Automatic Solar Lighting System

Nicholas Miller, Atahan Bakanyildiz, Romi Gilat, Cedar Maxwell, Wonhyeok Jang

Problem

In recent years Texans have witnessed issues regarding the power grid when the weather gets colder. These issues come from an increase in demand that the power grid fails to handle all at once, leading to more frequent power outages. Extended power outages are a nuisance and leave many without proper lighting which can be hazardous when there is a lack of natural lighting.

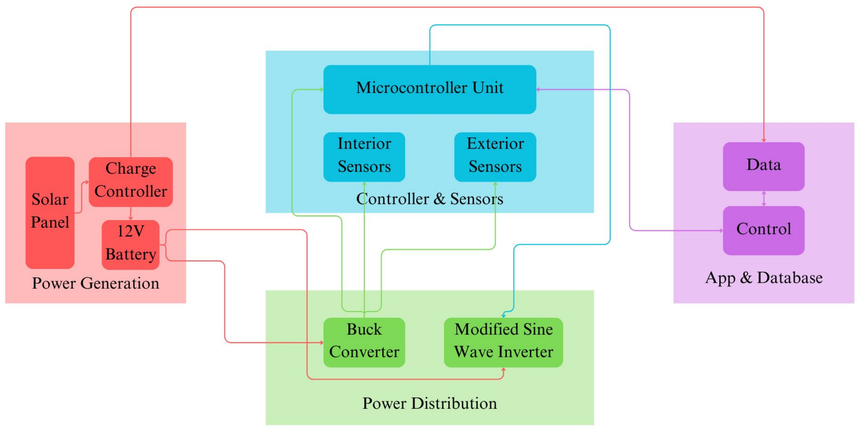
Solution

The Automatic Solar Lighting System is an energy independent exterior and interior lighting system for residential use. Utilizing motion and infrared sensors this system is capable of automatically turning on a set of exterior and interior lights for a duration of time. During the day the Automatic Solar Lighting System harnesses solar energy through a flat mounted solar panel and stores it in a 12V lead-acid battery to be used when it becomes dark outside.

1: AI generated image displaying theoretical Automatic Solar Lighting System.

Subsystem Developers

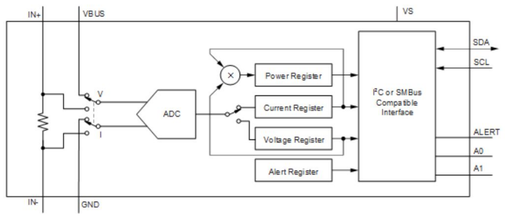
- ★ Power Generation - Atahan Bakanyildiz.
- ★ Power Distribution - Nicholas Miller.
- ★ App & Database - Cedar Maxwell.
- ★ Controller & Sensors - Romi Gilat.
- ★ Sponsor - Wonhyeok Jang.



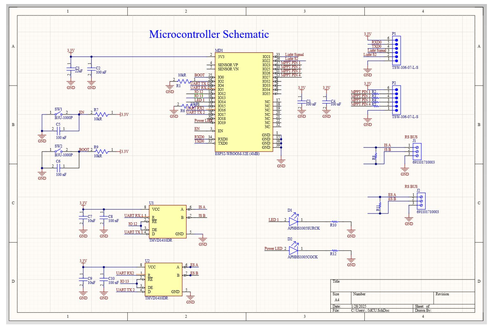
2: Block Diagram displaying how the different subsystems interact with each other.

Subsystem Functionalities

- ★ Power Generation - Charges 12V Lead-Acid Battery from 100W Solar panel and collects and communicates charging data.
- ★ Power Distribution - Converts 12V, 5A from lead-acid battery to 3.3V, 0.5A for ESP32 by means of a Buck Converter. Converts 12V, 5A from lead-acid battery to 220VAC, 1.4A by means of a Modified Sine Wave Inverter.
- ★ App & Database - Creating a user friendly Android app and cloud database for system control and data interface.
- ★ Controller & Sensors - The sensor system measures the amount of natural light and detects movement to determine if the lights should be on or off. The MCU collects this data, shares it with the App & Database, and turns on or off the lights.



3: Power Generation - INA 260 schematic.



4: MCU schematic designed in Altium Designer.

5: App display showing system data.

Power Generation

Accomplishments

- ★ Designed and Simulated MPPT Charge Controller for 18-22V solar panel to 12V Lead-Acid Battery.
- ★ Designed and manufactured PCB for Charge Controller using Altium Designer.

Goals

- ★ Design and manufacture battery management system PCB using Altium.
- ★ Integrate battery management system to communicate with MCU.

Power Distribution

Accomplishments

- ★ Designed and obtained desired simulation outputs for a Buck Converter and Modified Sine Wave Inverter using LTSpice.
- ★ Designed and manufactured PCB's for Buck Converter and Modified Sine Wave Inverter using Altium Designer.

Goals

- ★ 3D design PCB casings using AutoCAD.
- ★ Implement with the Power Generation Subsystem by the end of February.

App & Database

Accomplishments

- ★ Username/Password login and database stored data per user.
- ★ Data synchronized over the Internet between Android App and Firebase Database.

Goals

- ★ Store battery voltage readings from Power Generation subsystem by end of March.
- ★ Turn on lights from App by end of April (full functionality).

Controller & Sensors

Accomplishments

- ★ Designed and tested microcontroller, connecting to local laptop to monitor data.
- ★ Designed and built exterior and interior sensors, paired with passive infrared sensors for motion detection and ambient lighting sensors.

Goals

- ★ Integrate with application, buck converter, and power systems.
- ★ Obtain a 15% or less miss rate using sensors.