Rock ‘N’ Rover: RC Car

SENIOR DESIGN PROJECT
GROUP 15

Group 15: Laila El Banna, Sanya Wadhwa, Ryan Kohel, & Michael Patalano

OUR TEAM MEMBERS

Laila El Banna

Computer Engineering

Sanya Wadhwa

Computer Engineering

Ryan Kohel

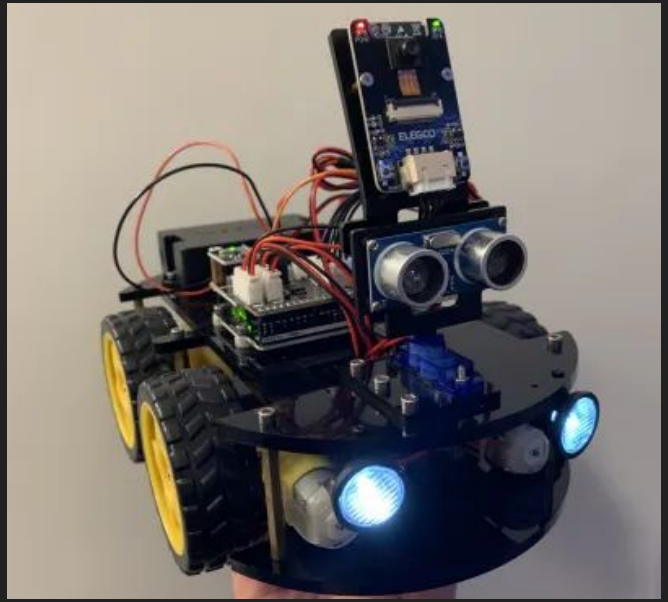
Electrical Engineering

Michael Patalano

Electrical Engineering

Introducing the Rock ‘N’ Rover

- ➔ Motivation & Background
  - ◆ Idea stemmed from bomb defusal robots with robotic arm extensions
- ➔ Goals & Objectives
  - ◆ To construct a remote controlled car with a companion app



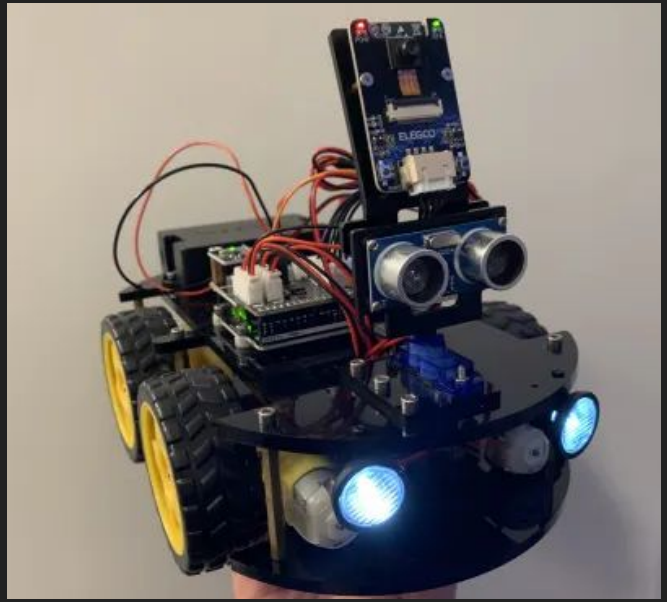
Important Goals

Main Goals:

- Hand-held Controller
- Companion App
- Camera for remote driving

Stretch Goals:

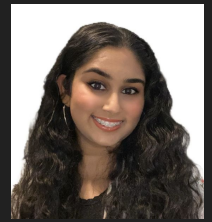
- Speaker and Mic for audio two-way communication
- Ultrasonic Radar detector



Engineering Specifications

Key Specifications	
Body of the car must be at least 3 inches in width and 5 inches in length	★
Battery must be able to power car for at least 1 hour	
Car must be able to move forwards and backwards and turn left and right	★
Cost of the car must be at a maximum of $800 ($200 per team member)	
Headlights must be visible from at least 3 feet away	
Must be able to drive a distance of at least 10 feet	★

