

The background features a dark blue gradient with technical diagrams on the left side, including circular gauges with numerical scales (150, 160, 170, 180, 190, 200, 210, 220, 230, 240, 250, 260) and various circular and arc shapes. At the bottom, there is a silhouette of a mountain range under a starry night sky.

SMART MIRROR CRITICAL DESIGN REVIEW

GROUP 31

TYLER NEWMAN – COMPUTER ENGINEER

AXEL ARISTUD ORTEGA – COMPUTER ENGINEER

JONATHAN MARTIN – ELECTRICAL ENGINEER

JACOB WILLIAMS-MOORE – COMPUTER ENGINEER

MOTIVATIONS

- Create a device that conveniently conveys information to the user during their daily routine
- Smart home technology is a rapidly growing industry
 - Amazon Echo
 - Samsung Smart Fridge
 - Ring
- Develop a unique smart home device not yet widely available on the market



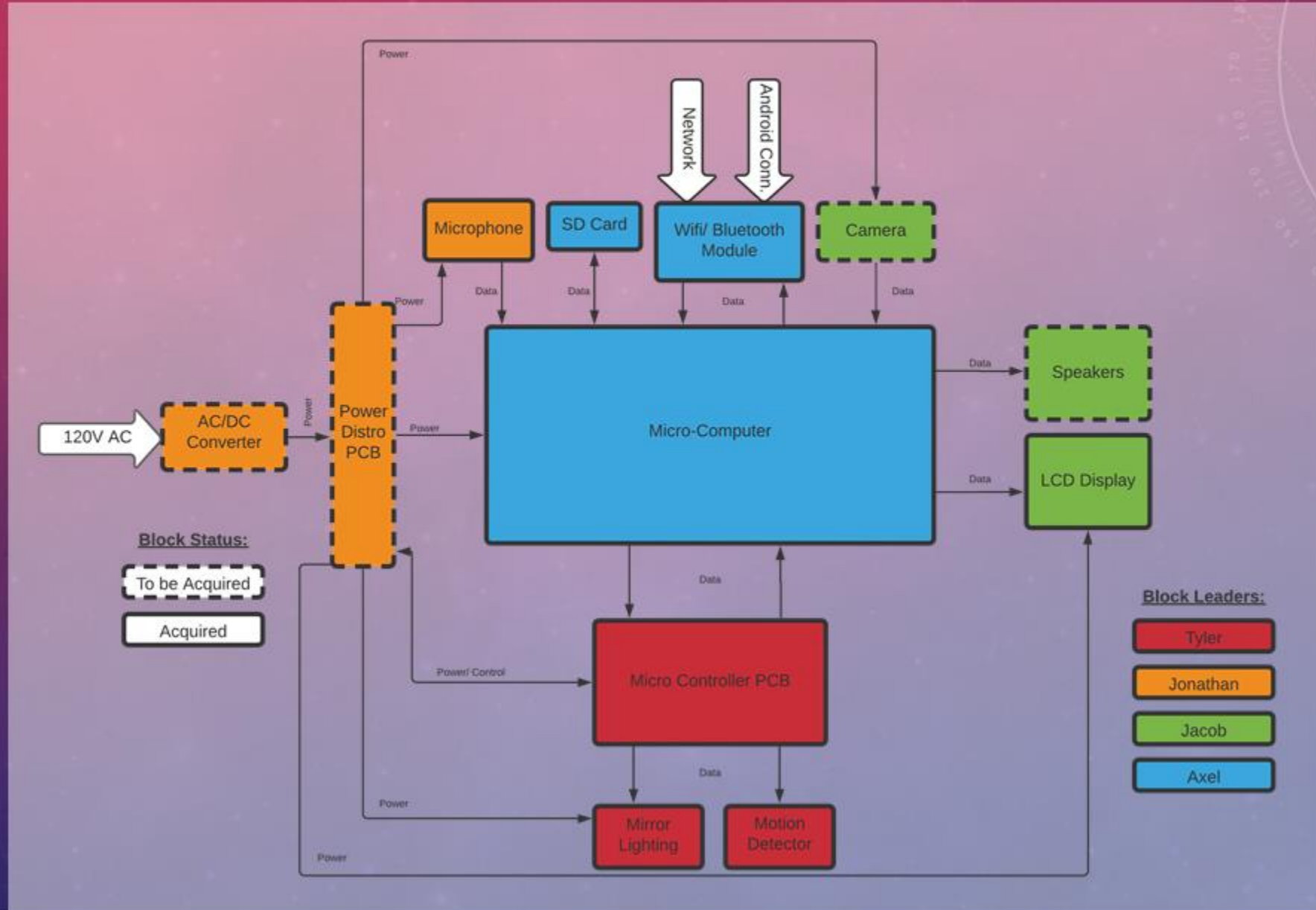
GOALS AND OBJECTIVES

- Improve on a person's morning routine and make preparation for the day a bit easier
- Deliver useful information to the user that they personally feel is important
- Assist in bringing more smart devices to users' homes to further improve daily life
- Create a device with a simple user interface with ease of use features
 - Presence Aware
 - Speech Recognition
 - Facial Recognition

PROJECT SPECIFICATIONS

Requirement	Design Specification
Display Size	18x24 Inches
Total Weight	Less than 25 Pounds
Power Input	120VAC 60Hz
User Input Method	Voice Recognition
User Detection	Facial Recognition and Proximity Sensing
User Detection Range	5 Feet
Functionality	Time/Date/Weather/News/Social Media/YouTube/IoT Control

PROJECT BLOCK DIAGRAM

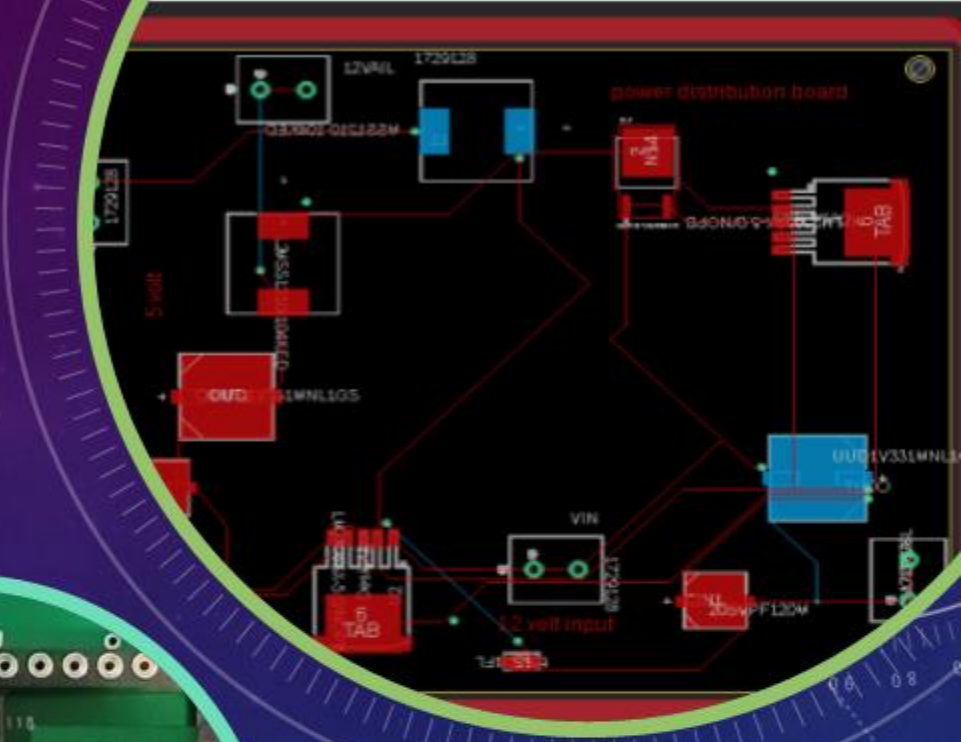




HARDWARE INTEGRATION

HARDWARE SEPARATION

- 3 separate boards will be used/ designed
 - **Raspberry Pi**
 - **ATMega328P Board**
 - **Power Distribution Board**
- Distributes load across multiple components
- Allows flexible mounting in final mirror frame
- Allows group members to work remotely from one another till final assembly



HARDWARE SEPARATION

Raspberry Pi

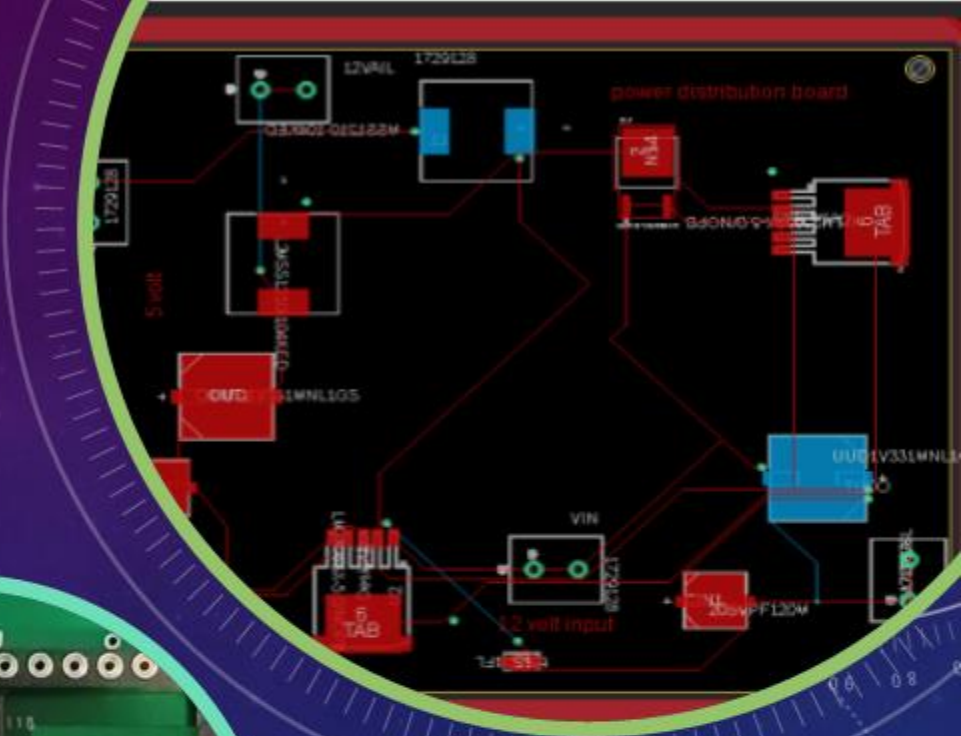
- Facial Recognition
- User Interface
- Screen Content
- Voice Recognition
- Networking

ATMega328P

- Vanity Lighting Control
- User Presence Detection

Power Distribution

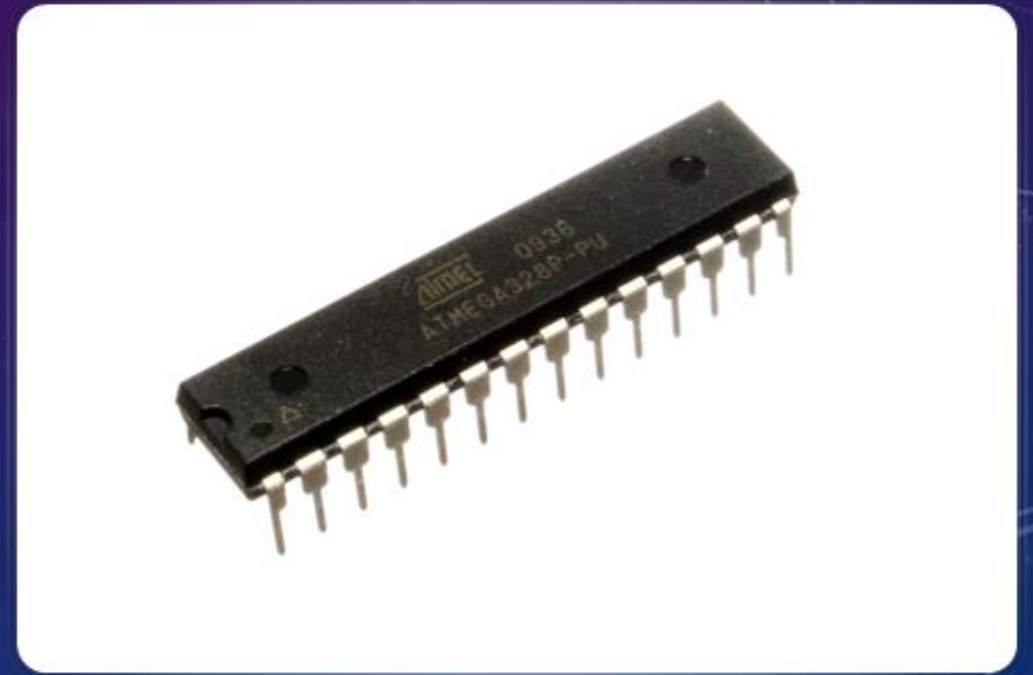
- Provide 5VDC Power
- Provide 12VDC Power



ATMEGA328P

- Will control lighting and user presence detection
- Will communicate user presence status with the micro-computer
- Will use external crystal for highest most reliable clock speed
- Easy to find and cost effective, can be found for a few dollars

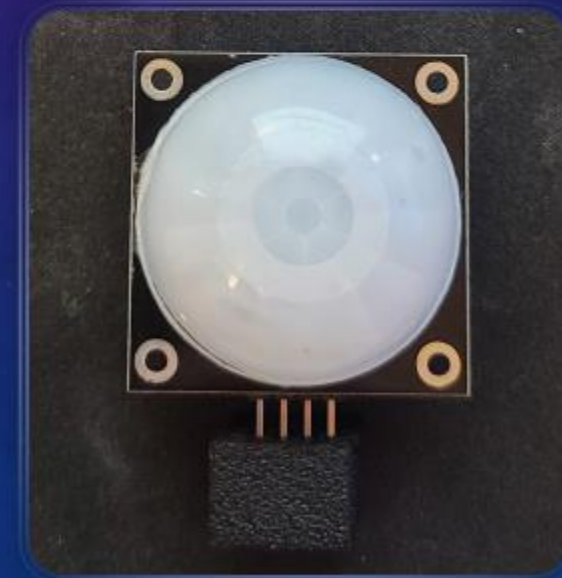
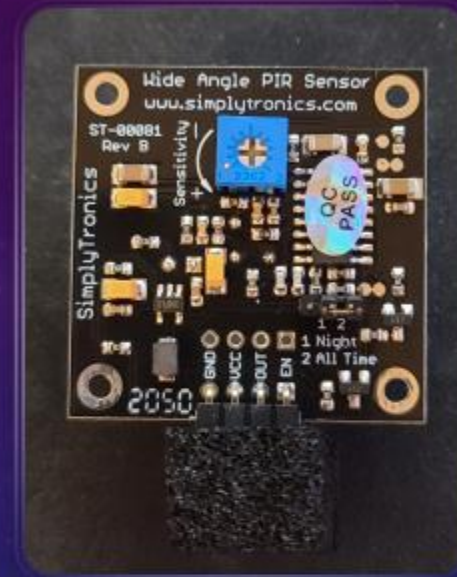
Feature	Specification
Voltage	5V
Clock Speed	16MHz
Memory	32KB
GPIO Pins	23



WIDE ANGLE PIR SENSOR

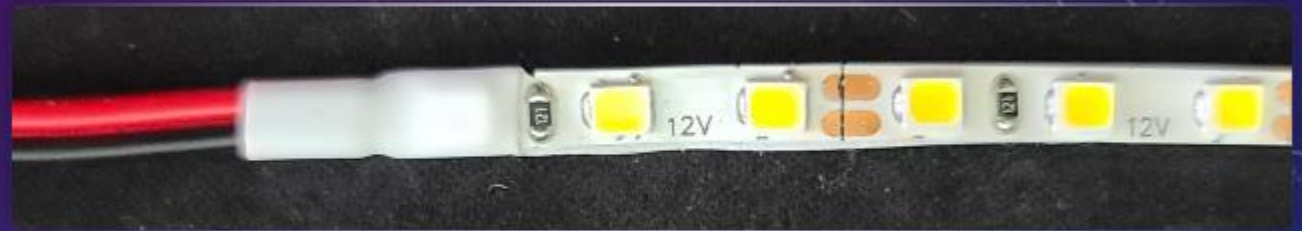
- Will tell the MCU when a user is present
- Will be mounted on the frame and communicate with the MCU via a cable
- Sensor has adjustable sensitivity as well as a low light mode

Feature	Specification
Voltage	5V
Communication	1/Bit
Detection Range	30ft
Detection Angle	180 Degrees
Cost	\$12.99



MIRROR VANITY LIGHTING

- Will be placed behind light diffusers
- Will be used to light the users face and mounted on the mirror frame
- Cheap 12V LED strips will be used
- Will be controlled using 12V power from distribution PCB running through a relay
- On/Off status determined by user presence and on off switch in series with one another



Feature	Specification
Voltage	12V
Width	4mm
LED Count	300
Length	16.4ft
Max Power Draw	36W
Cost	\$12.99

RASPBERRY PI

- Bluetooth and Wi-Fi enabled
- Small and compact design makes it simple to install behind mirror
- Enough power to run all the necessary software
- Most easily accessible MCU on the market with lots of online resources available.



