Web-Interfaced Power Control

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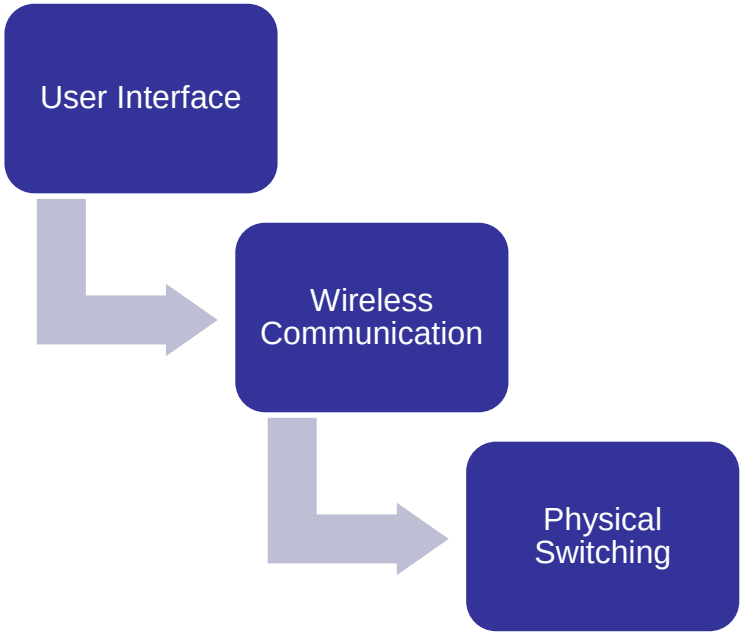
Motivation

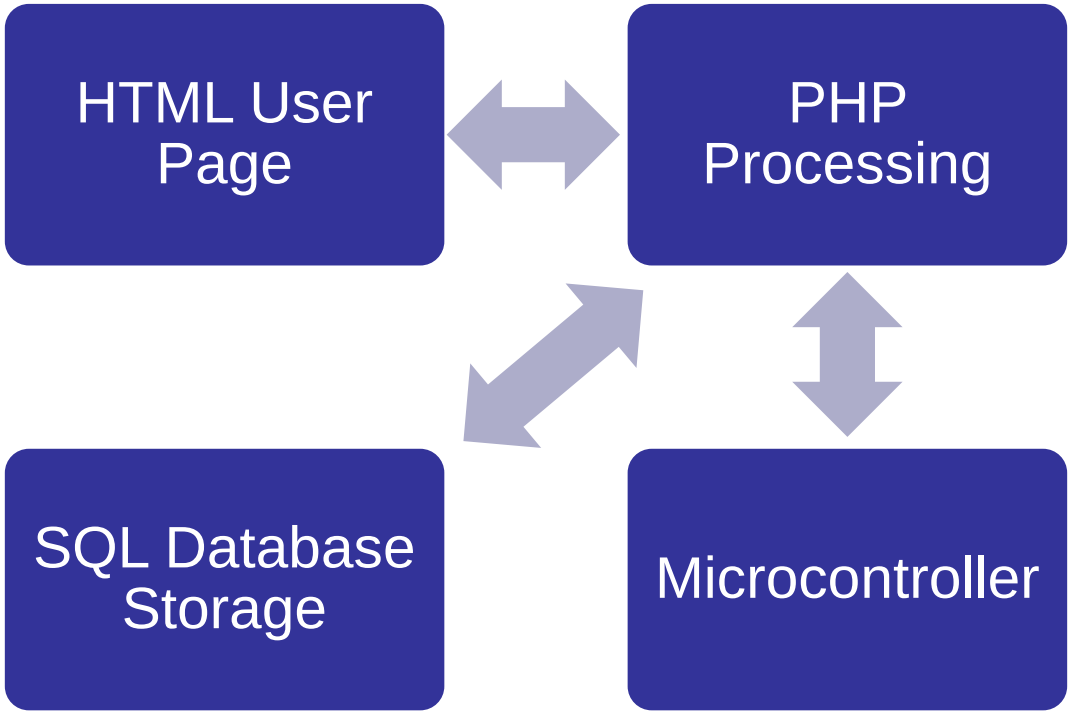
- We want to be able to save the world of power waste during idle time
- Provide a convenient remote control for home
- Provide a reliable and save communication system
- Make a very user friendly system
- Finally, we want to be able to do all of this very, very cheap.