★ = Demonstrable Features



Sanya Wadhwa, Computer Engineering

Choosing a Car Kit

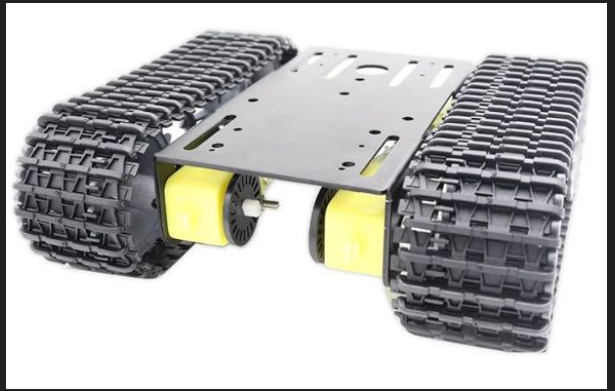
TT04 4WD Intelligent Tracked Robot Tank

Price: $21

Key Components: Four Motors, and Metal Frame

Pros: Super inexpensive and leaves room for creativity

Cons: Time and money gathering all of the other components



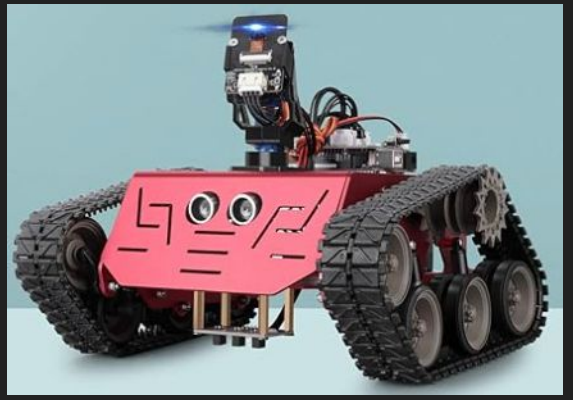
ELEGOO Conqueror Robot Tank

Price: $130

Key Components: Arduino, Camera Module, Ultrasonic Sensor, Four Motors, Line Tracker Module, and rechargeable battery

Pros: It’s a tank!

Cons: Very expensive and large (but it’s a tank!)



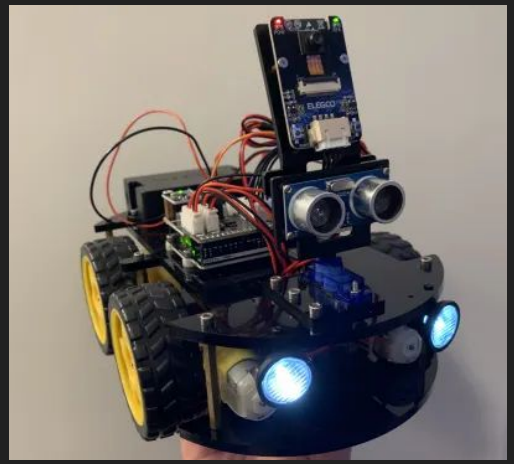
ELEGOO UNO R3 Smart Robot Car

Price: $80

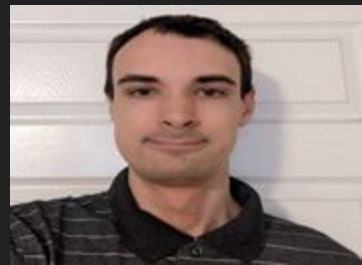
Key Components: Arduino, Camera Module, Ultrasonic Sensor, Four Motors, and Line Tracker Module

Pros: More reasonable price and compact

Cons: Not a tank!