REFLECTIVE PANEL

- Acrylic is a reflective material that can be used as a “mirror.”
- This material has a desirable “Visual Transmittance”
- With a VT of 40%, most light will be reflected, meaning the user will be able to see themselves.
- Just low enough that light from display can pass through



DISPLAY

- The display is taken from a 24-inch HP monitor (VH240a).
- This IPS display at a resolution of 1080p, this panel will provide a clear and bright picture for our product.
- The display will be connected through HDMI to the Raspberry Pi.



SPEAKER

- For audio feedback, an external speaker will be used (LIELONGREN USB Speaker).
- The connection will be made through USB to the Raspberry Pi.
- The speaker provides fair sound at high volumes.



MICROPHONE

- For input, a microphone is used to accept voice commands from the user.
- The (insert correct mic here) is used with the Raspberry Pi to accurately detect and process audio input from the user.

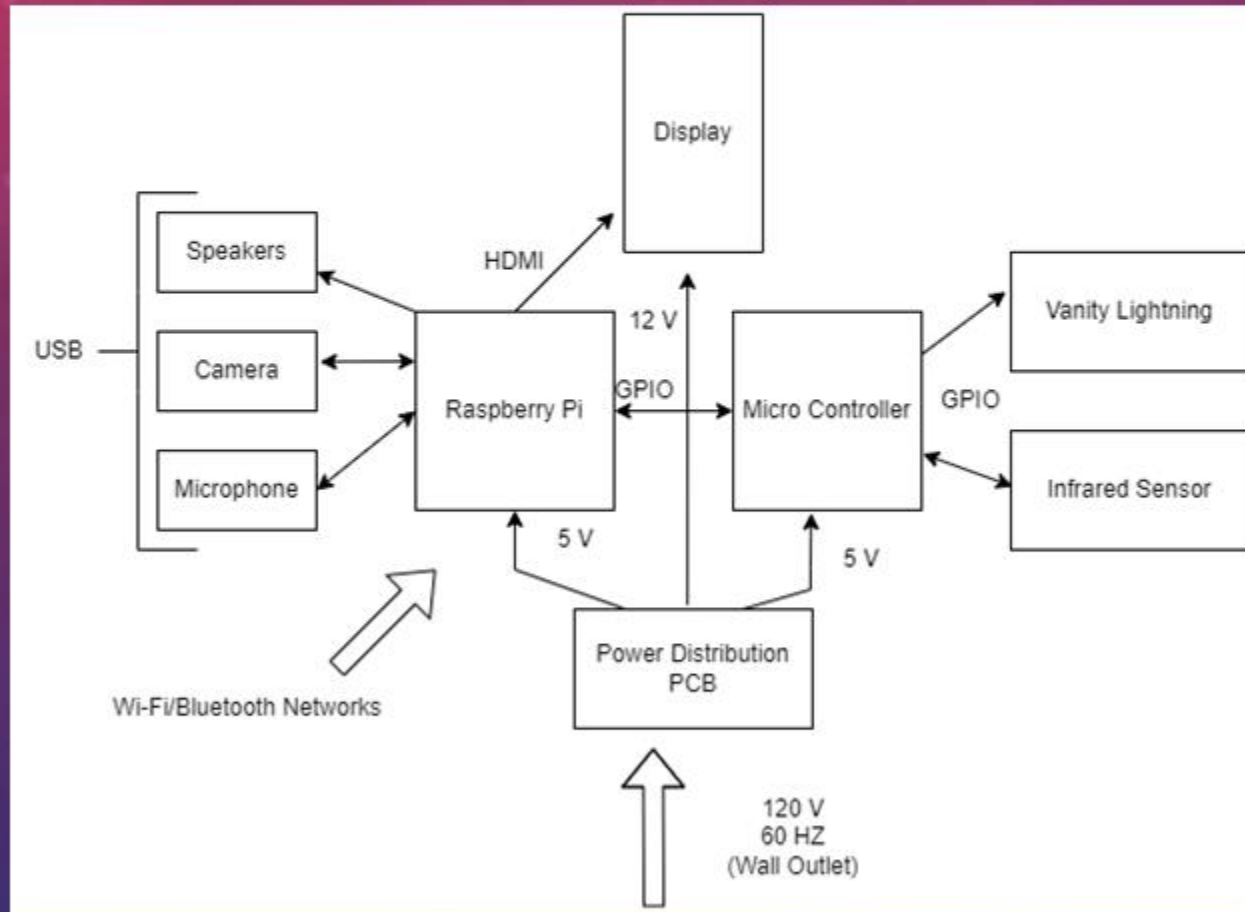


CAMERA

- The Raspberry Pi Camera Module 2 connects directly to the Raspberry Pi's CSI port.
- The camera will be placed discreetly at the top of the mirror.
- Once the presence of a user is detected, the camera will activate for facial recognition.



OVERALL INTEGRATION





SOFTWARE INTEGRATION

MCU SOFTWARE DIAGRAM

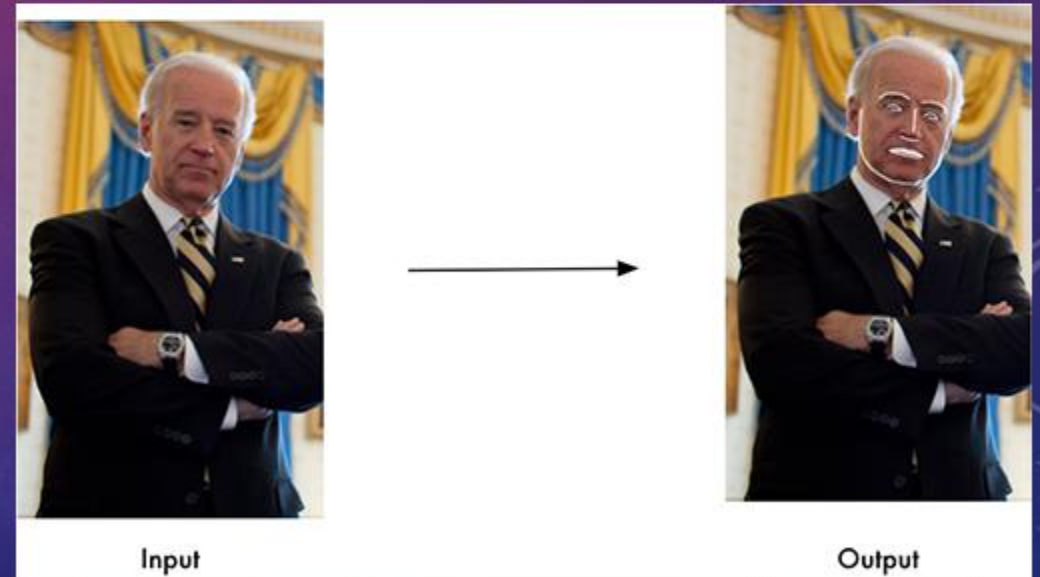


FACE RECOGNITION

Facial "landmarks" will be identified with training images. These landmarks include the nose, eyebrows, lips, and jawline.

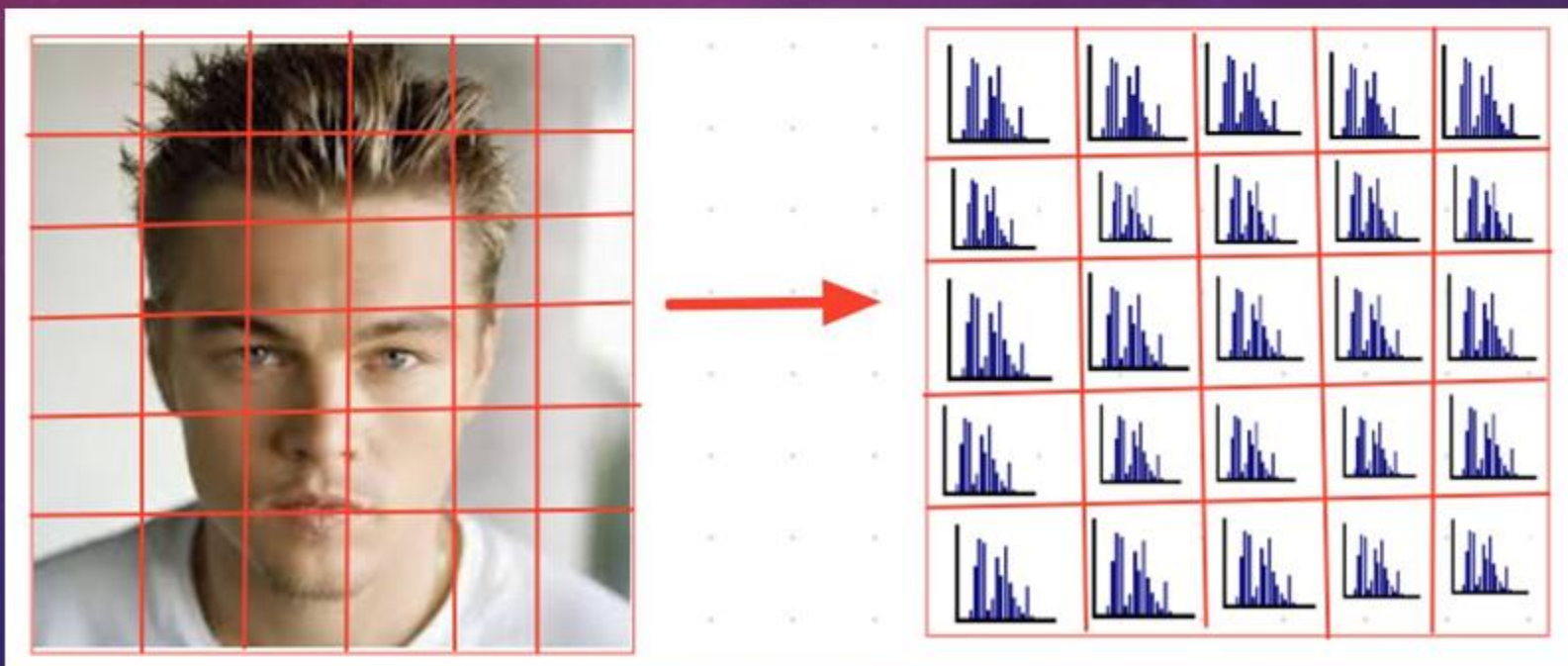
As user begins interaction, photo will be taken, then the mirror will perform an authentication process.

Photo will be matched against training images



HISTOGRAM OF ORIENTED GRADIENTS(HOG)

- Logic behind the face detection. Works by first dividing the entire image into grids.
- The pixels in each individual cell are organized into a histogram depending on several features of the pixel, such as color or intensity.
- These grid values can be saved into an xml file which the software can use as a face database.



MEDIA INTEGRATION

- Mirror will have designated sections for news/social media feeds
- Feeds will auto update after a set amount of time has passed
- Information displayed will depend on who is currently using the mirror

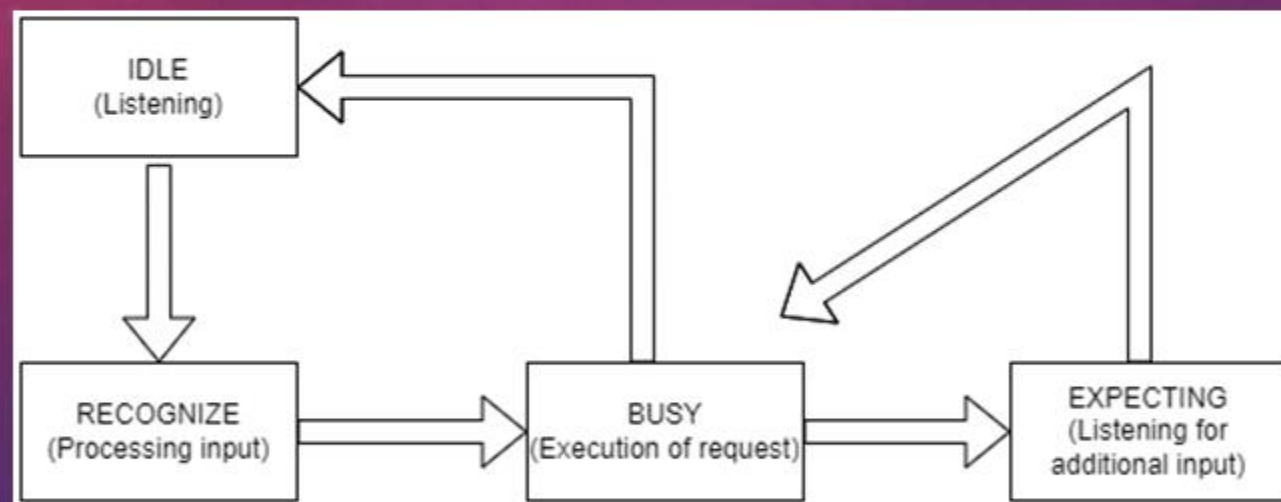


GOOGLE SMART ASSISTANT(SPEECH RECOGNITION)

