Light Control and Path Prediction Using Human Detection

User Guide

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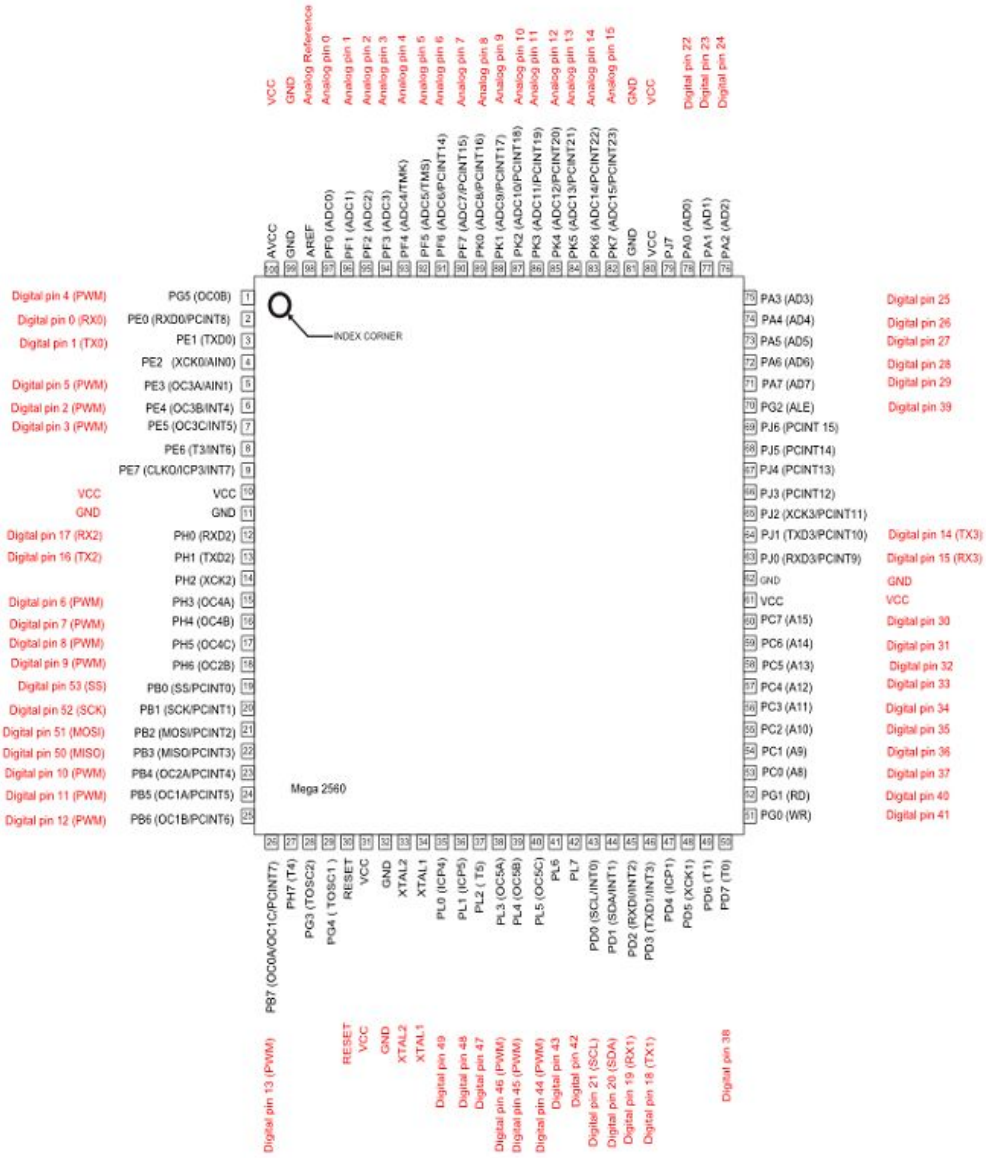
I. Introduction

A variety of different hardware components are used for this project. This includes a variety of different human-detection and object-detection sensors, environmental sensors, a microcontroller, basic hardware components, wireless transmitter and receivers, power relays, and power adapters. Each component is explained in detail below. Each explanation contains the component's primary functions, basic features, and descriptions of input and output pins. The final section of the document explains how to integrate components together with the microcontroller and relay in a working fashion.

