



# Smart Cat House

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# The Project

## Smart Cat House

- Pressure Pad Activated Door
- Temperature Activated Heating
- Light Sensitive Lighting





# Project Requirements

- Heating pad powers on whenever the temperature is cold
- Light powers on whenever it is dark outside
- Door to house opens when cat is detected outside
- Power source for system lasts an appropriate amount of time



# Thresholds and Objectives

## Threshold:

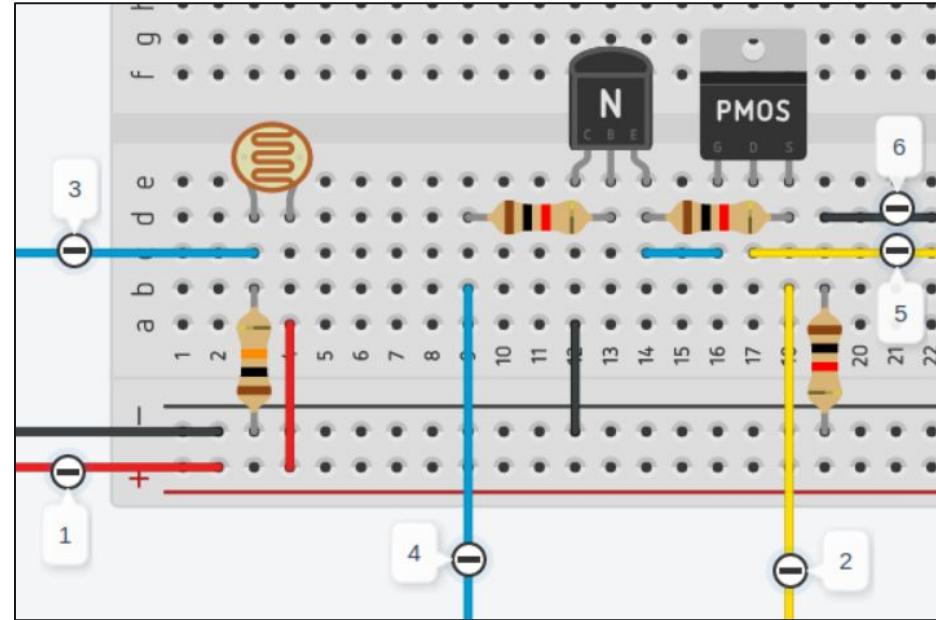
- Heating pad turns on below  $50 \pm 10$  °C
- Light turns on below  $100 \pm 10$  lux
- Door opens when anything activates the pressure pad
- Power source lasts for a week

## Objective:

- Heating pad turns on below  $50 \pm 5$  °C
- Light turns on below  $100 \pm 5$  lux
- Door opens only when cat activates pressure pad
- Power source lasts for a month

## Light Component

- Photoresistor and bias resistor voltage sent to microcontroller
- Microcontroller calculates the resistance of the sensor
- Threshold value was calibrated and set in the code
- Microcontroller sends a high output (wire 4) if the light sensor resistance is above the threshold
- A transistor circuit is used to send 12 volts to the light bulb (wire 2) when signalled

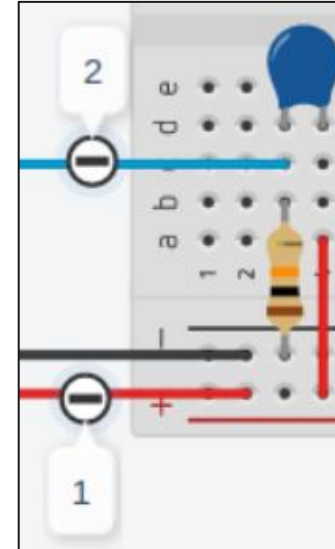


Light Circuit

- |                                |                                    |
|--------------------------------|------------------------------------|
| 1. 3.3 V Mbed output pin       | 4. Mbed light on/off output signal |
| 2. 12 V Source                 | 5. Lightbulb +                     |
| 3. Light sensor Mbed Input pin | 6. Lightbulb -                     |

# Thermistor Component

- Thermistor and bias resistor voltage sent to microcontroller
- Microcontroller calculates the temperature of the sensor
- Threshold value was calibrated and set in the code
- Microcontroller sends a high output to the relay if the thermistor temperature is below the threshold
- A 120 V relay powers on the heating pad when signalled