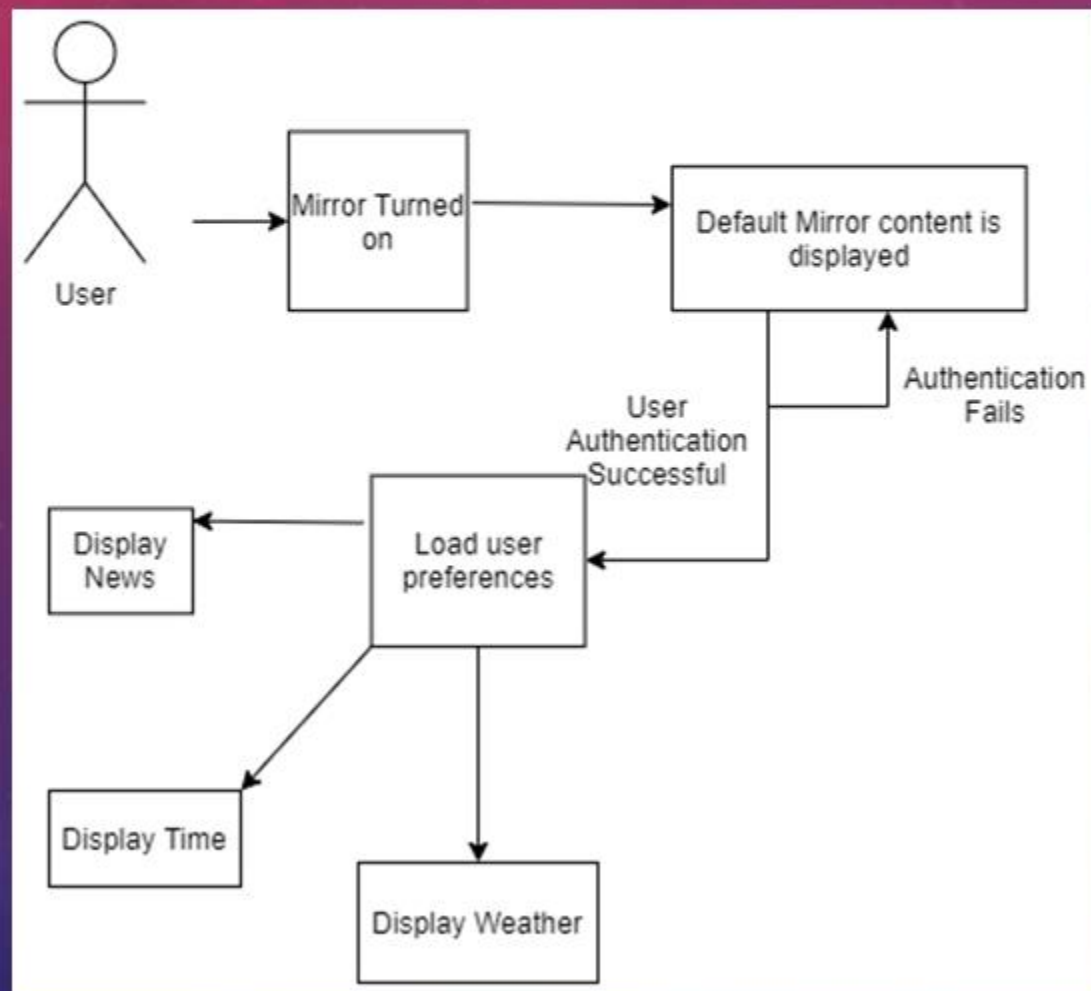
- Using the publicly available SDK, Google Assistant will be integrated for additional functionality
- Speech recognition is included in the assistant SDK
- Users will be able to ask their mirror questions and receive helpful information regarding the rest of their day
- Users may also log in to their google accounts from the assistant for a more personalized experience