II. Arduino MEGA 2560 Board

The controller used for this project is the Arduino MEGA 2560 Board.

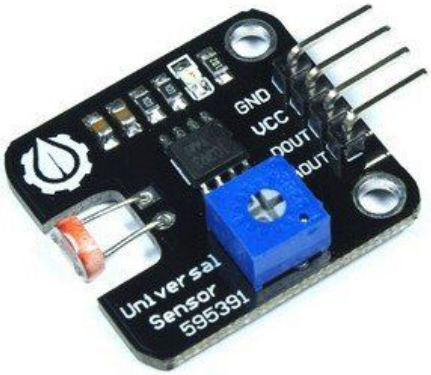
This board, like all Arduino boards, runs on the Arduino language, which is a variant of C++. This board has 54 digital input/output pins and 16 analog input pins, as well as four UART serial ports.



The board runs on a 5V supply, but can run with up 20V of power. The board contains a 16MHz crystal oscillator (Arduino, 2017).

III. Phantom YoYo Arduino compatible Mini Luminance Light Sensor

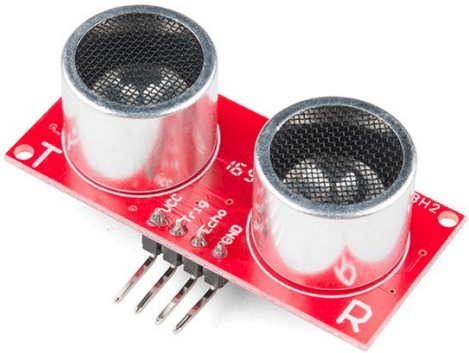
The Phantom YoYo Mini Luminance Light Sensor is able to detect atmospheric light.



This sensor has four pins: GND, VCC, DOUT, and AOUT. The board runs on 3.3V-5V. DOUT is a digital output pin, and AOUT is an analog output pin. The digital output pin outputs a boolean signal, depending on if atmospheric light is above or below a threshold. This threshold can be changed by adjusting the on-board potentiometer. The analog output pin gives an analog signal based on atmospheric light. This board is advertised as being Arduino compatible (amazon.com, 2017).

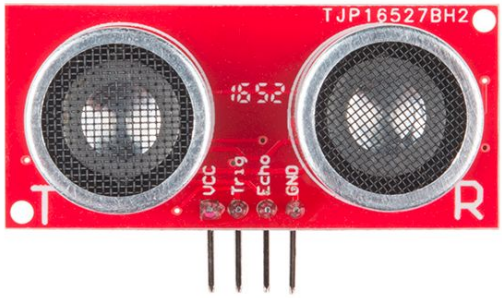
IV. HC-SR04 Ultrasonic Sensor

The HC-SR04 Ultrasonic Sensor is a detections sensor that uses ultrasonic technology to detect objects.



This sensor has a range of 2 to 400 centimeters with an accuracy of roughly 3 millimeters. The sensor has a digital output in the form of a pulse, which can be converted to a distance value in centimeters by dividing the pulse signal by 58.

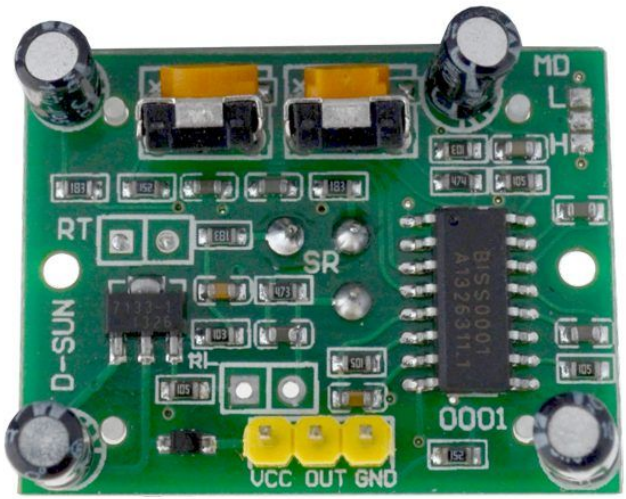
The sensor has four pins: a 5V power pin, a pin for GND, an input ‘range’ pin, and an output ‘echo’ pin.



A signal controlled by the ‘range’ pin is sent out, and its resulting echoed signal is sent out through the ‘echo’ pin (Sparkfun Electronics, 2017).