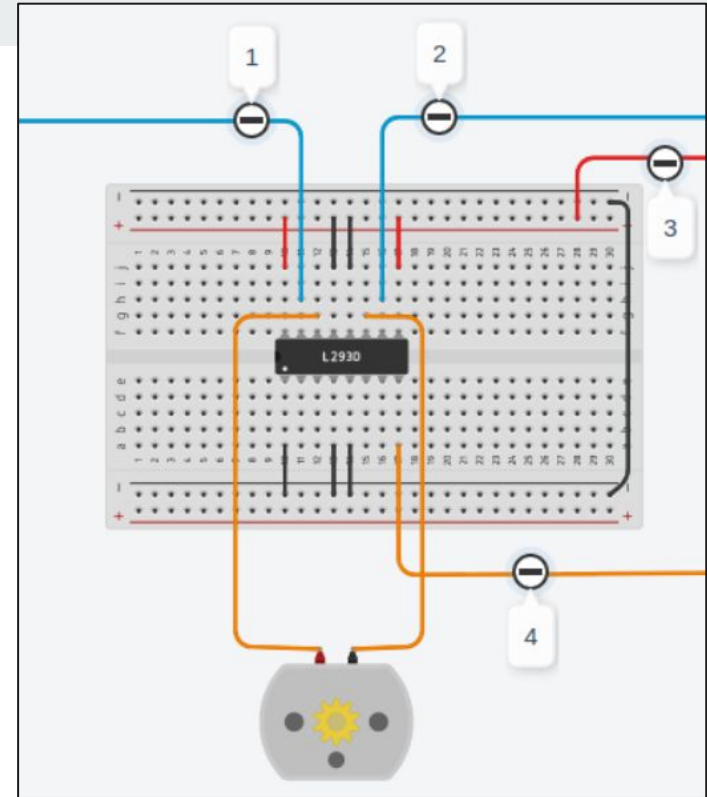
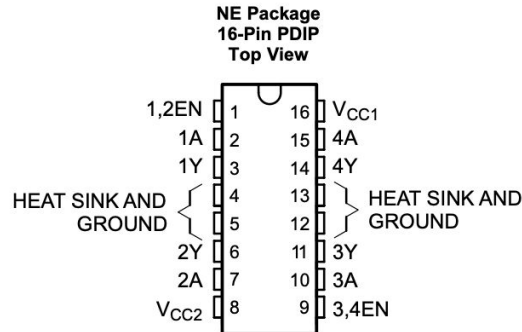


Temperature Circuit

1. 3.3 V Mbed output pin
2. Temperature sensor Mbed Input pin

# Motor Circuit

- When pressure pad is pushed once, door opens
- When pressure pad is pushed again, door closes
- Used an H-Bridge chip to control the direction of the motor
- Motor turns one way or another based on the microcontroller output, labelled 1 and 2 on the figure
- Motor is run on 12 V and the microchip is run on 5 V



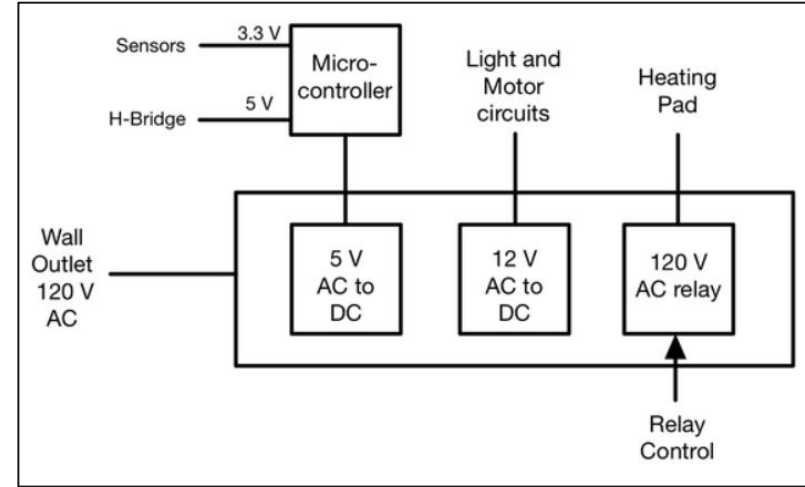
Motor Circuit

1. Microcontroller output up signal
2. Microcontroller output down signal
3. 5 V
4. 12 V

# Power

## Multiple Voltage Systems

- 3.3 and 5 V are provided by the microcontroller output voltage pins
- 12 V is provided by an AC to DC converter
- 120 V AC is provided by a store-bought relay
- Microcontroller is powered by a 5 V AC to DC converter
- Entire system is powered by a connection to a wall outlet

