Smart Window Blinds

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Abstract

This project aims to create and design an independent IoT system allowing users to open and close their household vertical blinds with just a simple tap on their personal mobile phones or tablets. The project requires three parts involving the software, hardware, and mechanical developments. The software aspect involves a web application which allows the user to open or close the blinds as they wish. The web application communicates to the hardware unit via WiFi where the user data is received by the System On Chip (SOC), ESP8266. The ESP8266 can then send out PWM signals to the stepper motor which along with the mechanical design is able to physically move the window blinds. The web application is implemented using HTML and CSS styling uploaded to the ESP8266 web server. The ESP8266 is programmed using the Arduino IDE, and the mechanical design independently sketched and designed using Tinkercad.

Materials

ESP8266-01 Microcontroller Unit

DRV8834 Motor Carrier Driver

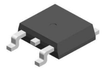
NEMA 17 (13 N-cm) Stepper Motor

USB to TTL Adapter

9V Battery

Rocker LED Switch

3.3V Regulator (LD1117AV33)

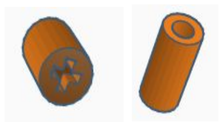


5V Regulator (L7805ACD2T-TR)

Mini Vertical Blinds For testing (24in by 24in)

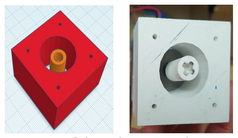
Tablet or Mobile Device with Internet Access

Mechanical Designs



Twist Bar

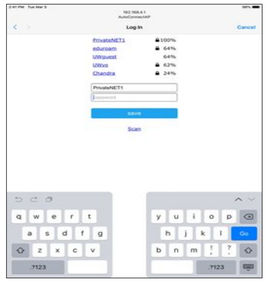
Connects the stepper motor to the small rotating fixture on the blinds



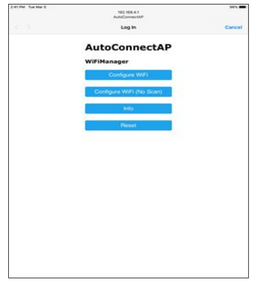
Motor - Blind Attachment

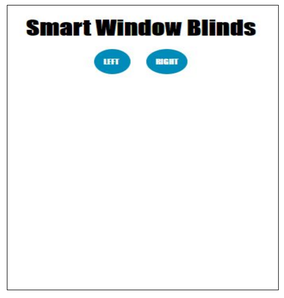
Square block attaches to stepper motor on one side and to window blinds on the other so that stepper motor can be mounted on the side of window blinds

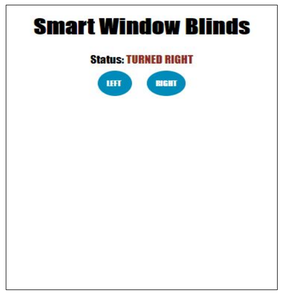
Web Application

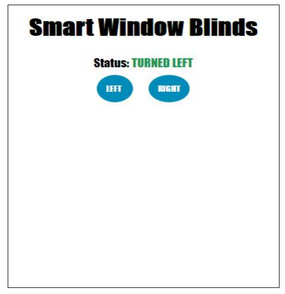


- AutoConnectAP shows up on mobile device's network list once system is switched on
- Provides user interface to enter WiFi information for ESP8266 to gain internet access
- Once mobile device and ESP8266 is in the same network, IP address of ESP8266 can be entered into the browser to access the smart window blinds web application





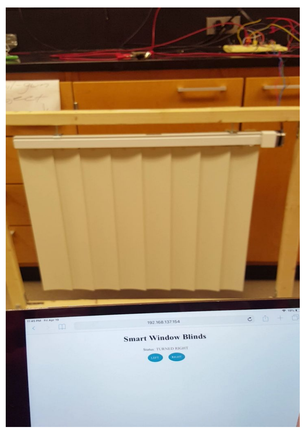


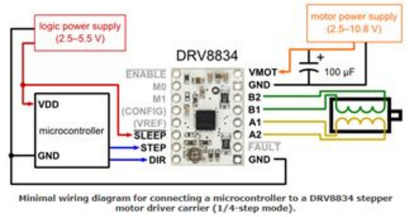


Testing and Results

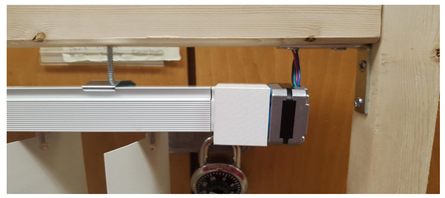
The schematic above was tested on a breadboard as shown with a 9V power supply. Initially, we tested each part of the project separately, starting with the web application.

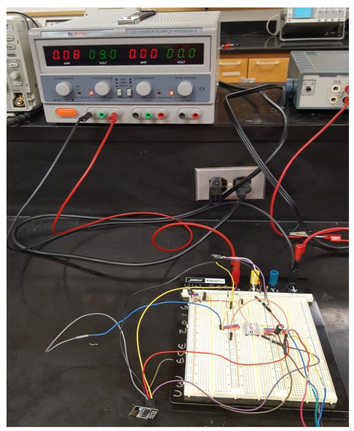
1. AutoConnectAP connects the ESP8266 to the network, the IP address is obtained to access the web application, then either the "LEFT" or "RIGHT" button was pressed. After pressing a button on the web application, we wrote out print statements for the serial monitor so we know that control signals are being transmitted from the output pins.
2. Connected circuit to oscilloscope to confirm that control signals were being sent to the input pins of the motor driver (STEP, DIR, and SLP).
3. Tested the entire system with stepper motor and rewired the motor driver as well as the stepper motor multiple times to get fluid rotations.
4. Adjusted the delay in the code so that the window blinds do not over-rotate.



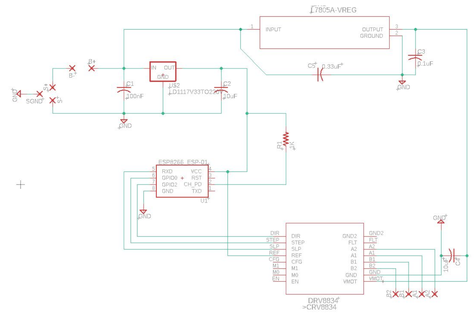


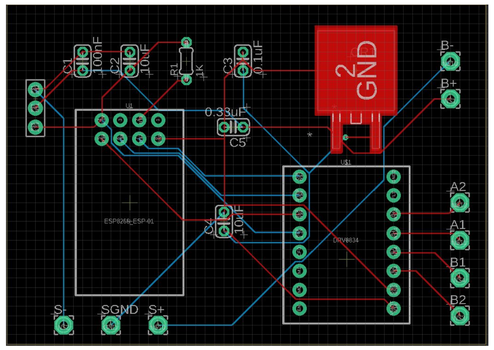
Minimal wiring diagram for connecting a microcontroller to a DRV8834 stepper motor driver carrier (1/4-step mode).





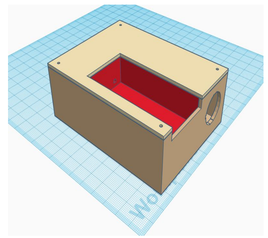
Schematic and PCB Layout

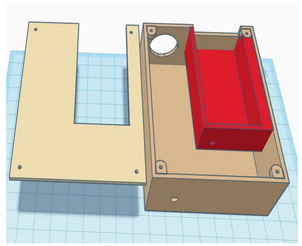




Packaging

Packaging design includes a battery case for 9V battery, a round rocker switch on the side so system can be turned on/off and enough space for PCB board to be mounted.





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