V. EMY 5 X HC-SR501 Adjust Ir Pyroelectric Infrared PIR Motion Sensor Detector Modules

The HC-SR501 PIR Motion Detector is used to detect the presence of a body.

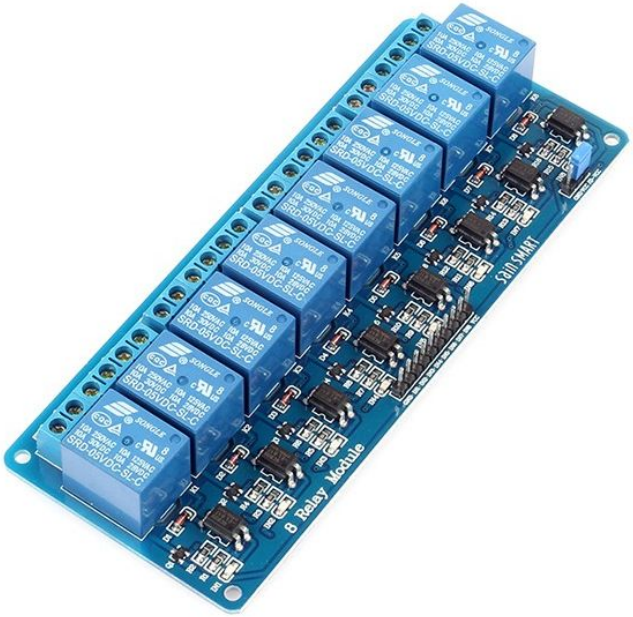


This sensor has three pins: power, GND, and high/low output. Its boolean output is determined by the presence of a body, which is confined to a threshold. This threshold can be set using two on-board potentiometers.

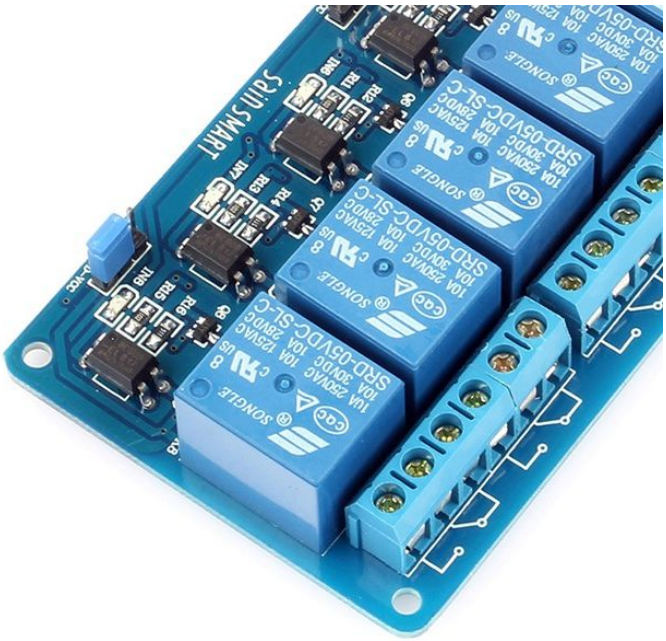
The first potentiometer controls sensitivity, and the second controls a time delay. The sensor takes close to minute to power on and become stable. The board runs on 5 volts to 20 volts (mpga.com, 2017).

VI. SMKAN 8 Channel DC 12V Relay Module for Arduino

The AMKAN 8 Channel DC 12V Relay is used for the control of external lights.



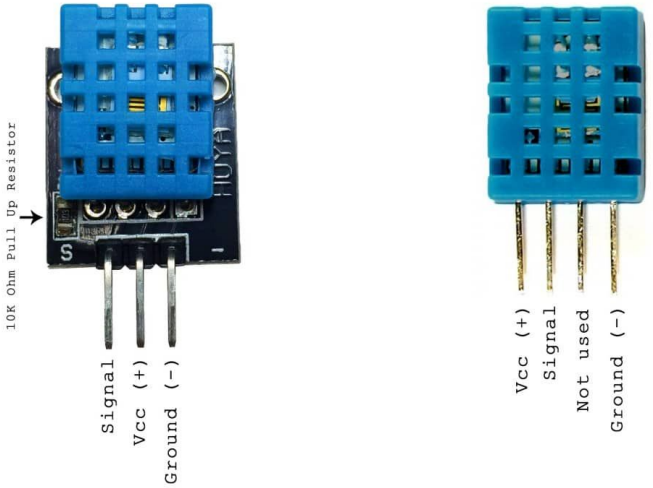
The relay board has ten pins: GND, VCC, and eight input pins. The board runs on 5V, and is Arduino compatible. Each input pin controls one of the eight relays, causing it to either be open or closed based on a boolean input.