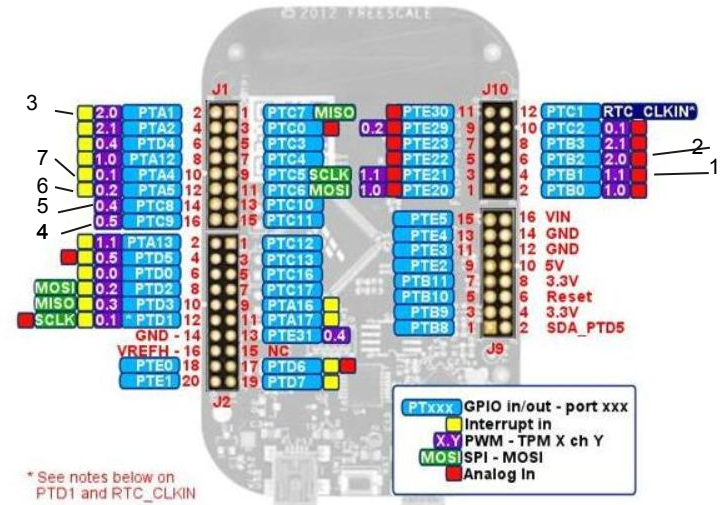


Power System



# Mbed Microcontroller Code

- Programmed the Mbed microcontroller to control each component of the project
- Controls heating pad and lightbulb by comparing threshold values set in code to voltages read across the light and temperature sensitive resistors.
- Controls motor using input from the pressure pad as an interrupt signal and a set of timers calibrated through testing



## Mbed Microcontroller Pins

1. Thermistor voltage input
2. Photoresistor voltage input
3. Pressure pad interrupt
4. Motor Up output signal
5. Motor Down output signal
6. Light on/off output signal
7. Heater on/off output signal

# Building the House



Constructing the house:

- The cat house is a solid wood construction; the dimensions are 24 x 33 x 16 in
- The interior of the house has two rooms; an eating room, and a sleeping room

Adding each component to house:

- The components inside the house are the heater and the light
- The electrical circuits reside within the roof, and holes were made to run wires
- Each part of the circuit is in a splash/tamper proof box

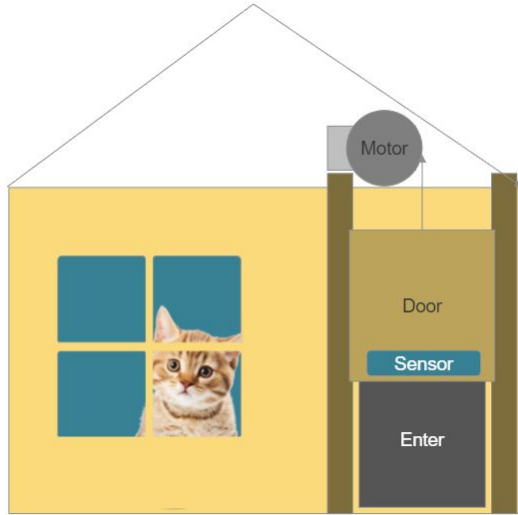
Building the motorized door

- The door is hanging by a rope connected to a motor above it; it's guided by rails along the frame

Building the pressure pad

- A pressure pad was built using aluminum and cardboard; when a weight is placed, the two sides connect and cause an interrupt

# Component Designs

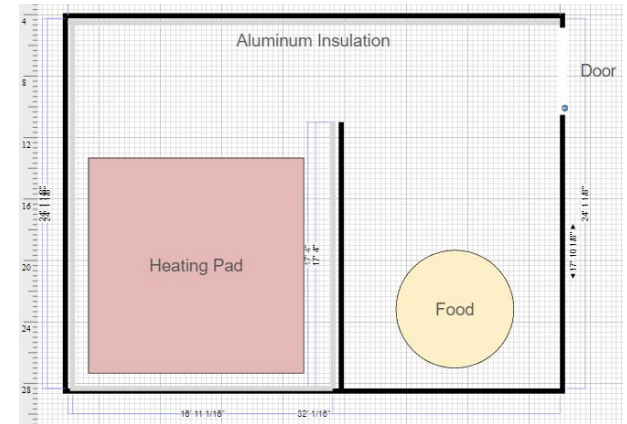


Entrance and Door



Pressure Pad Design

House Schematics





## Results

- Heating component activates at 48 °F, which passes the objective
- Light turns on under 103 lux , which passes the objective
- Door opens when any pressure is detected on the pad, which passes the threshold
- Power is drawn from the grid, so it lasts indefinitely, which passes the objective