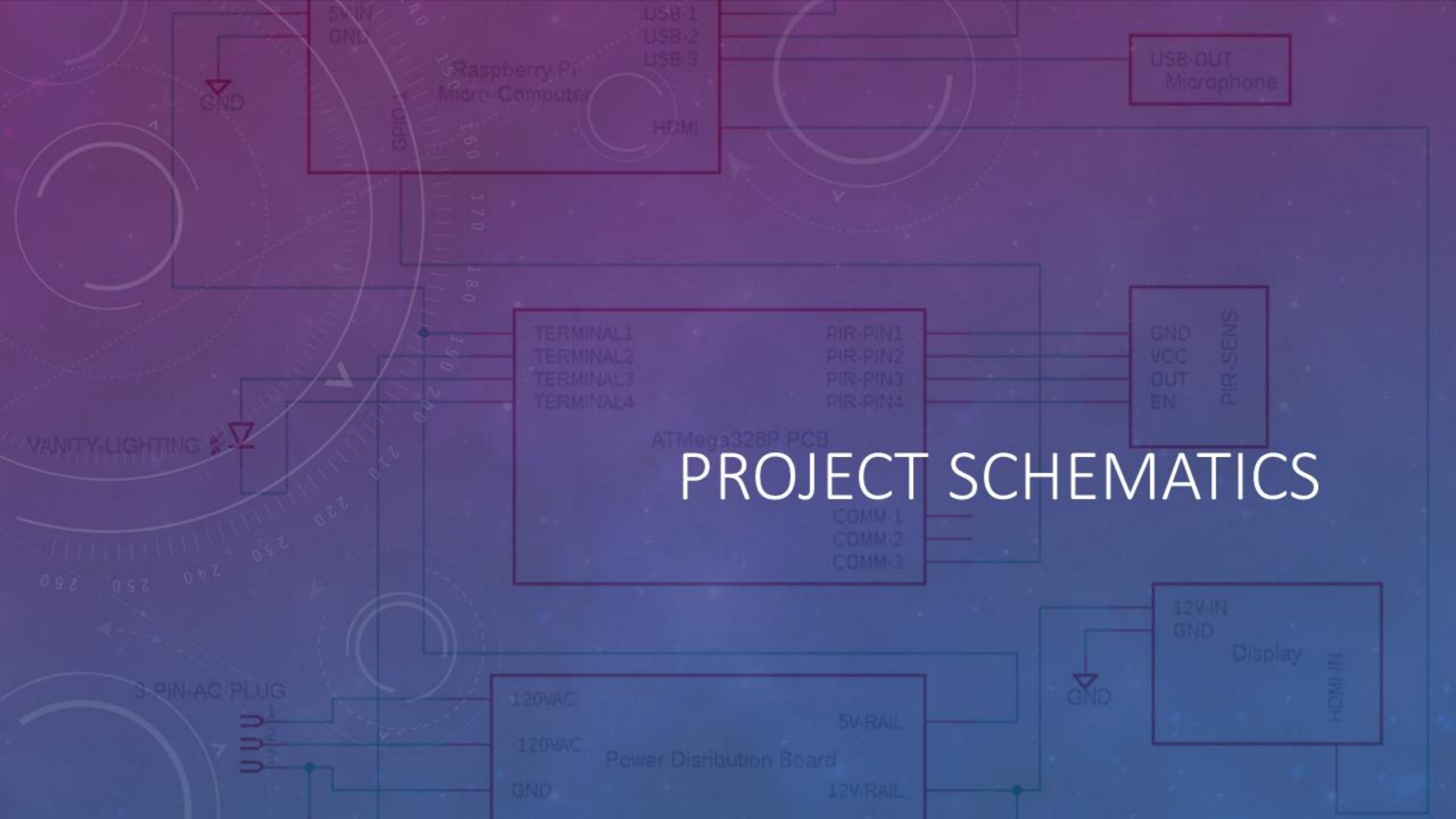
SPEECH RECOGNITION FLOWCHART



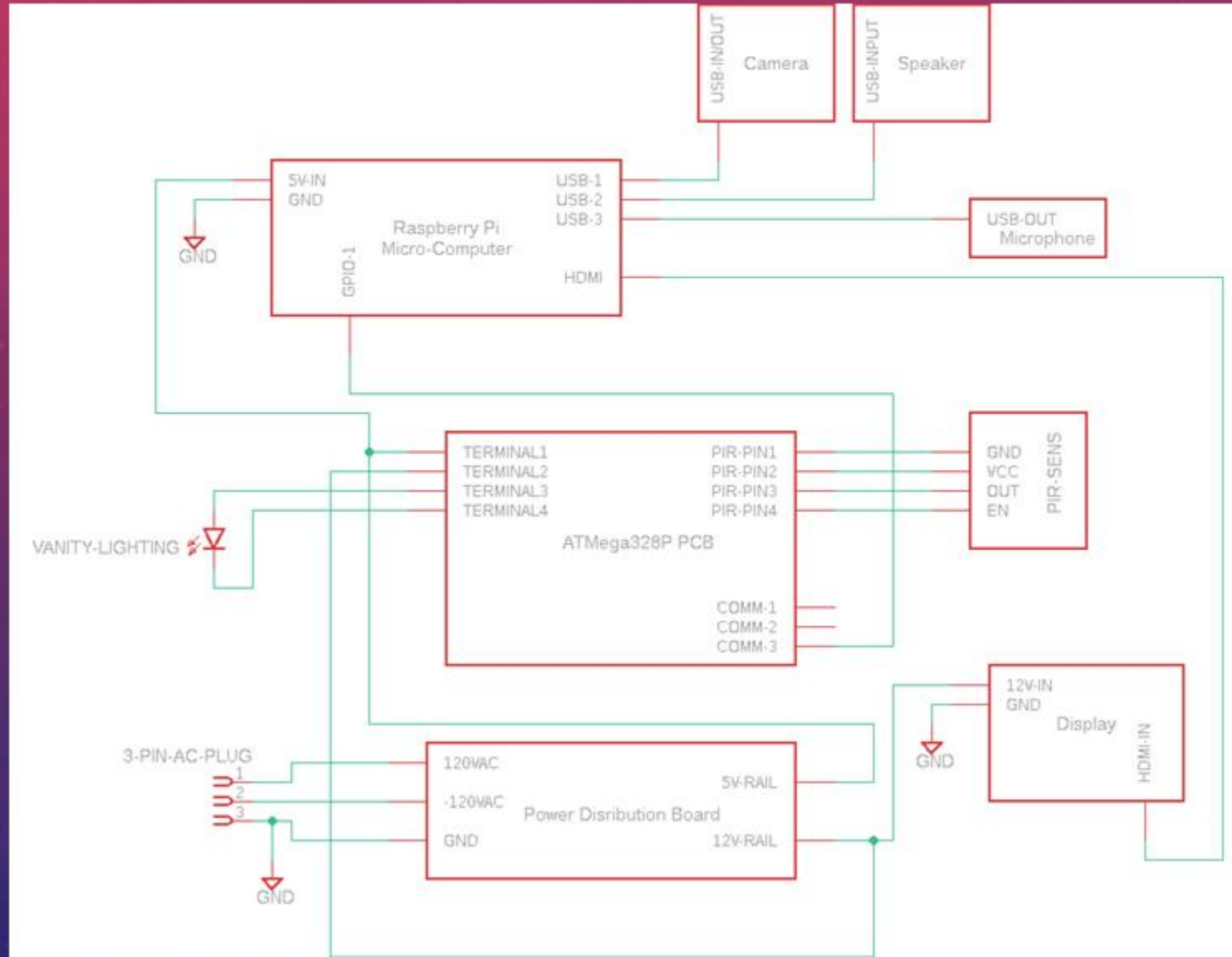
AUTHENTICATION FLOWCHART



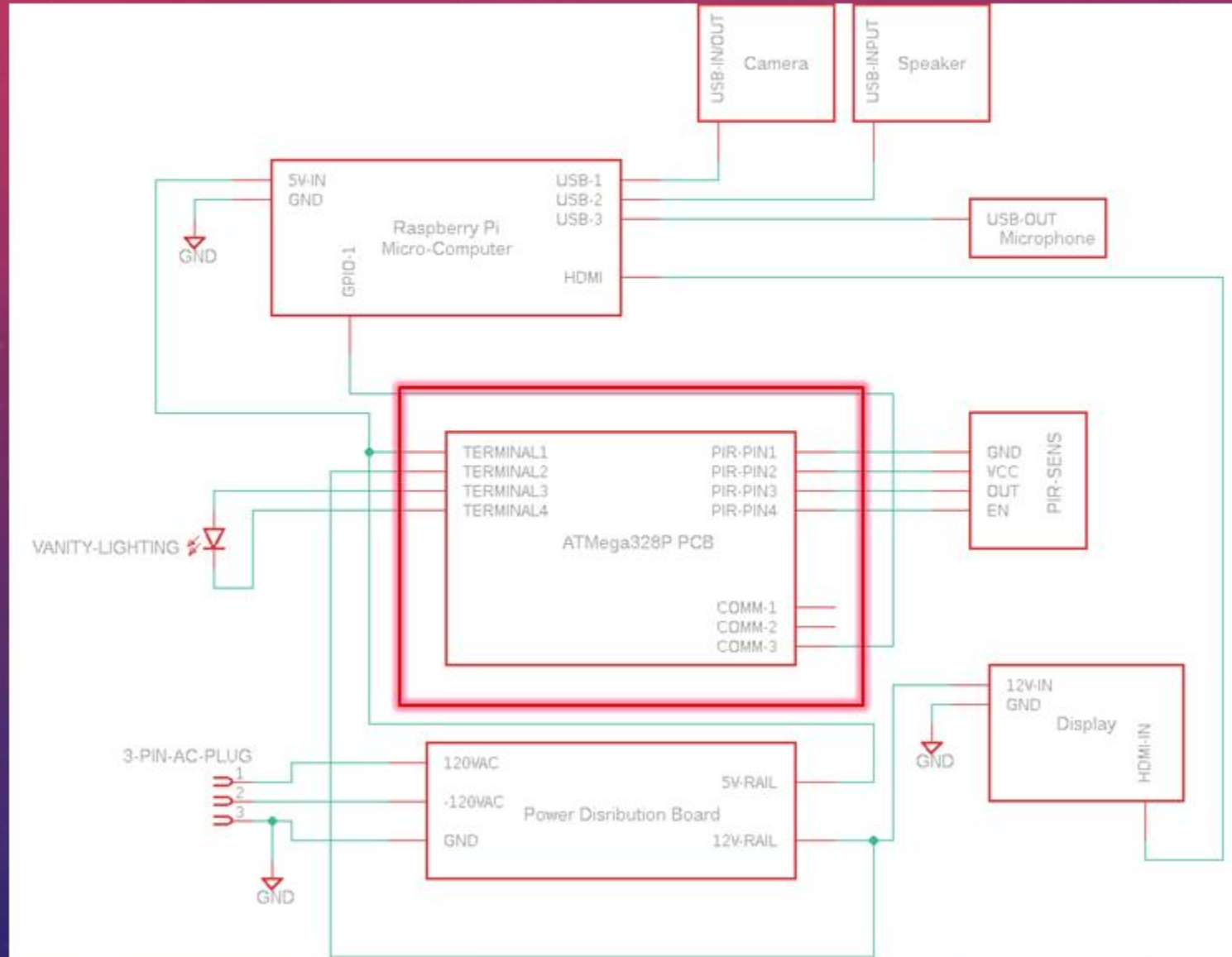
PROJECT SCHEMATICS



MODULE CONNECTION SCHEMATIC

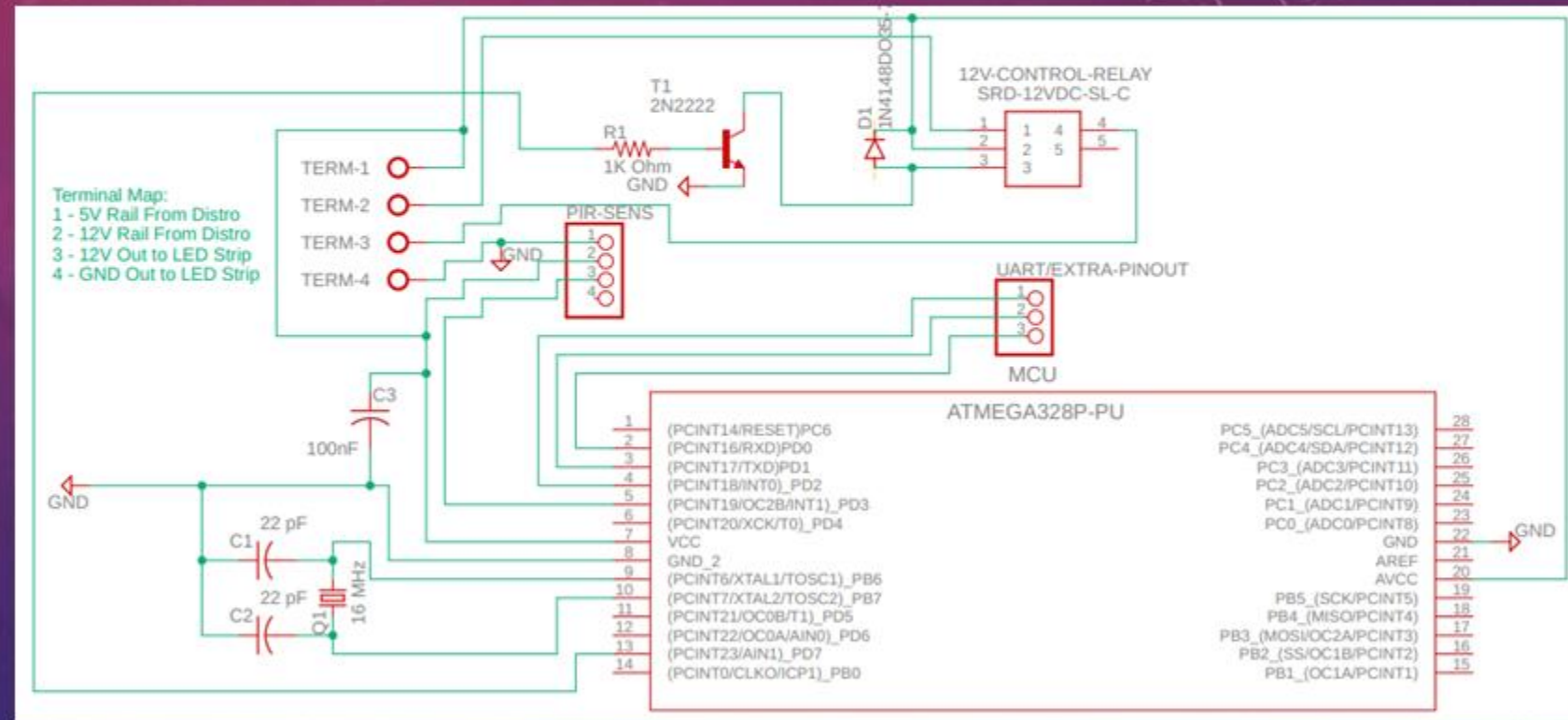


MODULE CONNECTION SCHEMATIC



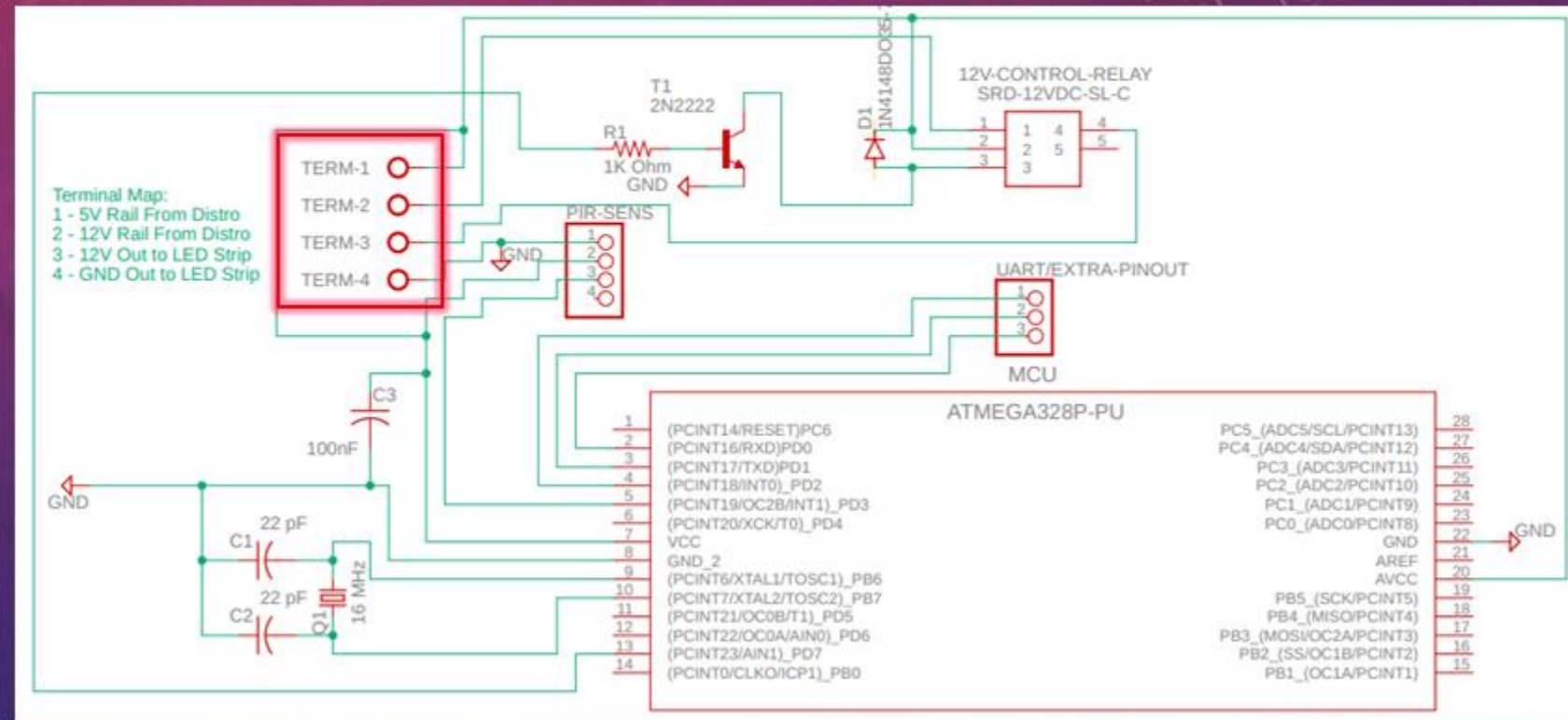
MICRO-CONTROLLER PCB SCHEMATIC

- 4 Terminal connection for power input and output
- 4-Pin header for presence sensor
- 3-Pin header for UART and MCU pin
- External 16MHz crystal
- Transistor and diode for relay control to protect MCU



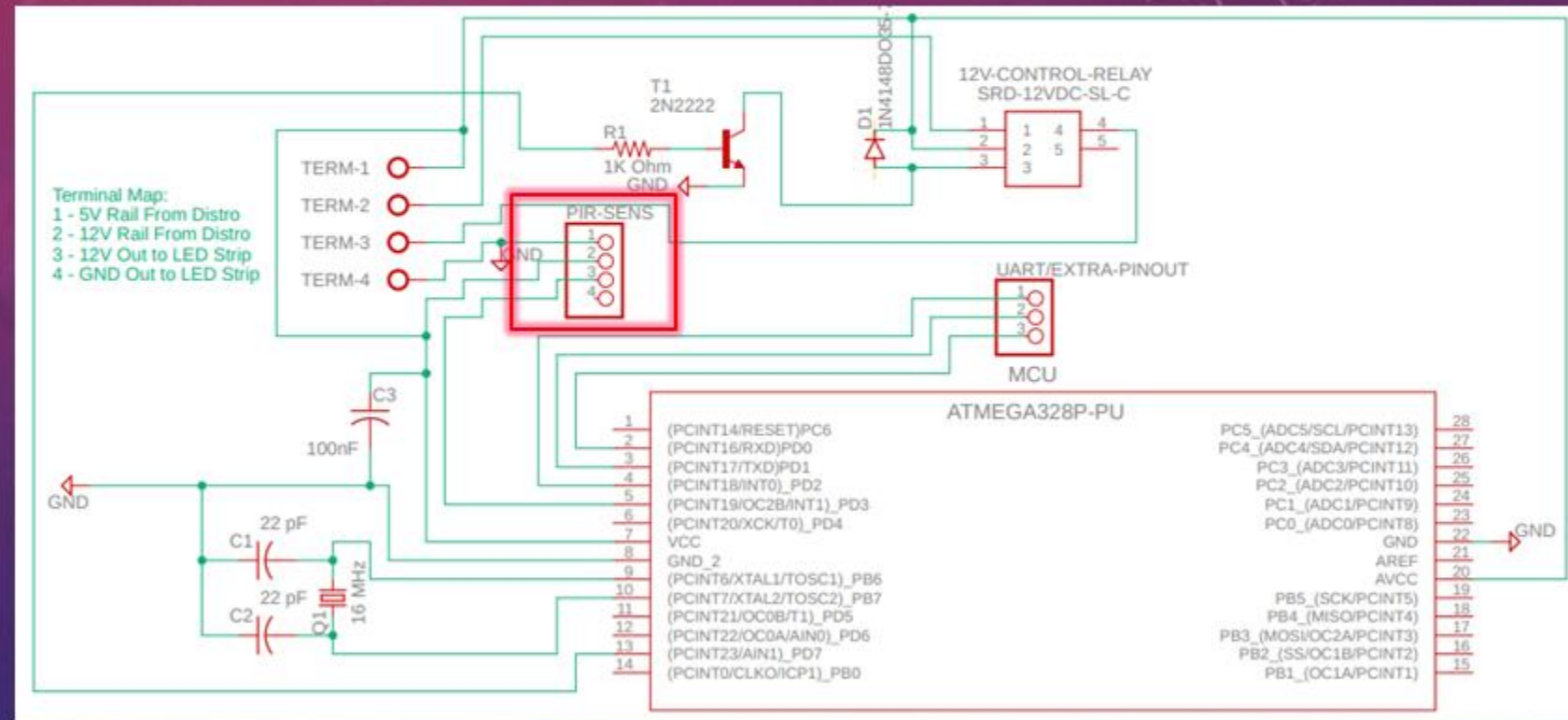
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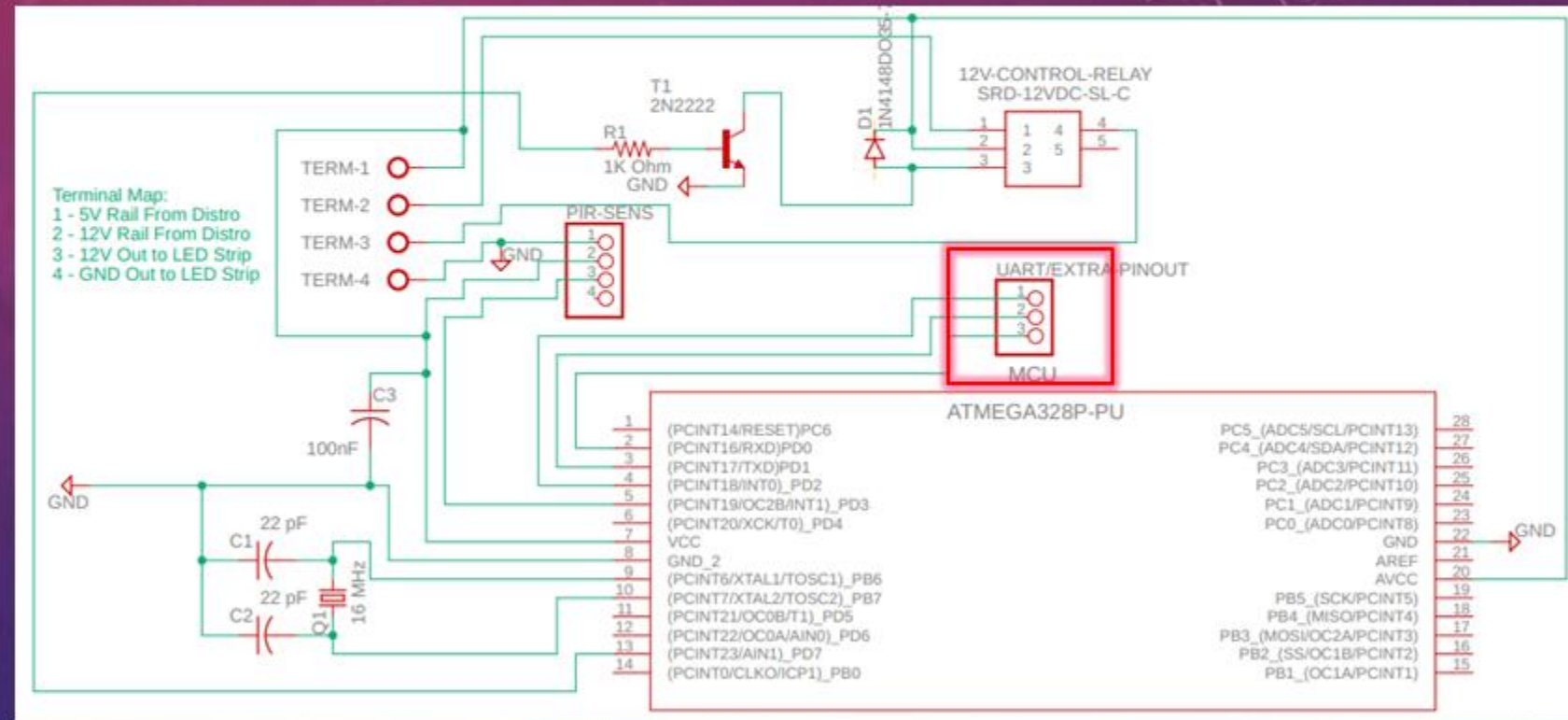
MICRO-CONTROLLER PCB SCHEMATIC