Each relay has three connectors. Connecting two ends of a circuit to the middle and right-most pin will cause the circuit to be closed unconditionally. Connecting the left-most pin to either of the other pins will create a circuit that is conditionally closed. Indicator LED's are used to show when a relay is open and closed. Each relay is closed when its controlling signal is low, and open when its controlling signal is high (SainSmart, 2017).

VII. Arduino DHT11 Temperature & Humidity Sensor Module

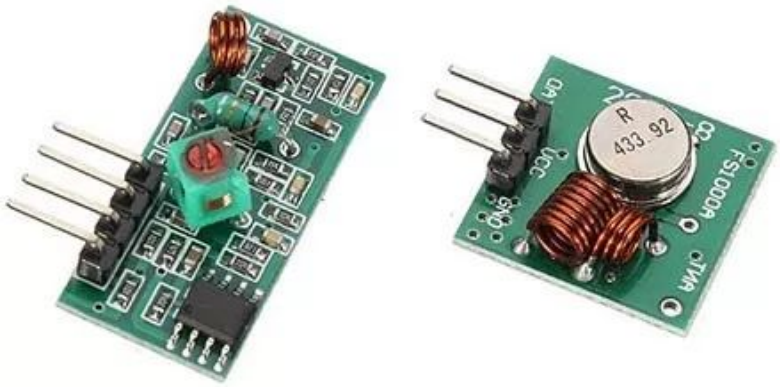
The DHT11 Temperature & Humidity Sensor Module is an Arduino-compatible sensor that is able to measure humidity and temperature.



The board has three pins: Ground, Vcc, and Signal. The board runs on 3V-5.5V. The Signal pin is used to output a digital signal, which contains humidity and temperature information. Humidity is measured within 5% of its actual value, and temperature is measured within 2% of its actual value (Circuit Basics, 2017).

VIII. RF 433MHz Transmitter/Receiver

The RF 433MHz Transmitter and Receiver are wireless communication devices capable of sending signals over a few meters in ideal conditions.



The transmitter has three pins: GND, VCC, and OUT. The transmitter runs on 3V-12V. Packets from a controller are sent through the OUT pins, and the transmitter broadcasts a signal. The receiver has four pins: GND, VCC, MX, and RM. The receiver runs on 5V. The MX pin is used to output a received signal to a controller. The RM pin acts as a push-button controller, which controls the output of signals through the MX pin. The RM pin is not necessary for basic function of the receiver (Random Nerd Tutorials, 2017).

IX. 110 Volt AC Socket to USB adapter

This component is a simple USB to 110V AC Adapter, which is used to provide the proper 5V DC connection to a USB cable by using a 110V AC power socket. (cablemart.com, 2017).

X. Basic incandescent light bulb socket, 40W Bulb, and 110V AC power plug

These components are basic hardware components. The light bulb sockets hold 40W bulbs, and has two wires as connectors for integration into a circuit.

The bulbs used are 40-Watt Incandescent A15 Appliance Reveal Light Bulbs.

The power plug used is a 15 Amp 125-Volt 3-Wire Plug.