System Overview



- UI: an intuitive and responsive input system that leverages the versatile connectivity of the internet
- Wireless Communication: provides ultimate modularity and geometric freedom for local environment
- Switching: small switching circuit is cheap, reliable, and reproducible

User Interface Overview



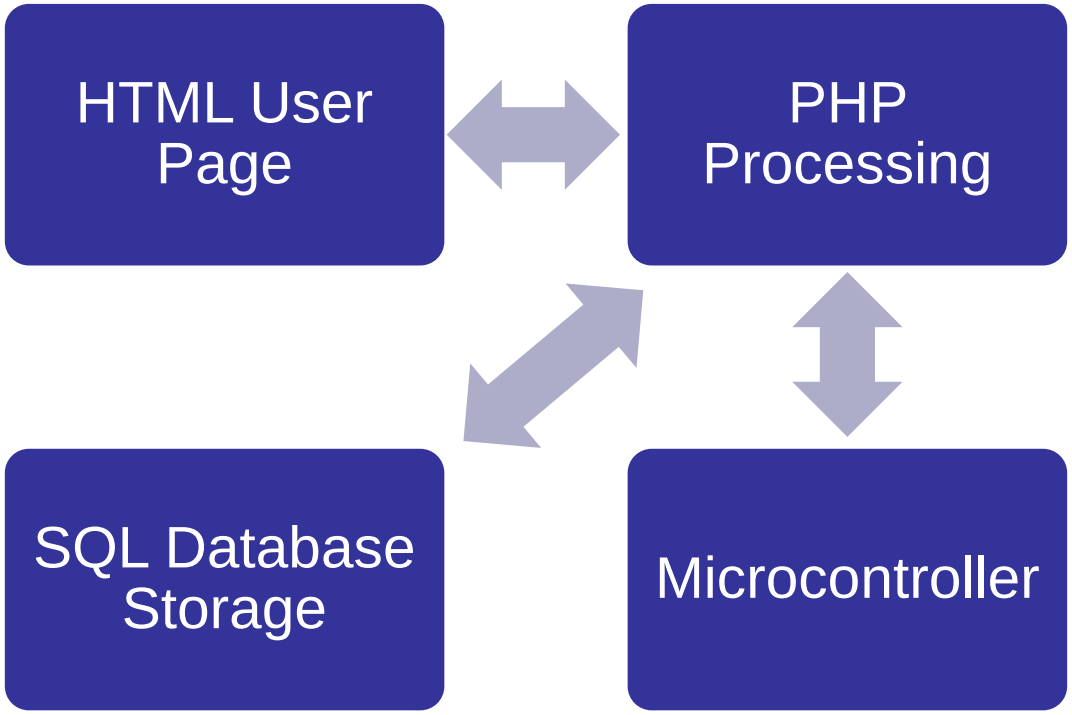
HTML User Page

- User friendly interface
- Provides the user with:

1. ON/OFF functionality
2. Status
3. Timer functionality

- jQuery countdown timer

User Interface Overview



User Interface Challenges

Challenges	Solutions
• Storing status of power distribution for web display	• Decided on SQL database to store status, interfaced well with PHP
• Server communication with microcontroller	• Found serial data method, allowed for bi-directional communication
• Timer feature implementation	• jQuery library implementation

User Interface Testing

User Input to Server

- Allow user to decide between ON/OFF and transmit selection to server
  - Print received input to screen and verify
- Save timer input selections and transmit to server
  - Save input selections and timer length into database and verify

Server & Microcontroller

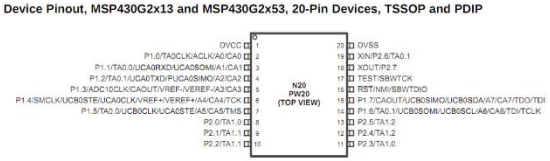
- Send a character to microcontroller through serial
  - Use Serial monitor to verify printed character from MCU
- Send a character from microcontroller through serial to server
  - Have server read from serial port and perform page change if character is verified