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- **4-Pin header for presence sensor**
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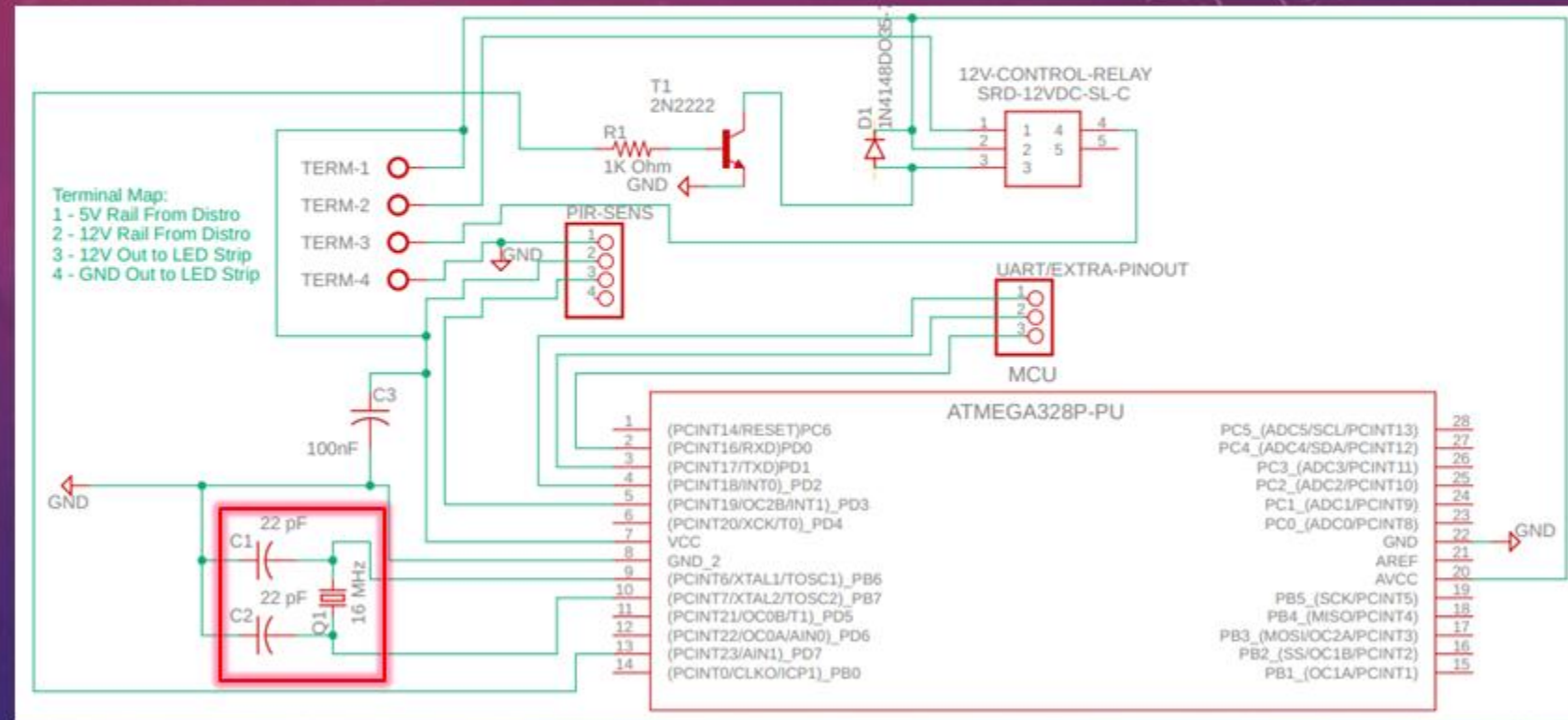
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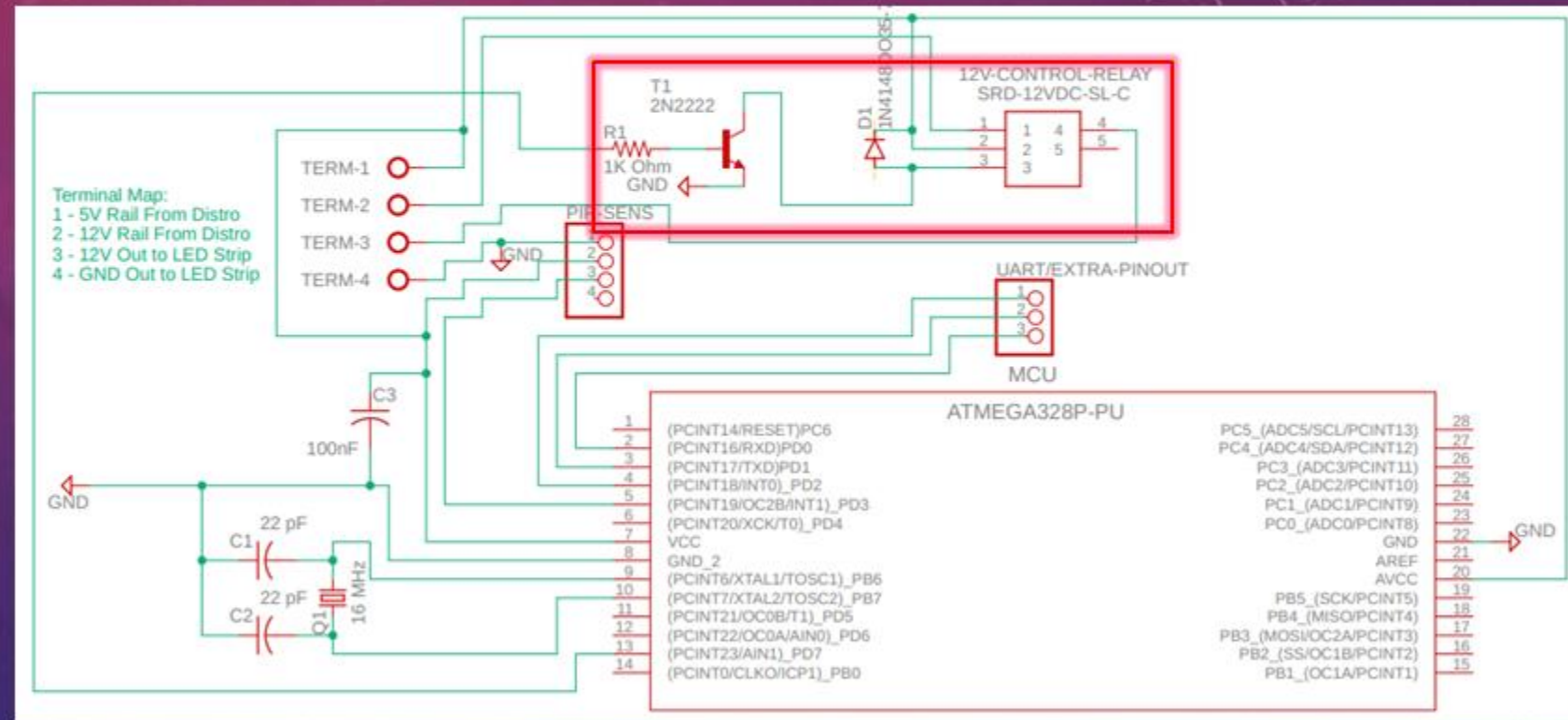
MICRO-CONTROLLER PCB SCHEMATIC

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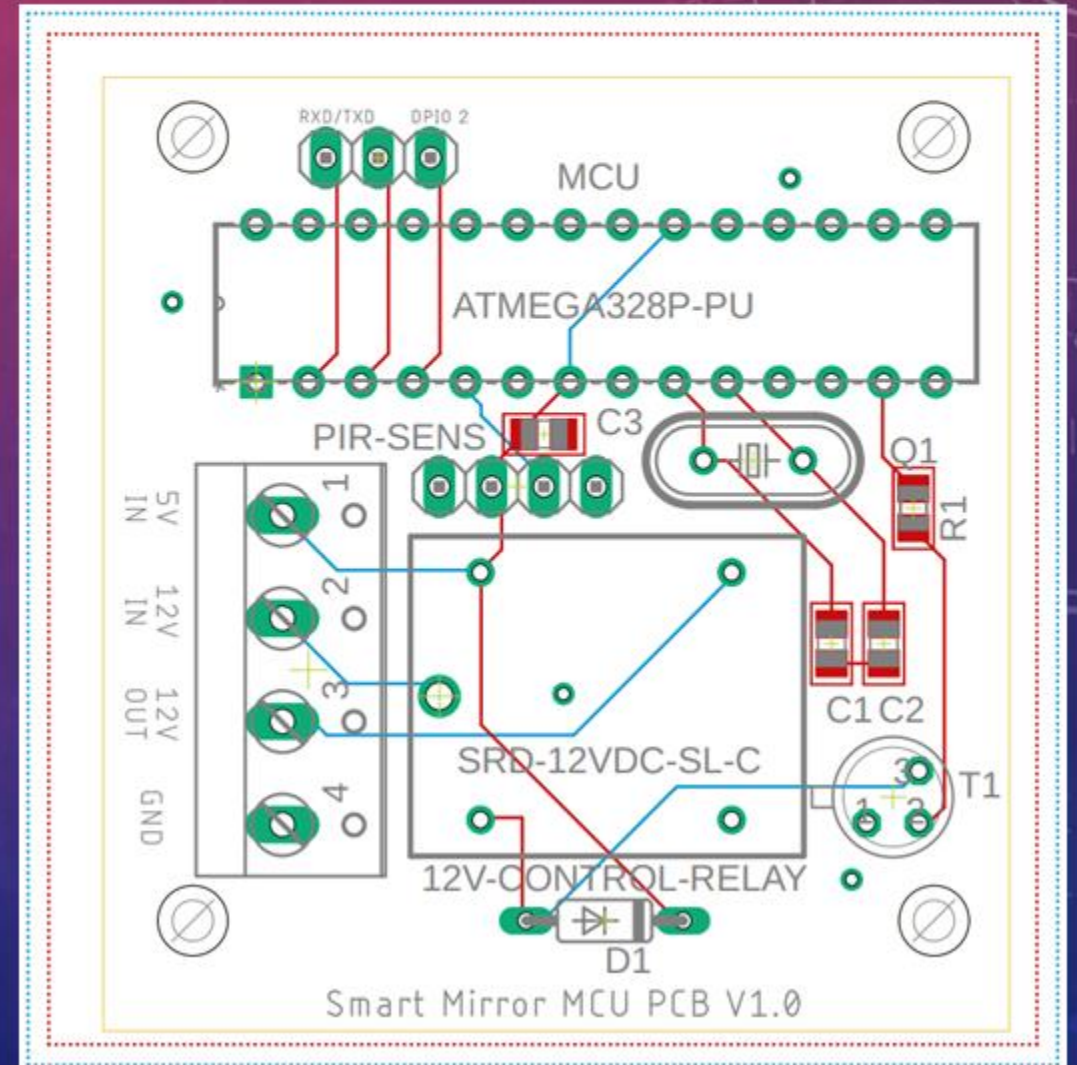
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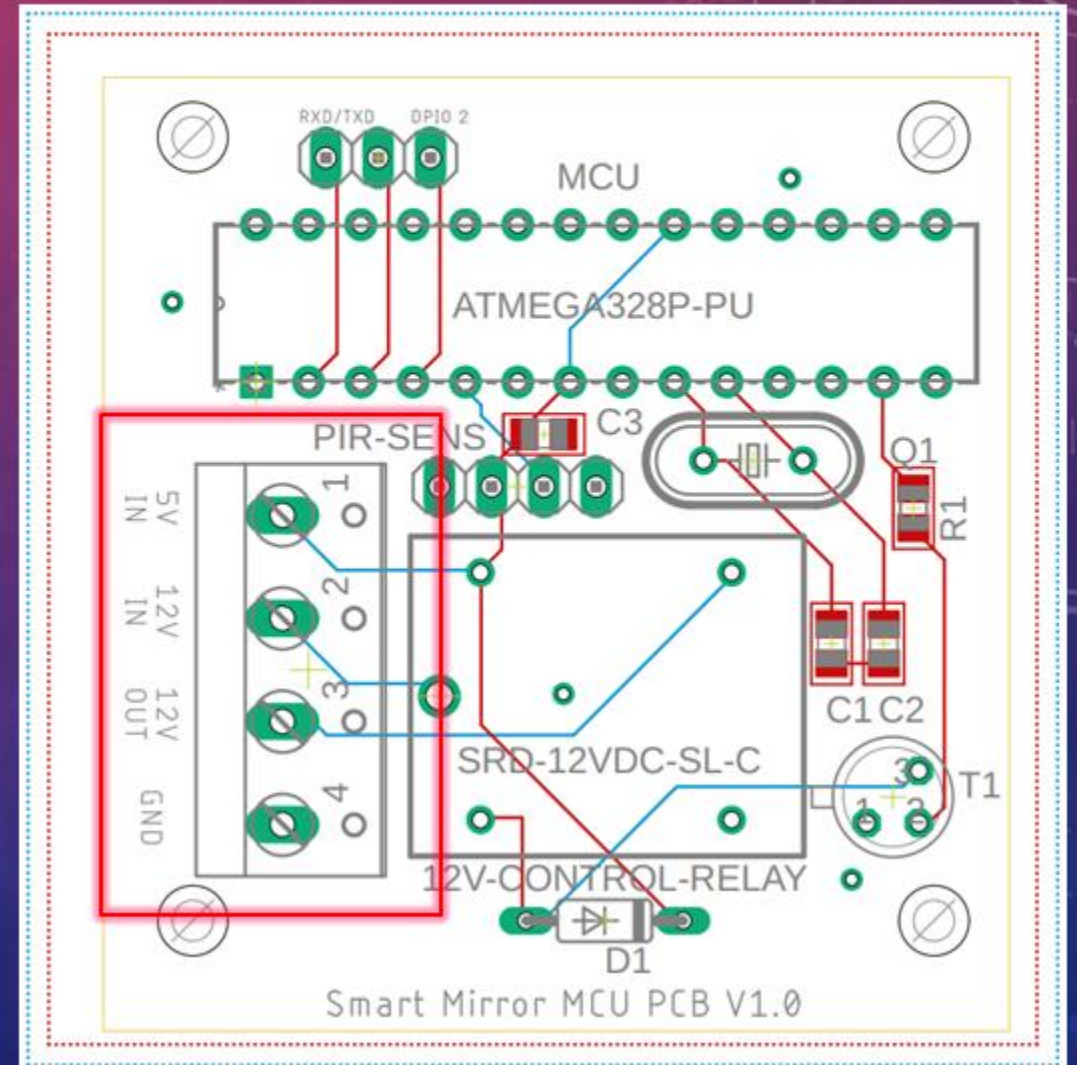
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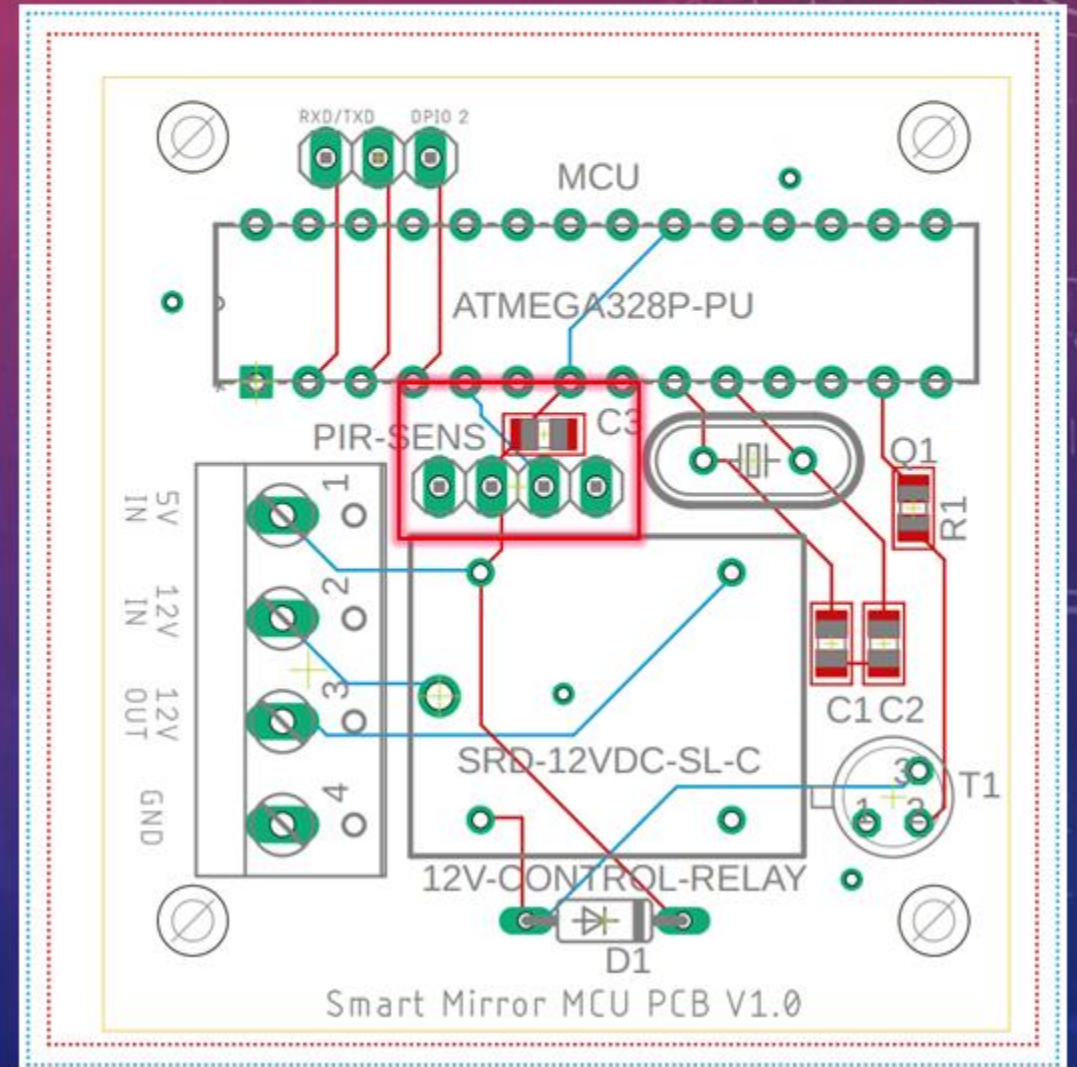
MICRO-CONTROLLER PCB DESIGN

