EC6020

Embedded Systems Design

Project Proposal

By:

Group 16
Faculty of Engineering
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1) Title and Team Members

Title : IoT-Based Smart Inverter System for Efficient Energy Management

Team Members :

- Naveen V.V.D 2021/E/170
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2) Introduction

Our project, IoT-Based Smart Inverter System for Efficient Energy Management, aims to optimize energy usage through IoT technology. It monitors and controls energy consumption in real-time, prioritizing essential devices during overloads using a greedy algorithm. With renewable energy integration, such as solar panels, and a user-friendly web interface for remote monitoring and control, the system ensures sustainability and efficiency. Voice alerts and notifications provide real-time updates, making it a smart and modern solution for effective energy management.

3) Problem and Solution

Problem

As energy demand increases, traditional inverters lack the ability to dynamically manage loads, integrate renewable energy sources, and provide real-time monitoring. This inefficiency leads to higher energy consumption and reduced reliability, especially during power shortages.

Solution

The IoT-Based Smart Inverter System addresses these challenges by:

- Monitoring and controlling energy usage in real-time.
- Dynamically detecting and resolving overloads.
- Providing a user-friendly web interface for load management and data visualization.
- Seamlessly integrating renewable energy sources like solar panels.

4) Novelty

- **Greedy Load-Shedding Algorithm**: Dynamically adjusts load priorities based on real-time battery levels.
- **Renewable Energy Integration**: Solar panels charge the DC battery, and the inverter converts the DC output into AC for system use.
- **Voice Assistant Integration**: Provides real-time alerts and user interaction for critical events like low battery and overloads.
- **IoT Features**: Utilizes MQTT for efficient, cloud-based communication and real-time control through a web interface.

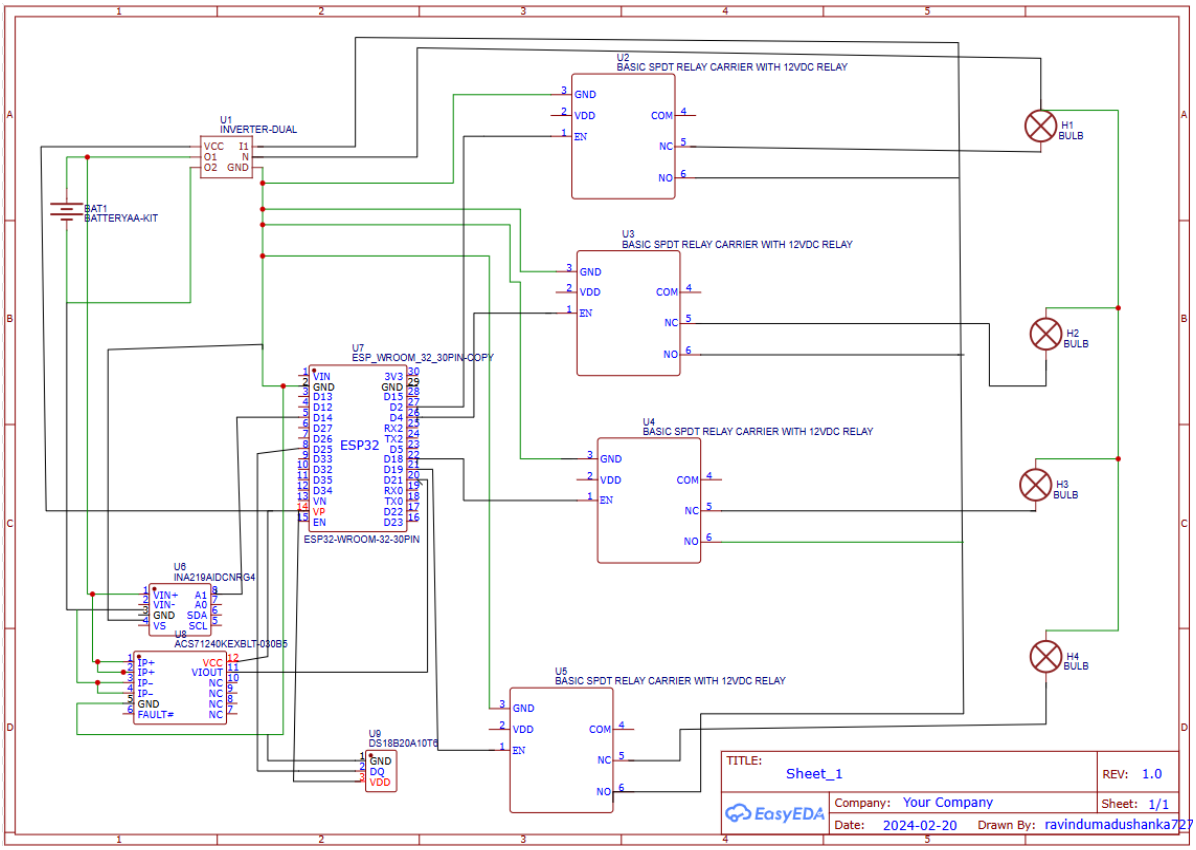
4) High-Level Architecture

The architecture includes:

- **ESP32 Microcontroller**: Selected for its IoT capabilities, low power consumption, and built-in Wi-Fi and Bluetooth.
- **MQTT Protocol**: Chosen for lightweight and efficient data transfer, ideal for real-time monitoring and device control.
- **Voltage and Current Sensors**: Ensures accurate load monitoring.
- **Web Interface**: Enables remote control and visualization of energy usage, built with modern frameworks like React and Flask.

6) Circuit Design and Protocols

Circuit Design :



Protocols :

- **I2C**: For efficient sensor data exchange.
- **UART**: For communication between ESP32 and the voice module.
- **MQTT**: For cloud-based IoT communication, enabling remote monitoring and control.

7) GitHub Repository

https://github.com/DhanukaNaveen/IoT-Based-Smart-Inverter-System.git

8) Budget and Timeline

Budget :

Component	Quantity	Unit Cost (LKR)	Total Cost (LKR)
ESP32 Microcontroller	1	2000.00	2000.00
Voltage Sensors	1	630.00	630.00
Current Sensors	1	500.00	500.00
Temperature Sensors	1	550.00	550.00
Relays	4	200.00	800.00
LCD Display	1	550.00	550.00
Voice Module	1	500.00	500.00
Inverter Components	-	800.00	800.00
Miscellaneous (wires, PCB, etc.)	-	1200.00	1200.00
Total			7530.00

Timeline :

Task	Week							
	5	6	7	9	10	11	12	13
Finalize components and system design								
Component Acquisition								
Circuit Design and Assembly								
Software Development								
System Integration and Testing								
Develop user interface								
Deployment and Evaluation								
Finalize the documentation								