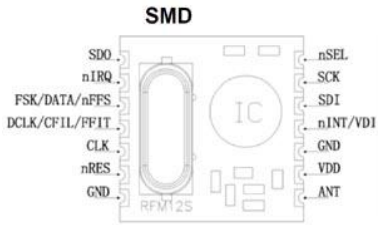
User Interface Summary

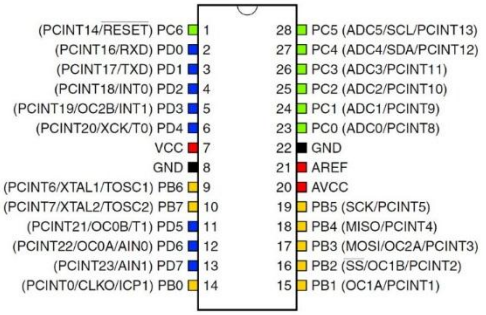
- All verifications were met for the user interface
- Next step was the transmission of user commands

Wireless Communication

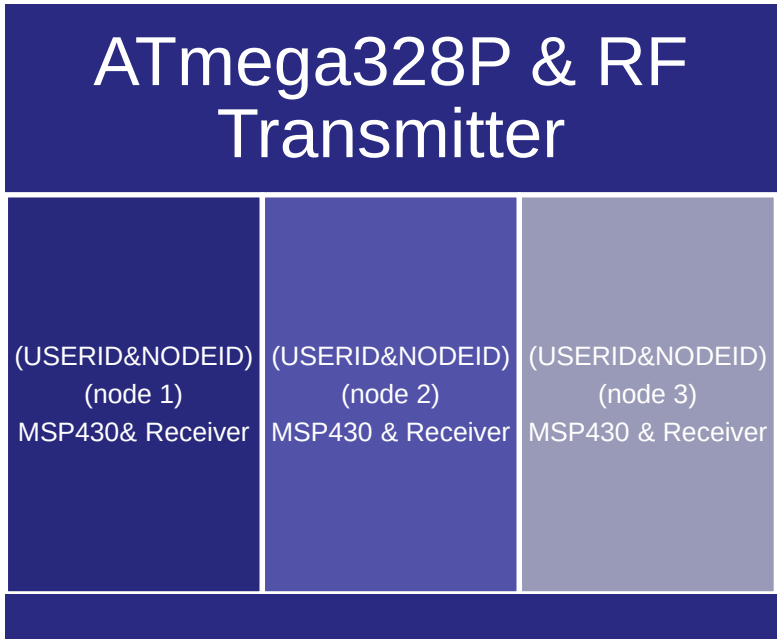
- The RF frequency that we decided to work with was 433MHz.*
- A Transmitting unit, relaying information from a webserver
- Any number of receiver modules.







Initial Design



- ✓ Use one transmitter and slave receivers per node.
- • The Transmitter would be a stronger processer because it has to do more logic analysis than do the receivers
- • Transmit Consecutive bits
- ✓ Meant to be a modular design
- ✓ Error Checking
- ✓ Unique Node IDs
- ✓ Secure*(Database USER ID)

Challenges

Software

- Max number of bits that an MSP430 can take.
- Bit loss
- Trying to make an active Transceiver (so as to have acknowledge)
- Mistakes in online reference code

Hardware

- Testing of RFM12b*
- Making a noise free connection with MSP430
- Figuring out the full wave transmission antenna length
- Bad Datasheet for RFm12B