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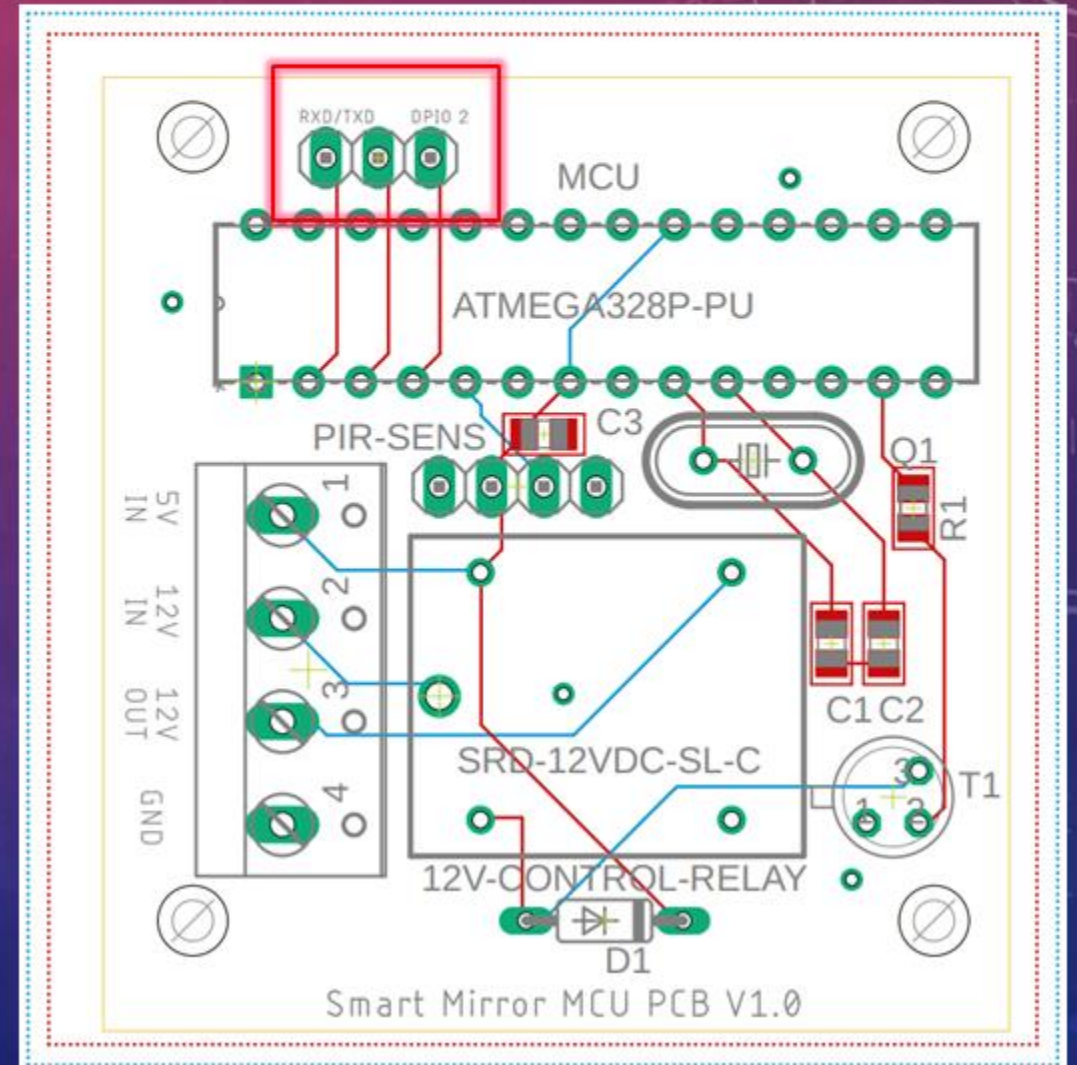
MICRO-CONTROLLER PCB DESIGN

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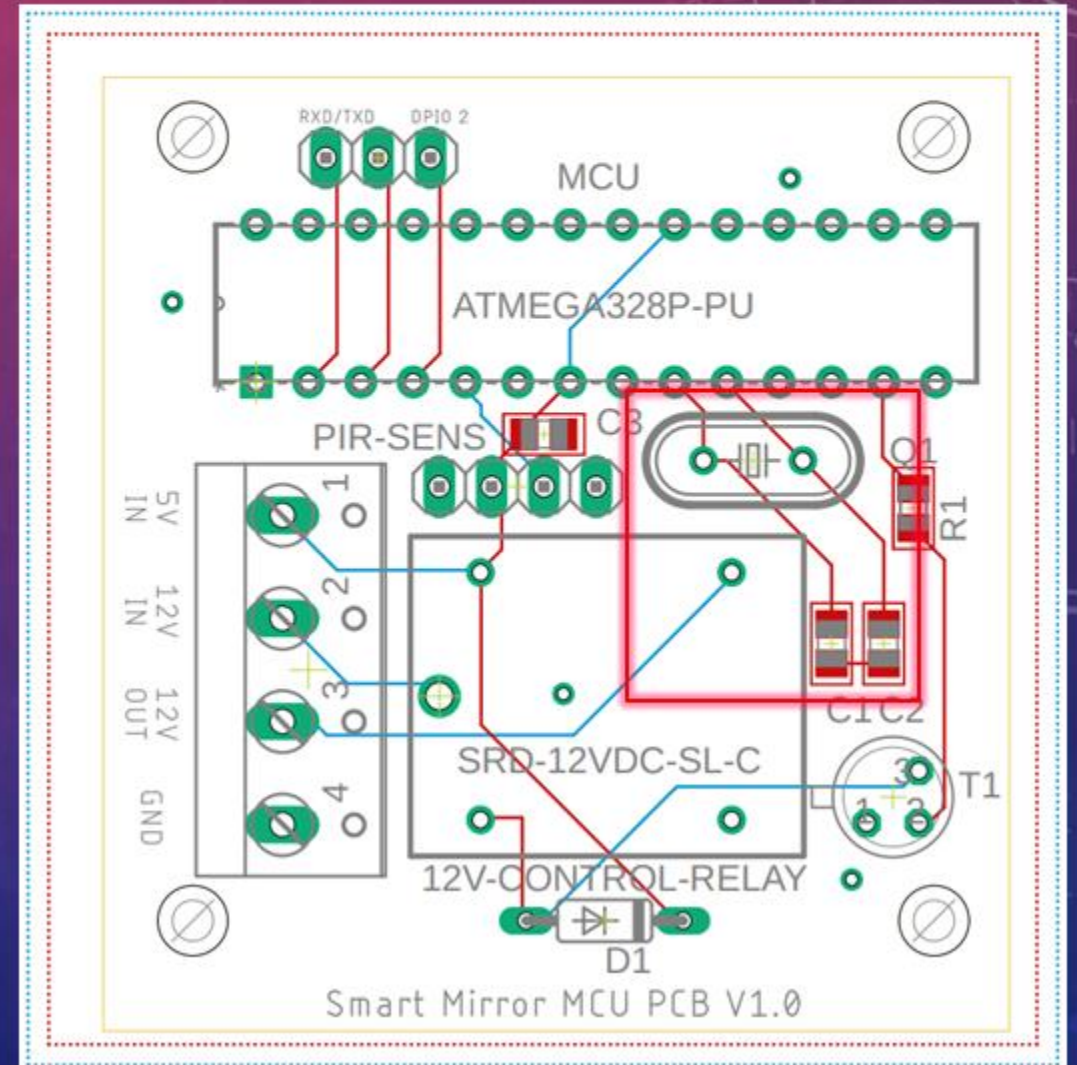
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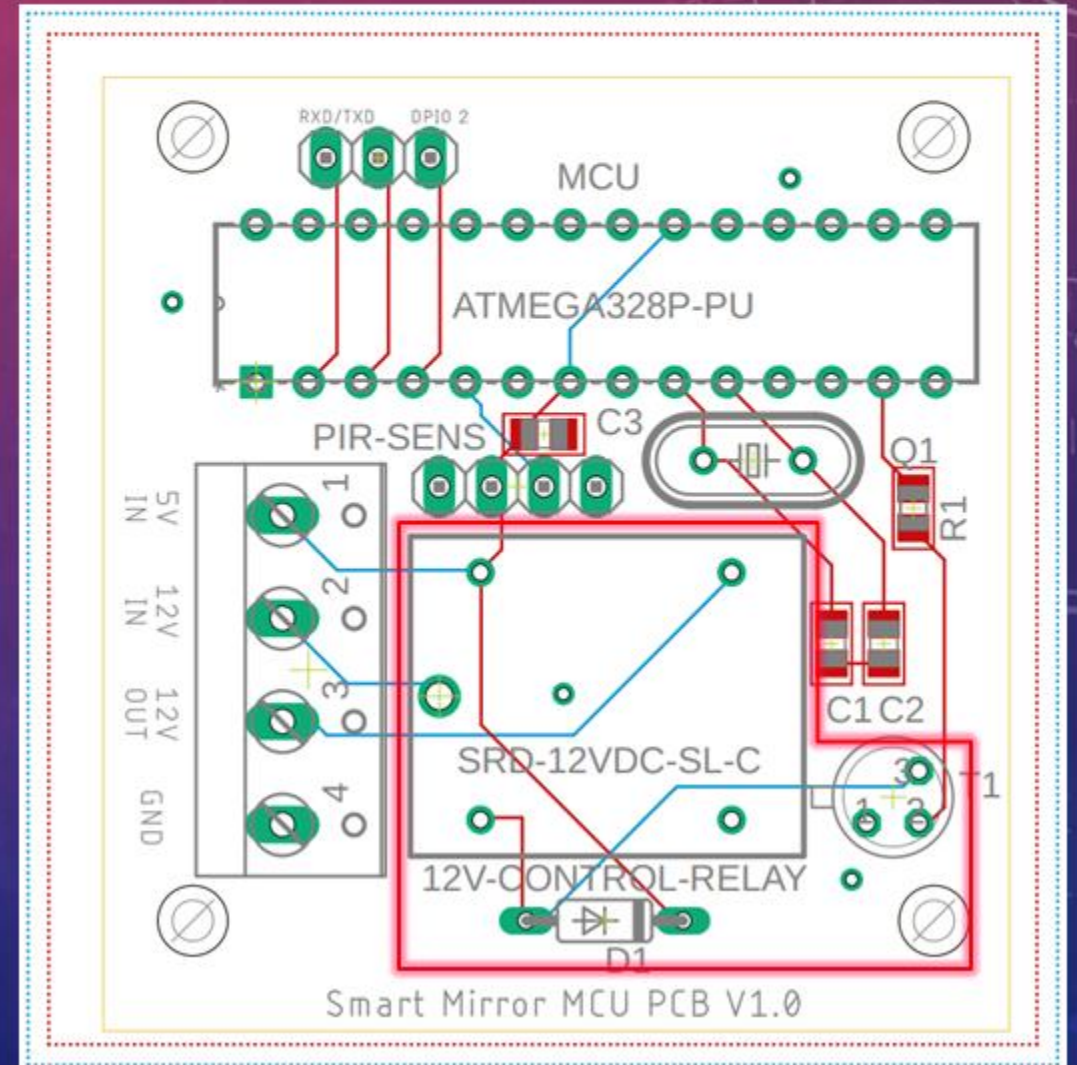
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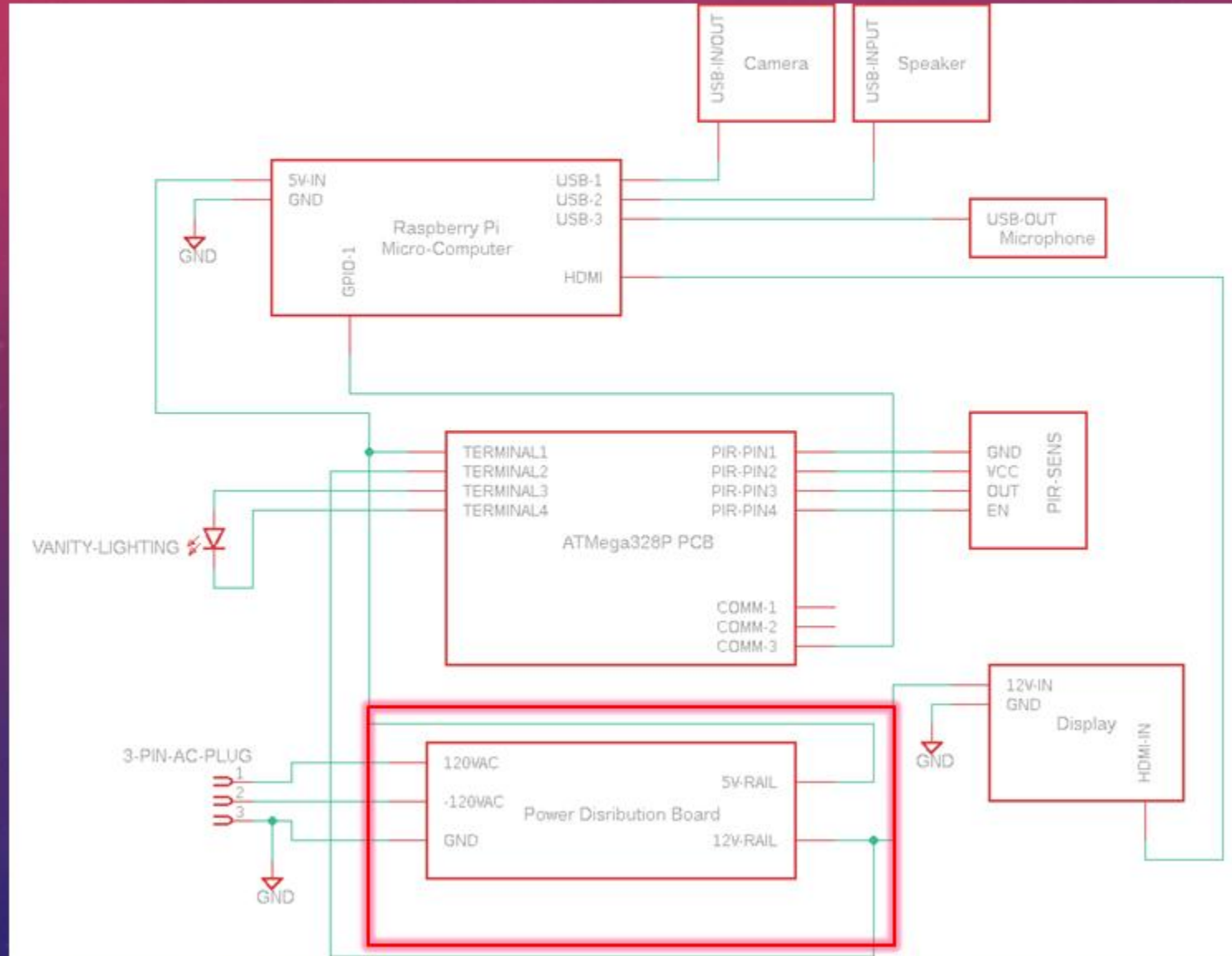