XI. System Integration

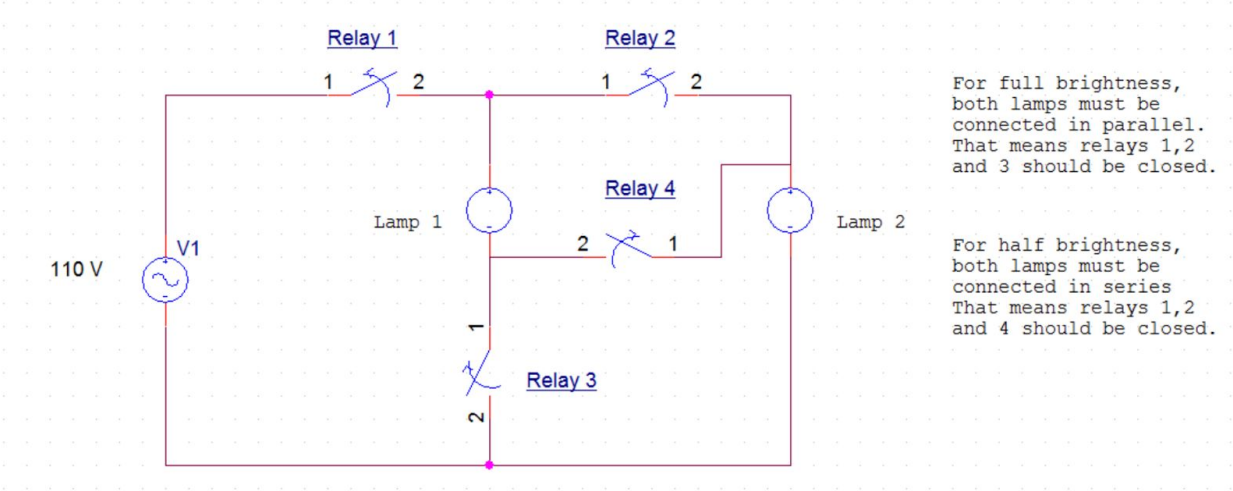
Each component is Arduino-compatible, and should be appropriately connected to the Arduino microcontroller according to the following pin description:

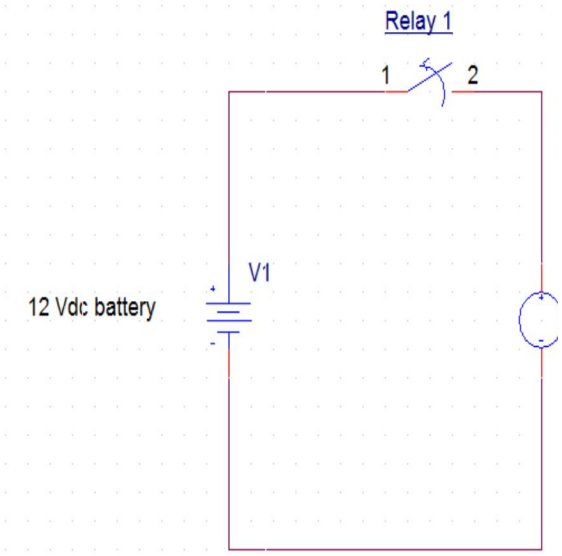
```
// Pin 12 - Dedicated TX pin
// Pin 11 - Dedicated RX pin
#define relay1 53   // Relays
#define relay2 52
#define relay3 51
#define relay4 50
#define relay5 49
#define lightsensor 7     // Light sensors
#define range_trig_NE 34  // Ultrasonic sensors, 2 for each package
#define range_echo_NE 35
#define range_trig_SE 32
#define range_echo_SE 33
#define DHT11_PIN 4     // Humidity sensor
```

Each line in the table above contains a define keyword, an object keyword, the Arduino pin number, and in some cases, comments noted by the '//'. The table below converts each object keyword into its appropriate pin, as described in the sections above:

‘Dedicated TX pin’	Section VIII: Transmitter pin ‘OUT’
‘Dedicated RX pin’	Section VIII: Receiver pin ‘MX’
relay1	Section VI: Relay input pin 1
relay2	Section VI: Relay input pin 2
relay3	Section VI: Relay input pin 3
relay4	Section VI: Relay input pin 4
relay5	Section VI: Relay input pin 5
lightsensor	Section III: Pin ‘DOUT’
range_trig_NE	Section IV: ‘range’ pin of first sensor
range_echo_NE	Section IV: ‘echo’ pin of first sensor
range_trig_SE	Section IV: ‘range’ pin of second sensor
range_echo_SE	Section IV: ‘echo’ pin of second sensor
DHT11_PIN	Section VII: ‘Signal’ pin

Some components are not included in the tables above. Components listed in section X should be connected to the appropriate connectors on the relays, as according to the following diagram:





Other components not included in the tables above include some detection sensors. These sensors can be connected to any Arduino digital pin, since all sensors not included in the tables above have boolean outputs. Power adapters were also not included in the tables above. These adapters should be connected to their appropriate wires and power cables, as needed. Basic wires should be used to connect each component to its appropriate place on the controller or relay.

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