Solutions

What Changed

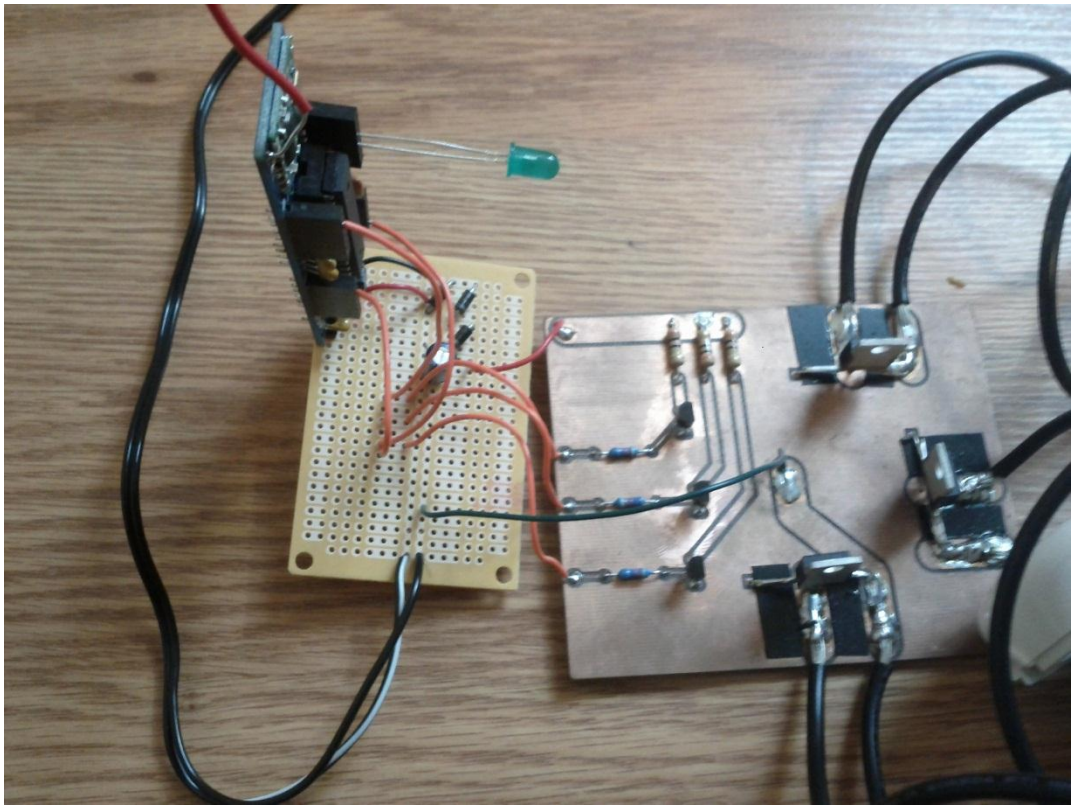
- No longer use MSP430
- JEENODE
- ATmega328 as receiver
- Use Arduino IDE for Transmission
- Instead of transmitting individual bits transmit a packet of data
- Transmit AWK bit on Receive, and Only Transmit status (from receiver) During transmitter downtime(hub)

Why

- Incoming 2 bytes, MSP only 1 byte
- Specified PCB compatible with receiver*
  - (because of bad datasheet on RFM)
- Can take 2 bytes easily
- Serial port communication made simpler
- Less loss between transmission*(parity)
- Caused no collisions.

Receiver System

Jeenode

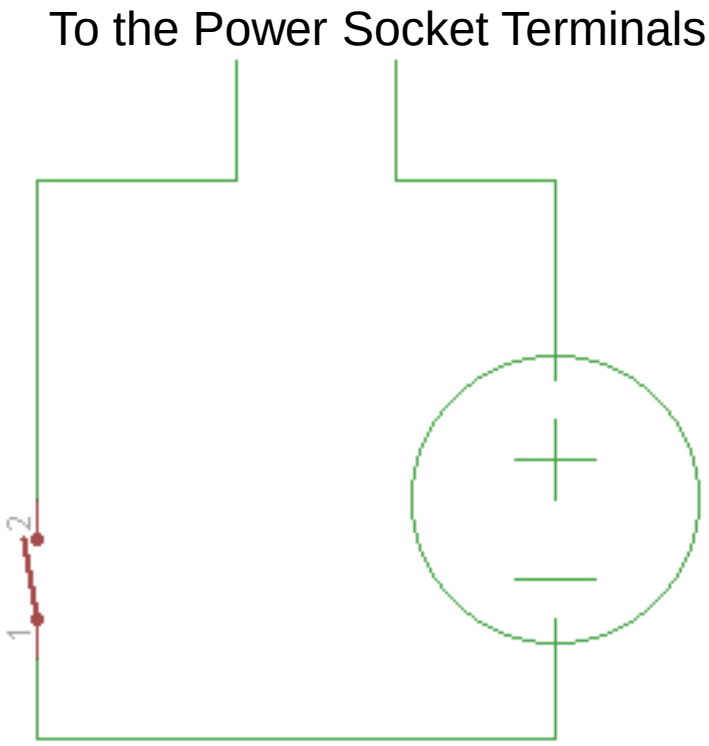


Testing

- Usage of an oscilloscope connected to the antenna pin*
- Turning on LED pins corresponding to received data(Distance)
- Making a serial connection with Transmitter and Receiver
- Making large packets and sending until receive AWK
- Placing Transmitter/Receiver in different rooms
- Set transmit with direct serial connection from Network*(problematic)