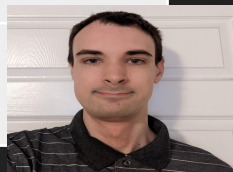


Hardware Selection



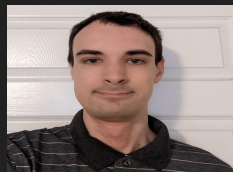
IR Transmitter Selection

	CSL1501R3T1	VSMB10940	IN-S126ESGHIR
Manufacturer	ROHM Semiconductor	Vishay Semiconductors	Inolux
Max. Power Dissipation	100 mW	104 mW	180 mW
Max. Forward Current	50 mA	65 mA	100 mA
Max. Peak Forward Current	200 mA	130 mA	1000 mA
Forward Voltage	1.5 V	1.3 V	1.5 V
Radiant Intensity	2.5 mW/sr	3.05 mW/sr	92 mW/sr
Viewing Angle	70 degrees	75 degrees	30 degrees
Wavelength	940 nm	940 nm	940 nm
Cost	$0.71	$0.39	$0.55

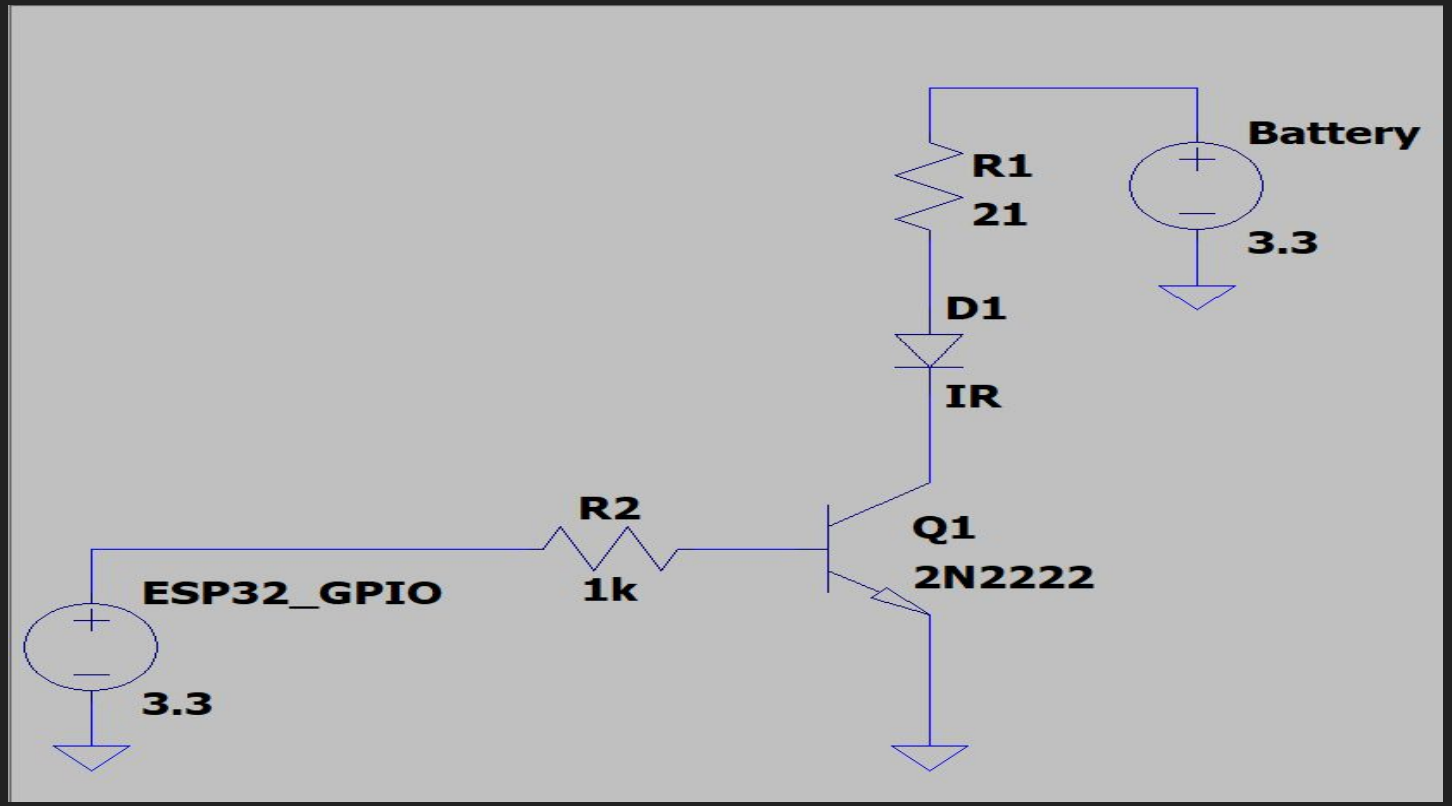


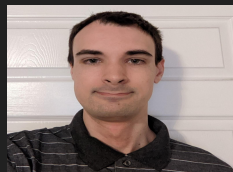
IR Transmitter Design Problem

- Each GPIO pin is rated for a maximum current of 40 mA.
- The IR transmitter can draw up to 100 mA.
- In order to prevent damage to the microcontroller, the current flowing through the GPIO pins must not exceed 40 mA.