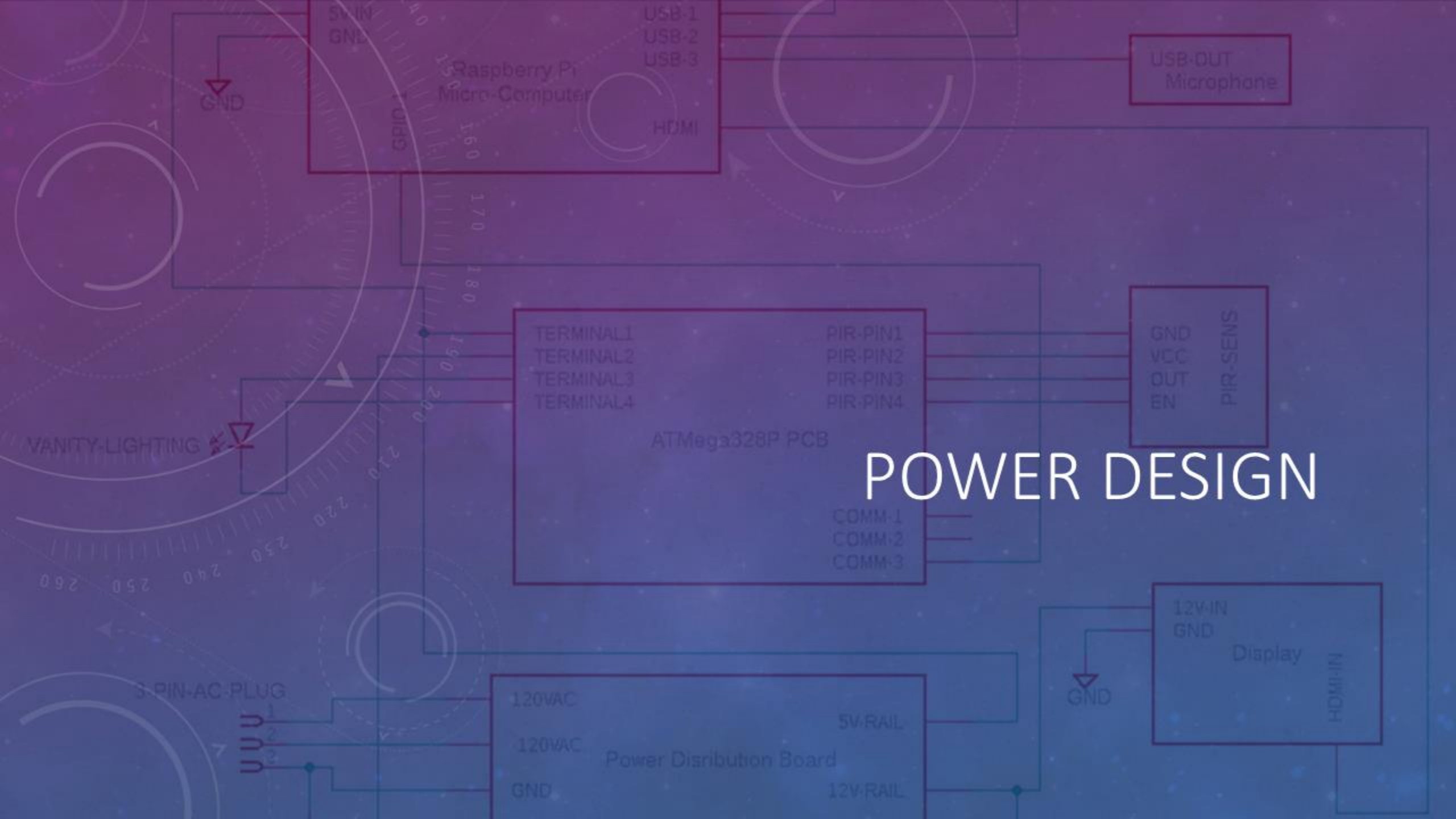
MICRO-CONTROLLER PCB DESIGN

- Final design includes DIP-28 connector so ATmega328P is removable
- Final size is almost half the size of the Arduino development board
- All non-essential elements removed from development board for efficiency
- Essential things like external clock and decoupling capacitor included in new design



MODULE CONNECTION SCHEMATIC



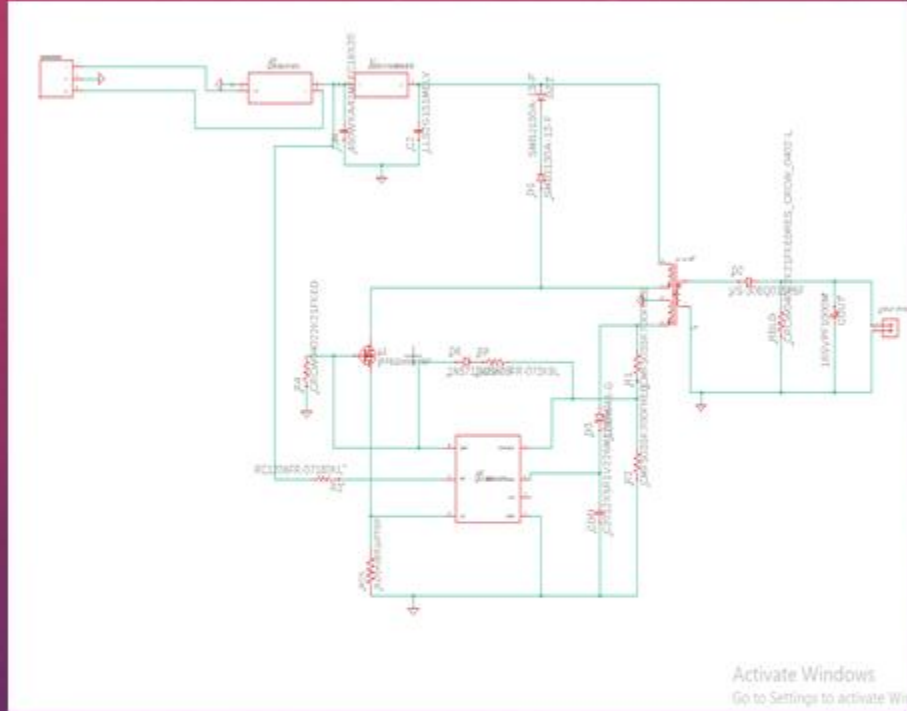


POWER DESIGN

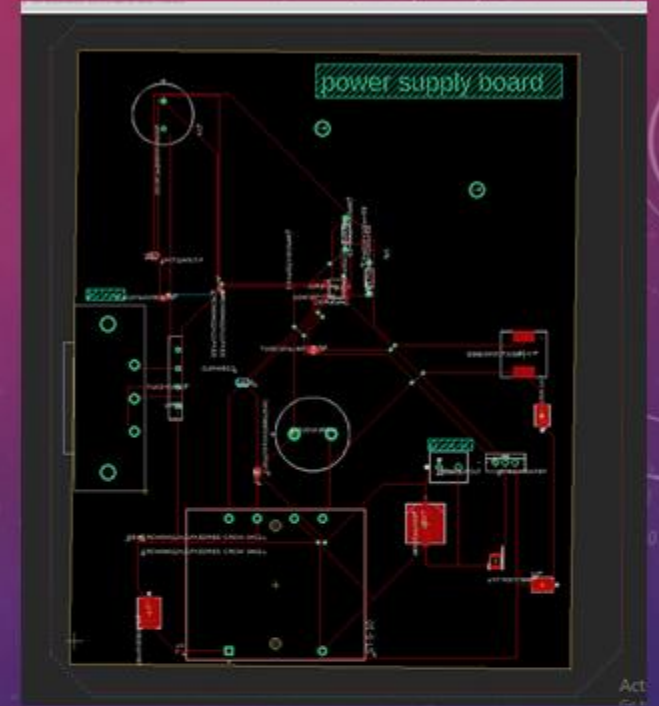
POWER CONSUMPTION

Device	Voltage (volts)	Current Amps	Power Max Watts
Raspberry Pi 4 Model B	5	3	15
ATMega328P	2.7 to 5.5	2mA	0.011
Monitor	12	2.5-3A	36
Led Lights	12	3	36
Total Power			87.011

POWER SUPPLY



UCC2863x, High-Power
Flyback Controller



- Overbudget at \$70-\$80
- 20 items on board some were back ordered

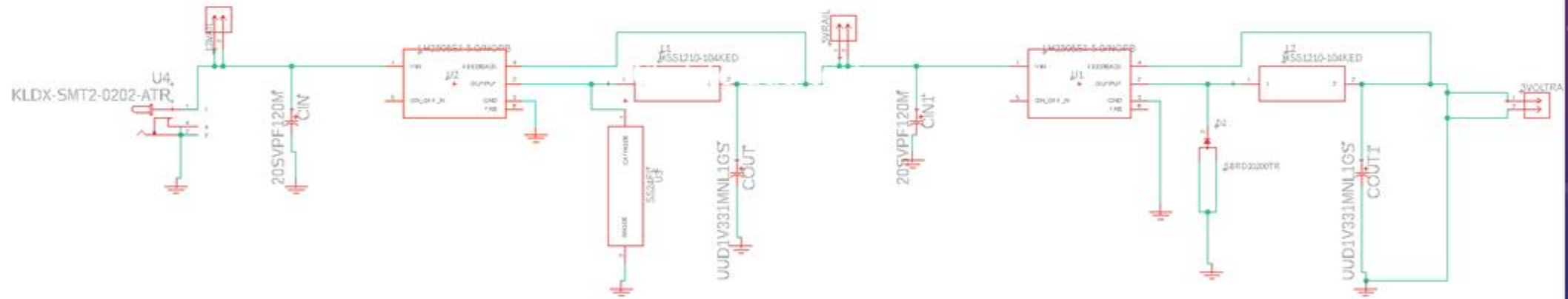
NEW POWER SUPPLY



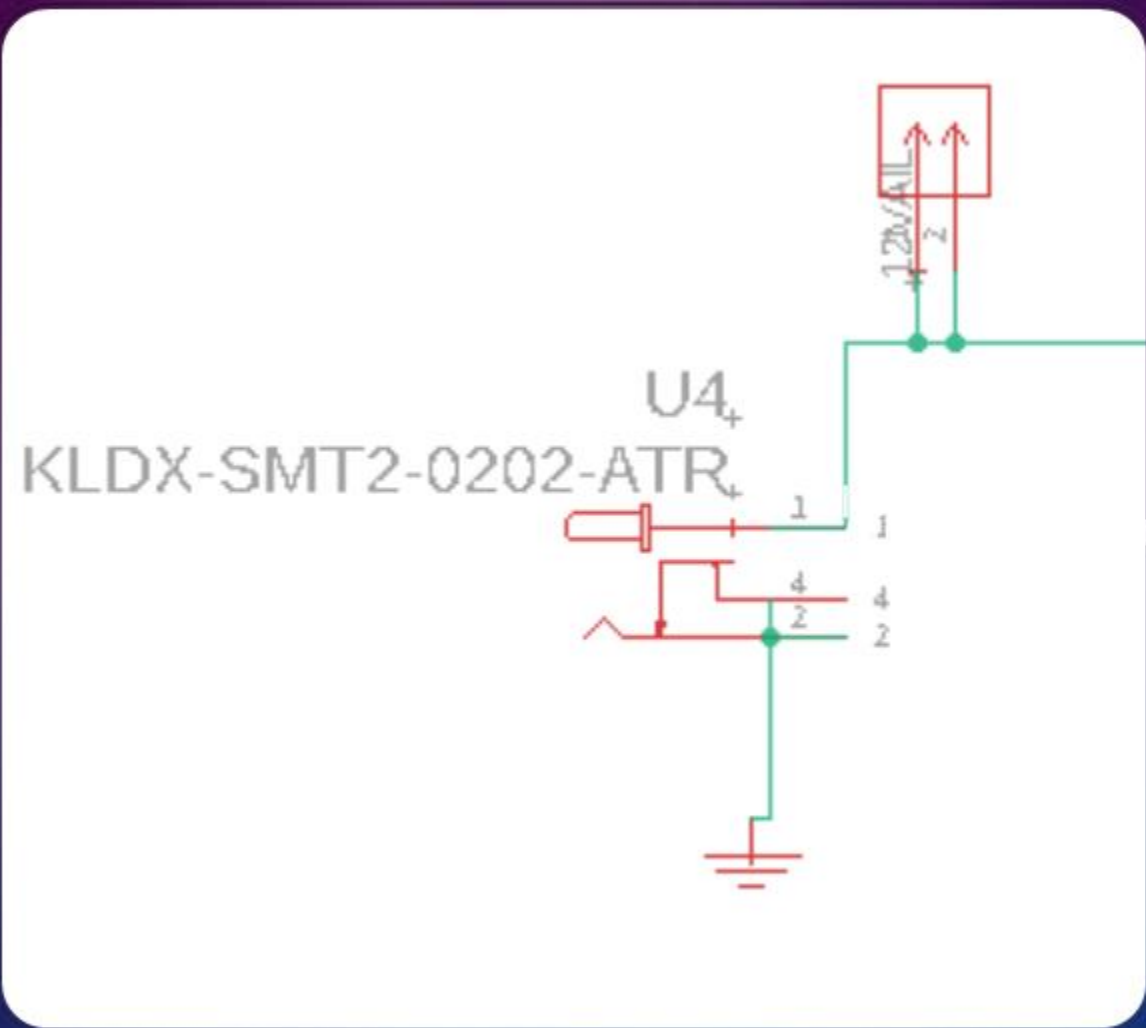
input: AC 100 - 240V, 50 / 60Hz ; Output: DC 12V, Max 10A, 120W ; Output DC tip size is 5.5mm x 2.5mm, compatible with 5.5mm x 2.1mm.

- Certified by FCC CE ROHS. No noise, low temperature operation stable output. Automatic overload cut-off, over voltage cut-off, automatic thermal cut-off, short circuit protection.