Socket Switches

- Every Socket on the power strip is fitted with a switch
- Functions as a high or low impedance in series with the load



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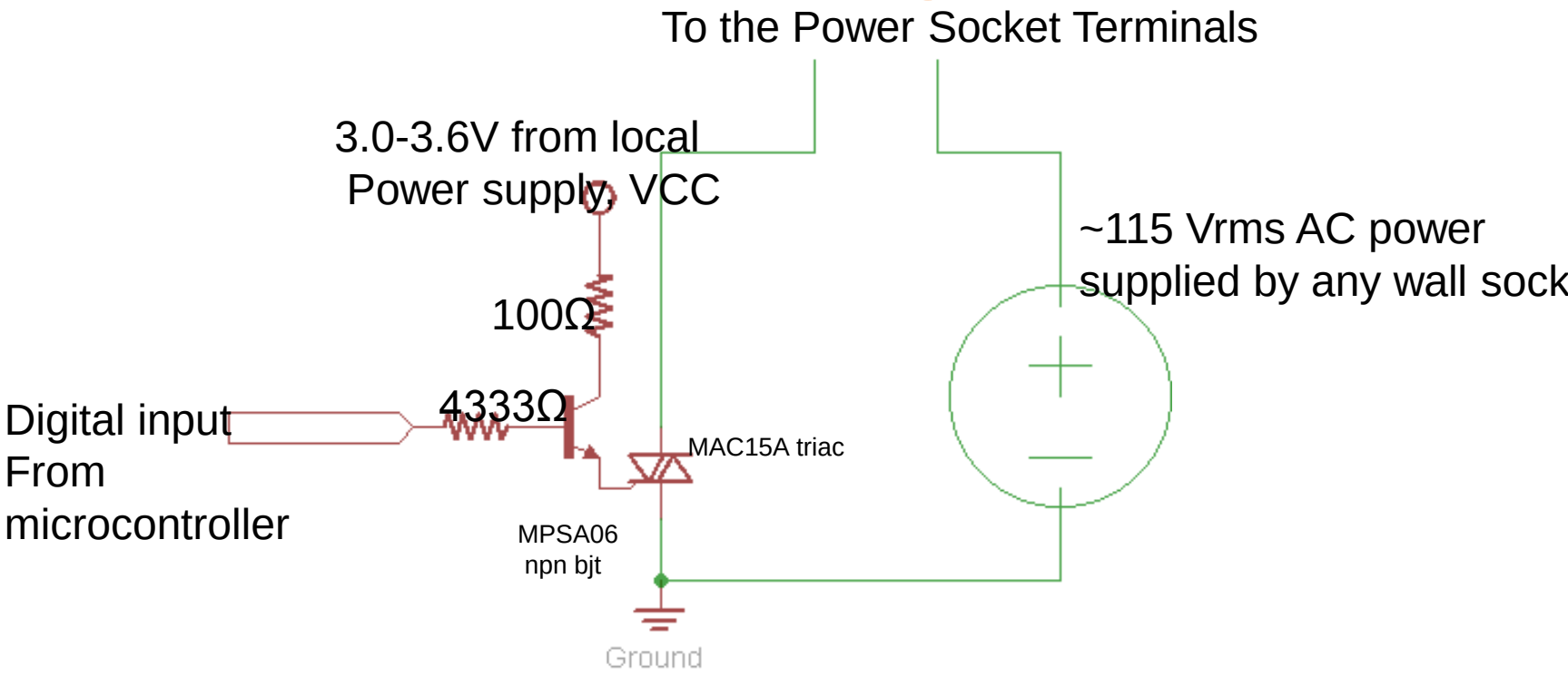
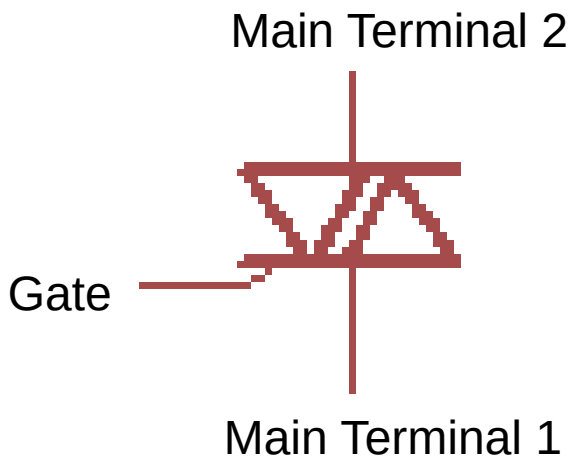


