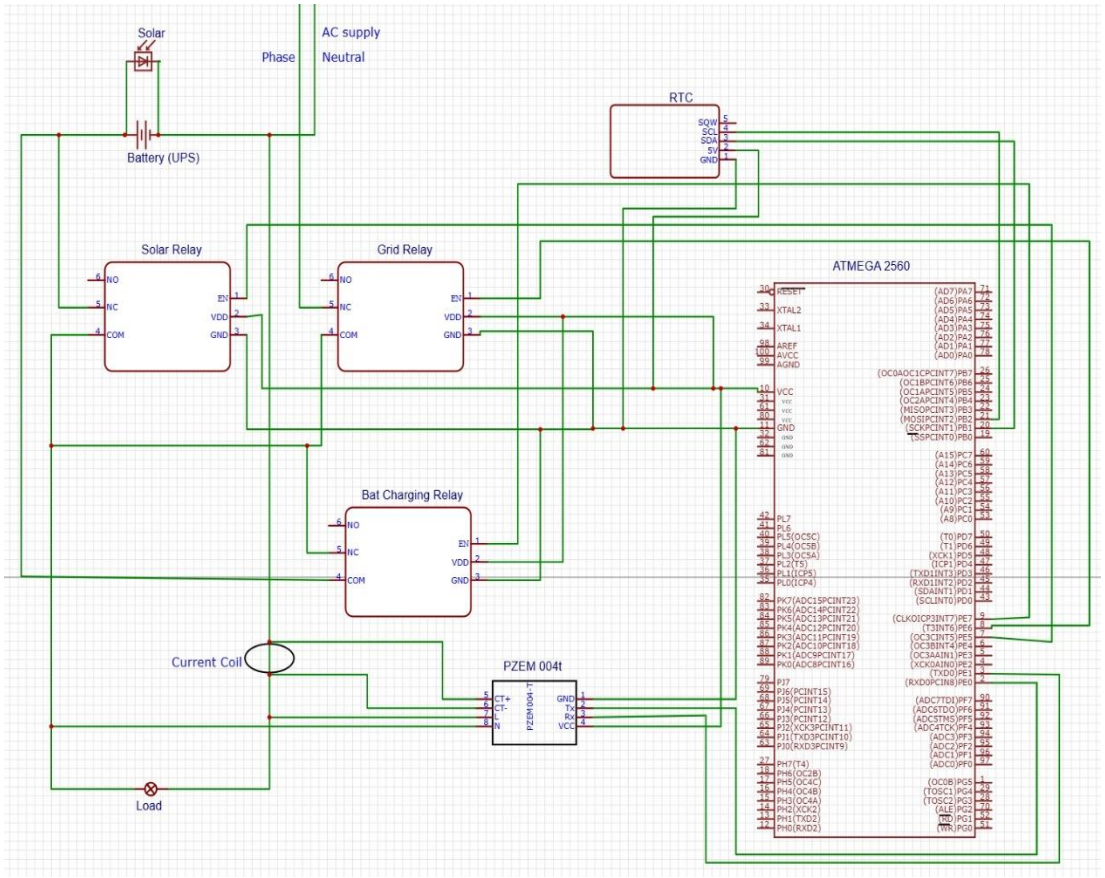

Figure 1 - Source switching circuit diagram

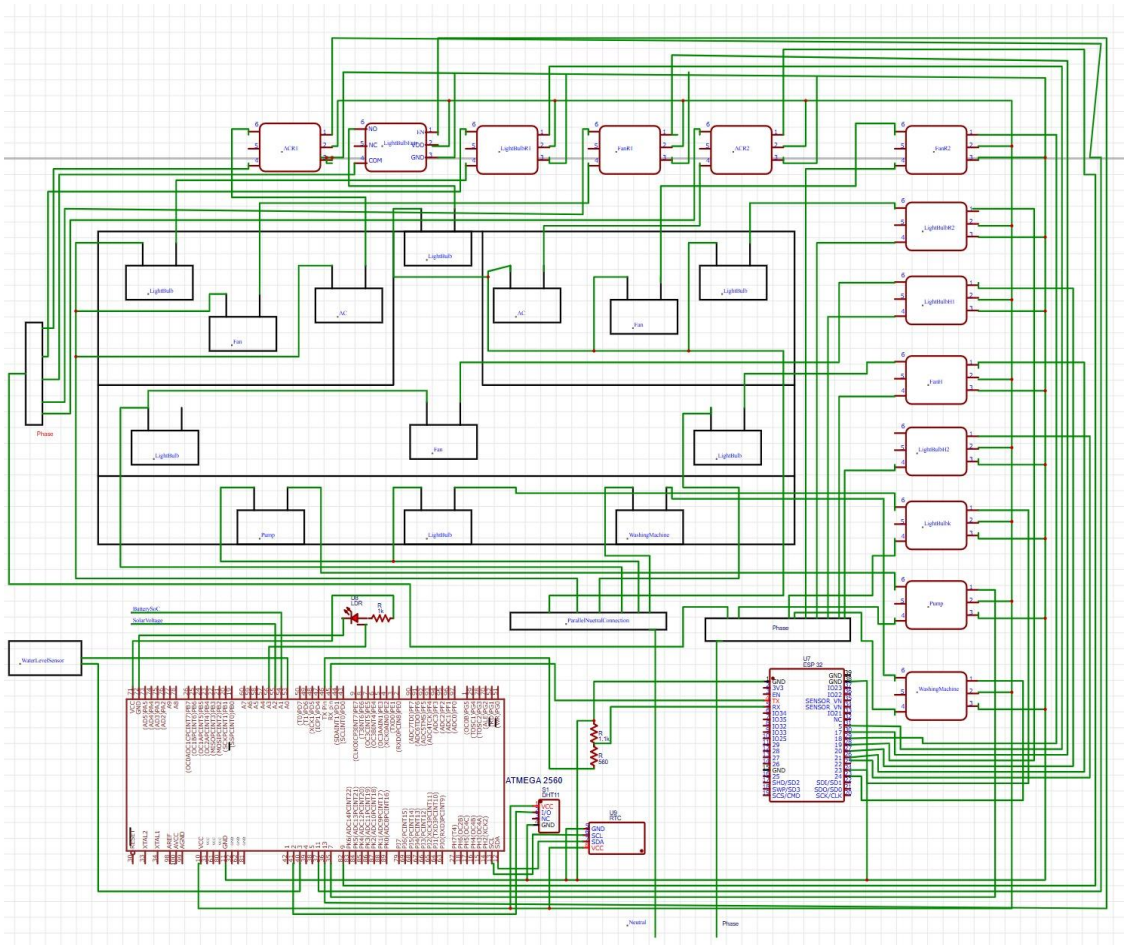