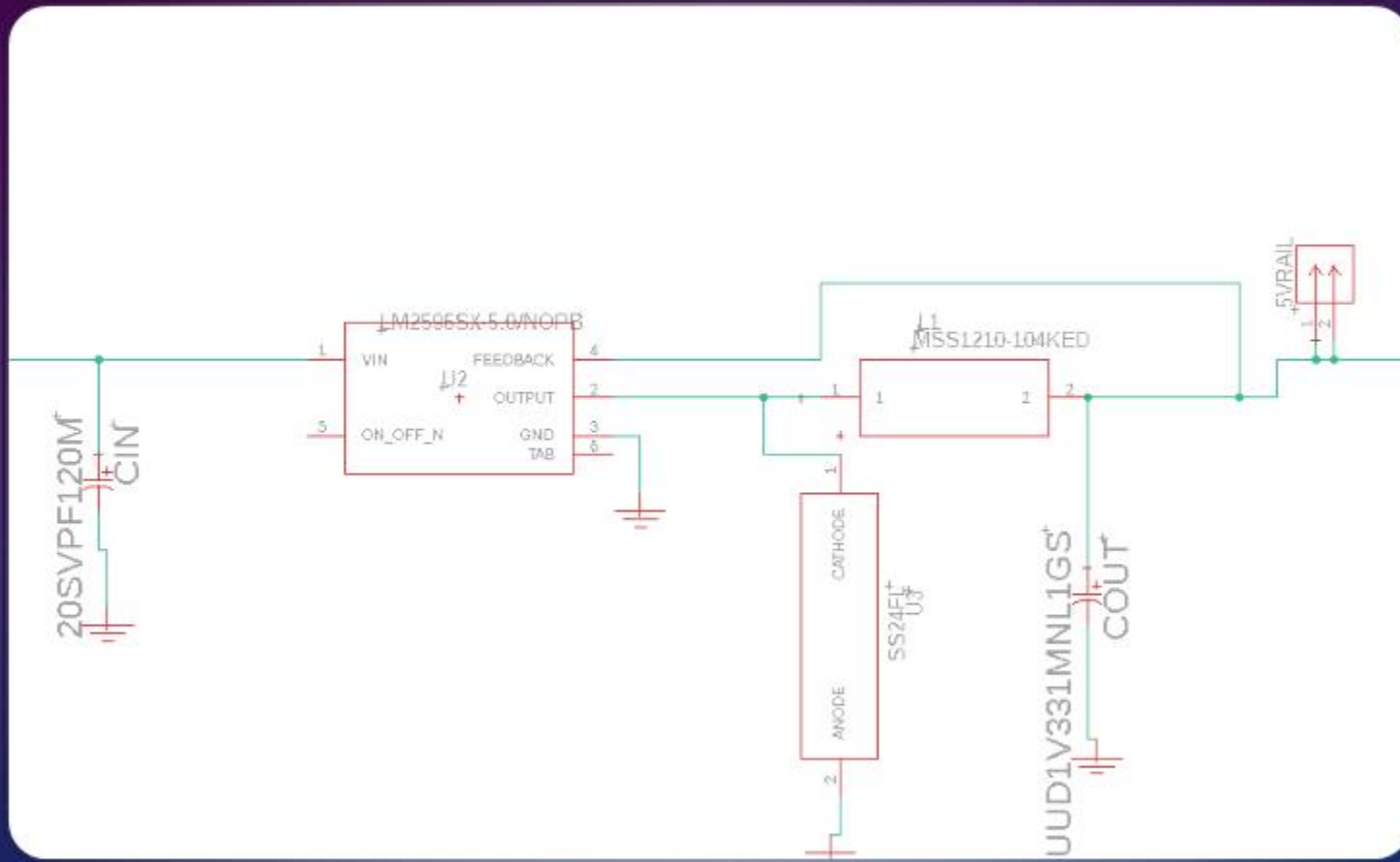
POWER DISTRIBUTION PCB SCHEMATIC



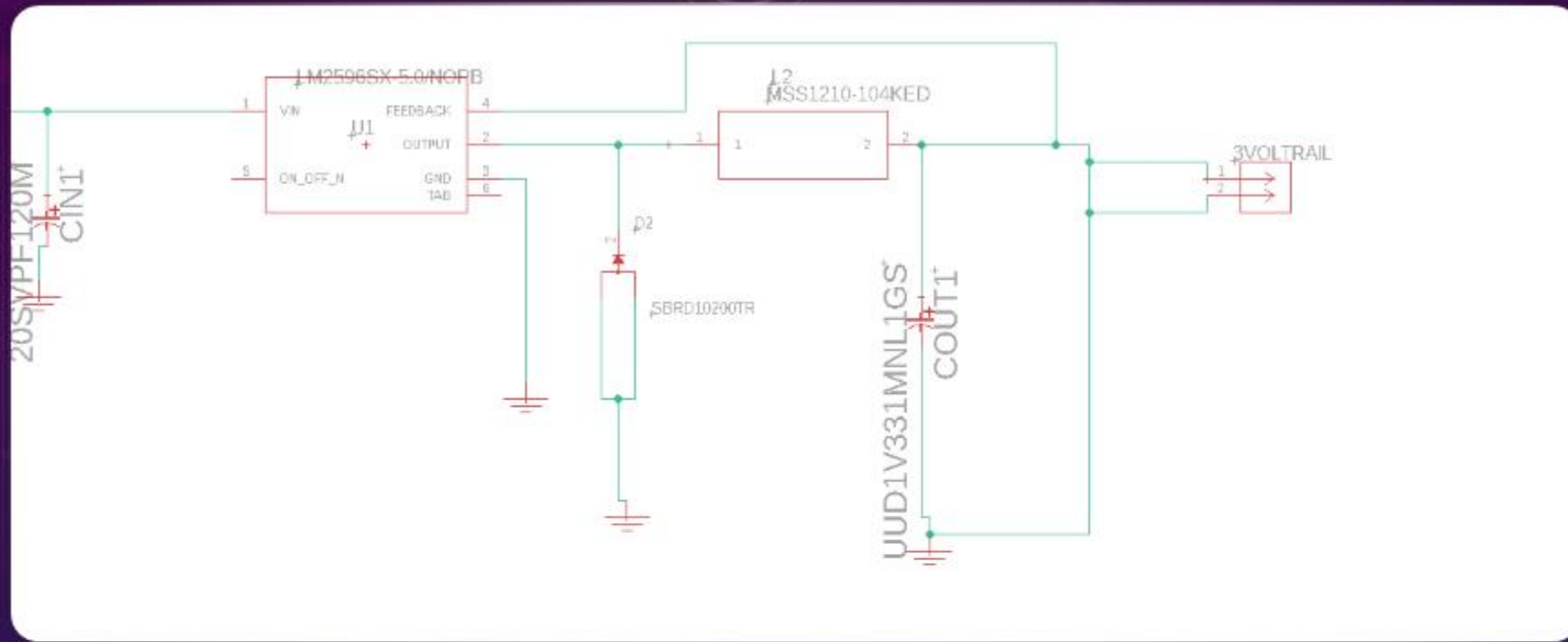
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- Power Barrel Connector jack
- 2 Terminal connector for 12 volt output

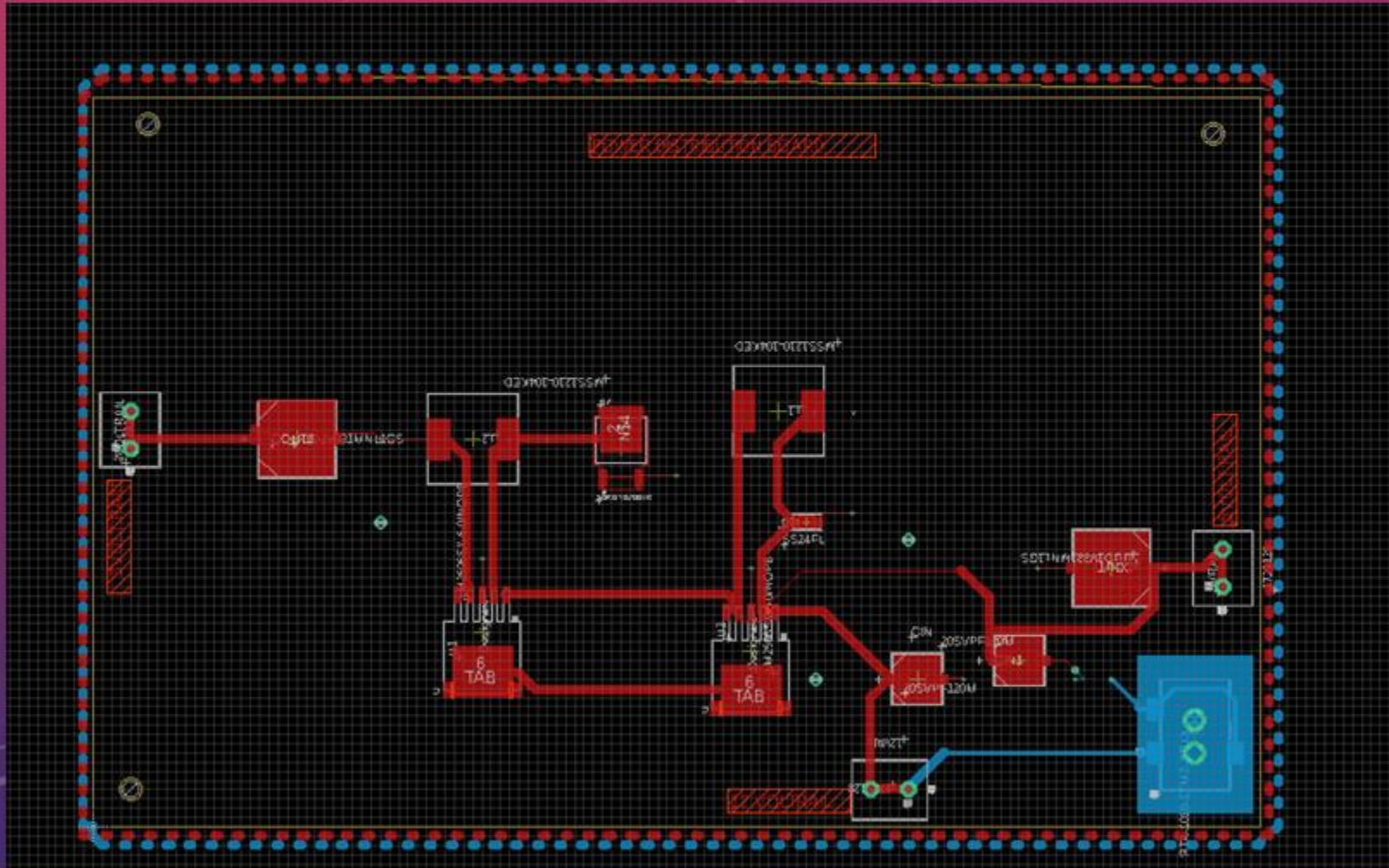


- LM2596S 5 volt Voltage regulator output
- 2 Terminal connector for 5 volt output



- LM2596SX Voltage regulator output
- 2 Terminal connector for 3 volt output

POWER DISTRIBUTION PCB DESIGN



1.27MM Trace width for high 3 amp current flow



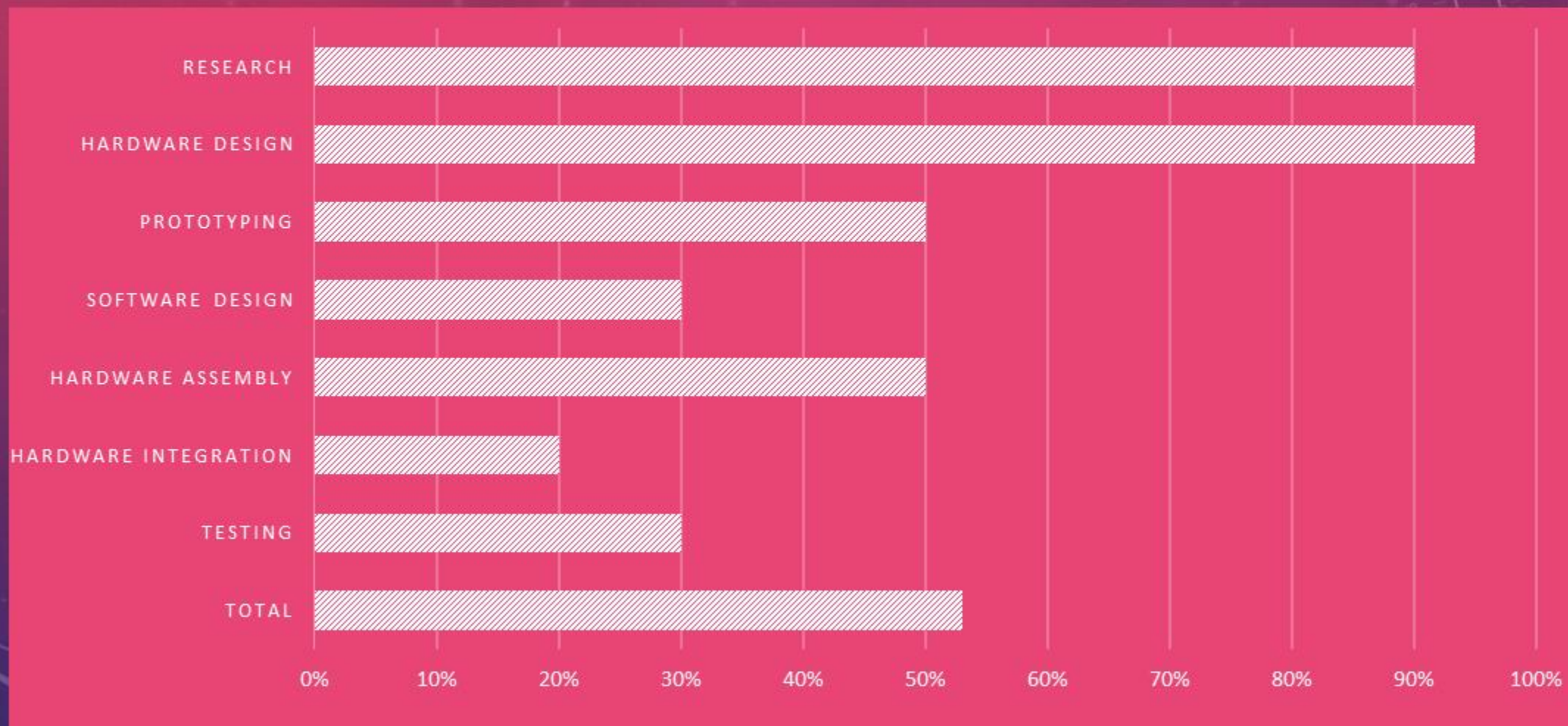
ADMINISTRATIVE CONTENT



BUDGET

Item	Cost
MCU PCB/ Components	\$50
Micro Computer	\$62
Display	\$100
Camera	\$30
SD Card	\$9
PIR Sensor	\$13
LED Lighting	\$13
2-Way Acrylic	\$25
Wood Stain	TBD
AC/DC Converter	\$20
Power Distro PCB/ Components	\$50
Speakers	\$20
2x4x8 Frame Wood	TBD
Total:	\$392

PROGRESS



WORK ASSIGNMENTS

	Tyler Newman	Axel Ortega	Jonathan Martin	Jacob Williams-Moore
MCU Software	✓			
MCU Circuit/PCB Design	✓			
Raspberry Pi Software		✓		✓
Power Distro Circuit/ PCB Design			✓	
API Integration		✓		✓
Project Testing	✓	✓	✓	✓
Frame Design			✓	



Q/A SECTION