Triac as a switch

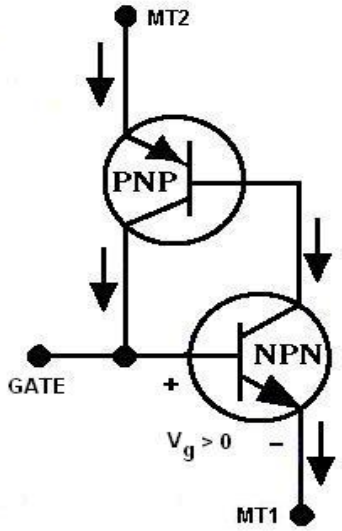
- Gate current causes AC current to conduct through the main terminals
- Main current will continue to conduct even when Gate current is cut off
- Only about 1 V drop across the main terminals when conducting



Challenges – Operating the triac

- No standard for which terminal is Main Terminal 1, 2
- If the wrong terminal is used as the reference terminal, then the triac will not respond to switching signal
  - It will behave as a half-wave rectifier

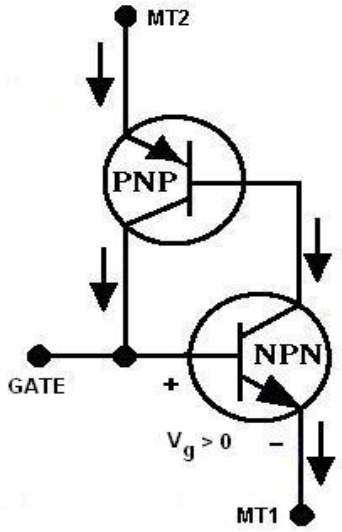
Triac Equivalent Circuit



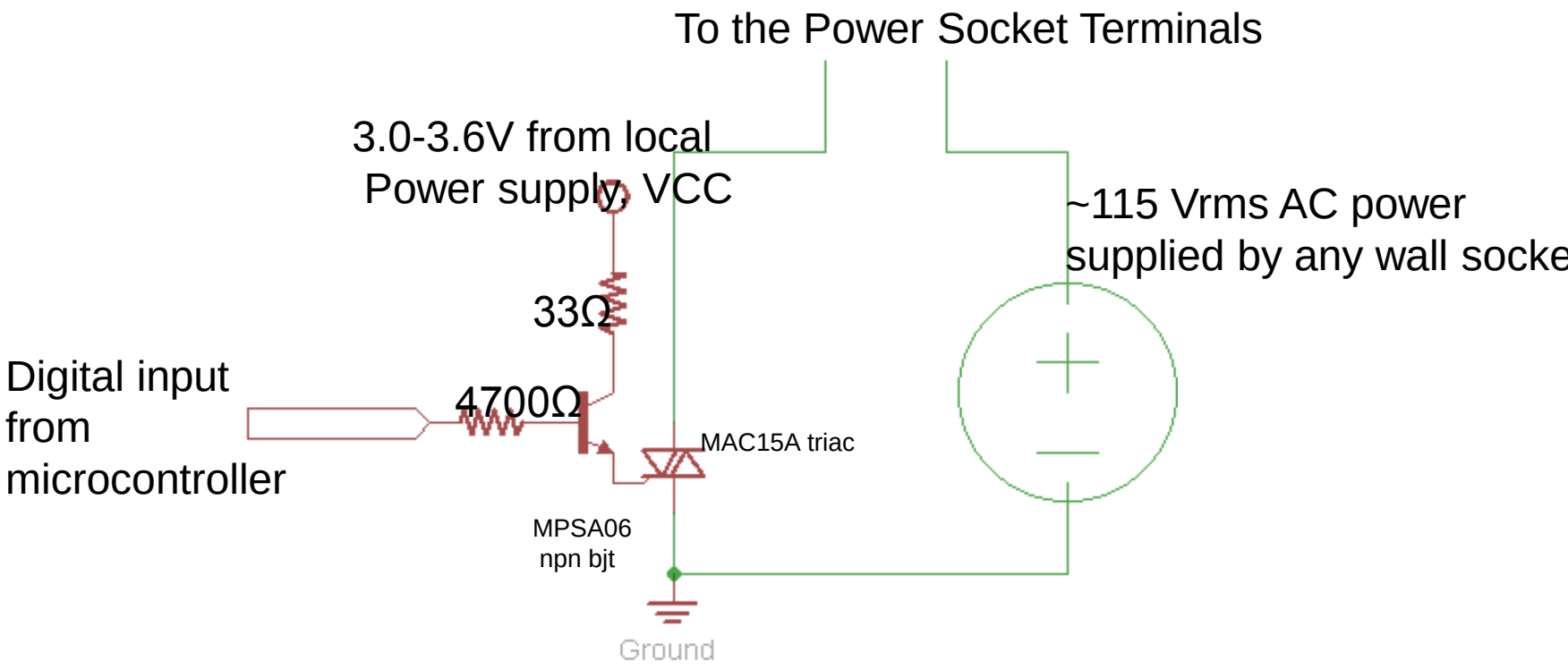
Solution

- The impedance as measured from Gate to reference terminal will always be very small
  - PN junction
- Always measure the impedance of the device from gate to each terminal to verify the pin assignments