Figure 2- Automation Circuit Diagram

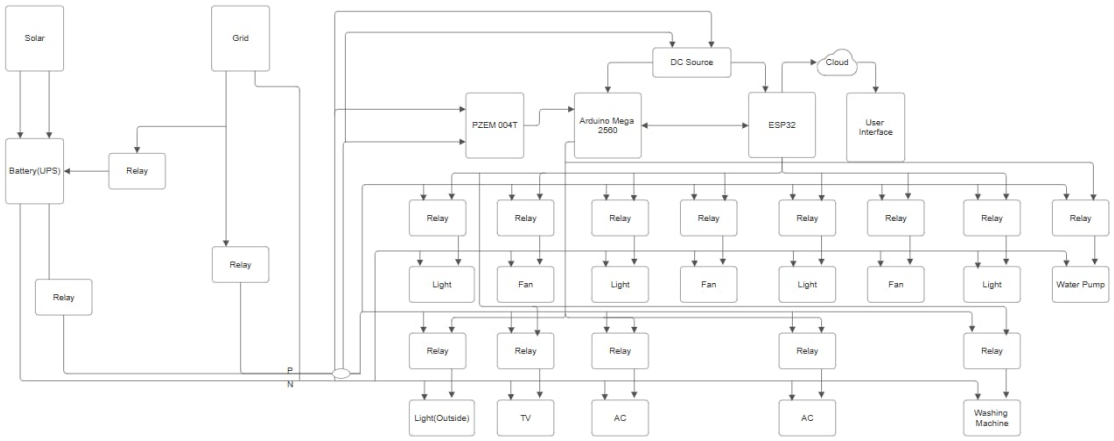

Figure 3- Complete Block Diagram.