Triac Equivalent Circuit



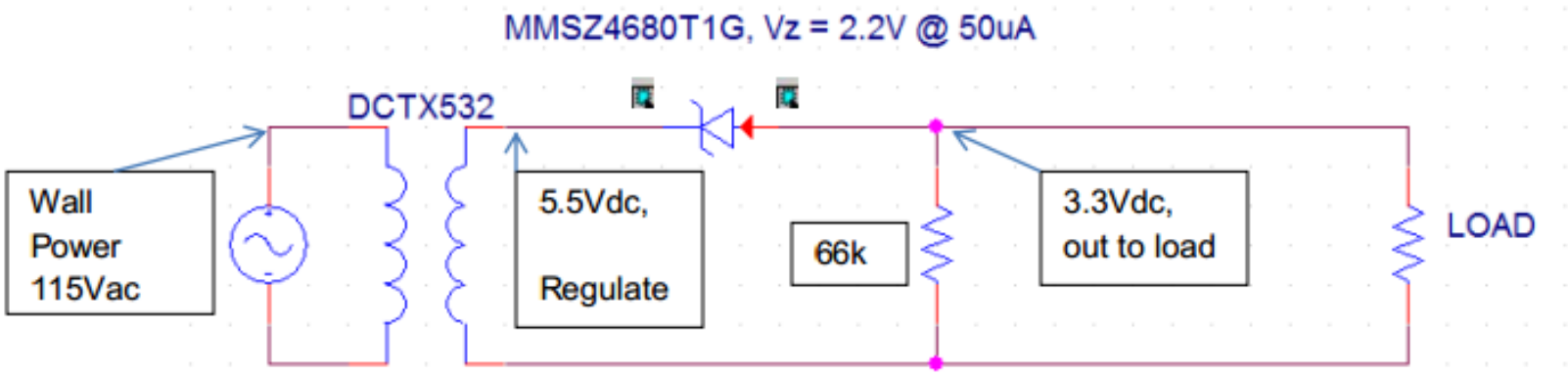
Final Design



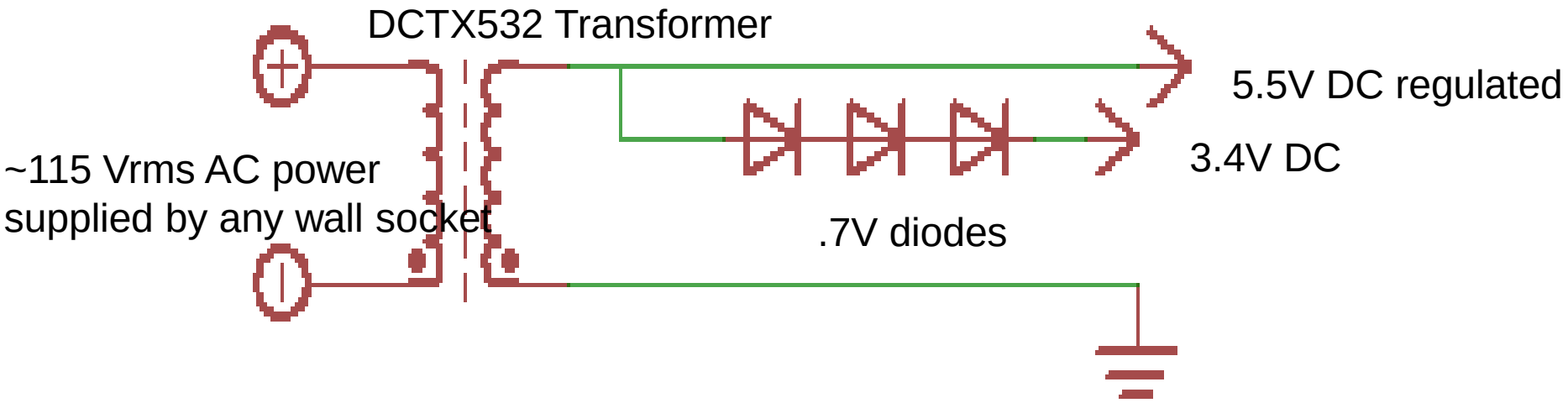
Power Supply

- Supply power for digital processing
  - 5.5V for microcontroller and radio
  - Between 3.0 and 3.6 Volts for the switch
  - Must supply at least 300mA
- One per power strip
- Draws power from the wall socket

Initial Design

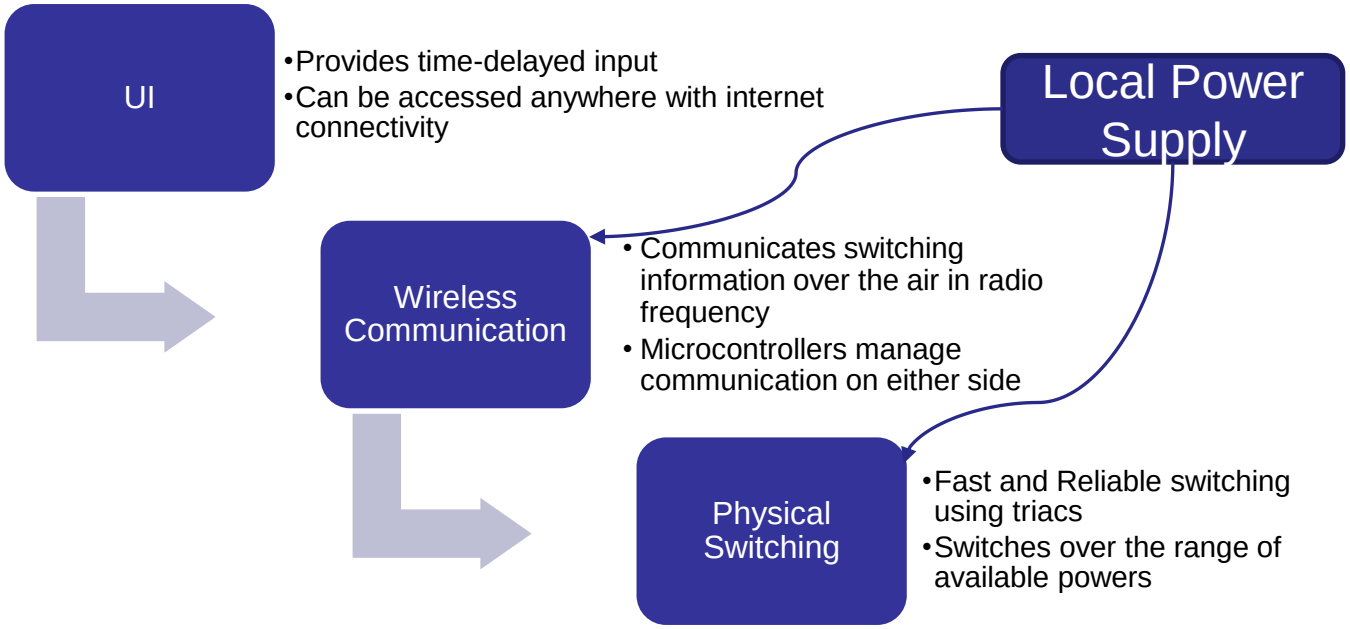


Final Design



Ground is common between IC, power supply, and switching circuit

Project Summary



Recommendations

- Zwave for communications, already an established standard
- Use CAD to design an enclosure
- Extra timing features, possible login portion of database
- Enclosure

Special Thanks

- Igor Fedorov
- ECE parts shop
- Kevin Colravy
- Professor Singer
- Professor Lilly

THANK YOU!