- If we limit the current flowing through the IR transmitter to 40 mA, it will limit the brightness of the IR transmitter and reduce the range.
- Therefore, there are two options: limit the current to 40 mA OR use a transistor to switch the IR transmitter ON/OFF.

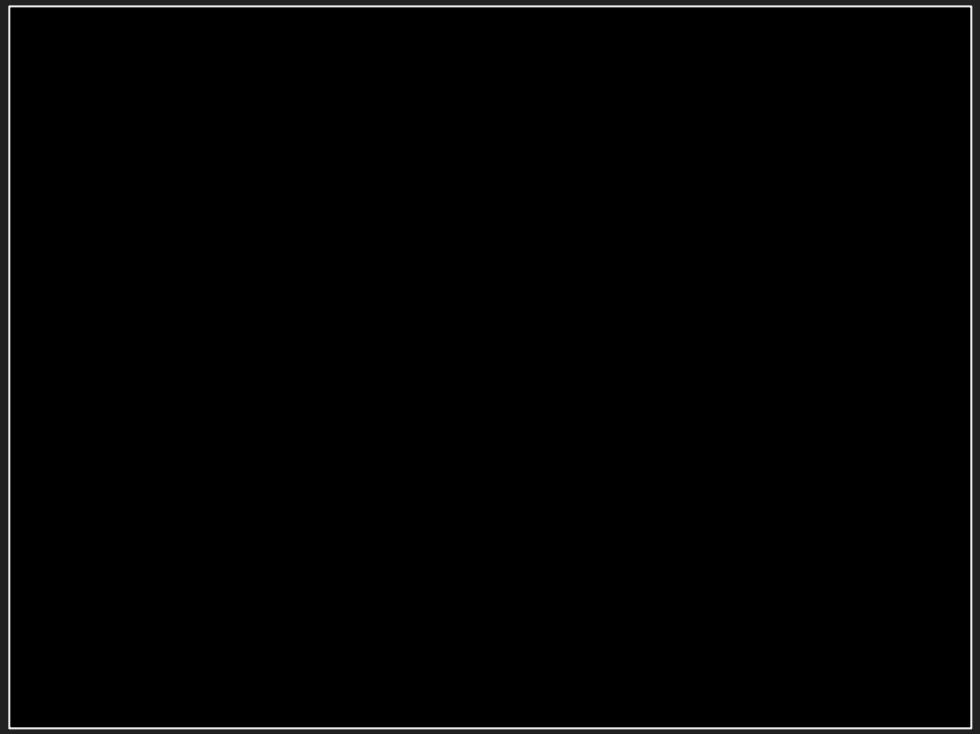


IR Transmitter Design Solution



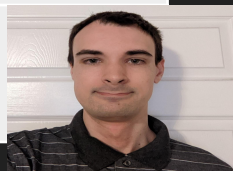


IR Transmitter Demonstration



Microcontroller Selection

	ESP8266	RP2040	ATmega328P	ESP32 Series
Manufacturer	Espressif Systems	Raspberry Pi Ltd.	Atmel	Espressif Systems
WiFi?	Yes	No	Yes	Yes
Bluetooth?	No	No	No	Yes
Internal Flash Storage?	No	No	Yes	Depends on model number
SRAM Capacity	50 KB	264 KB	2 KB	520 KB
Operating Voltage	3.3 V	3.3 V	3.3 V/5 V	3.3 V
Maximum Current Draw	12 mA	50 mA	14 mA	500 mA
Price	$1.60	$0.70	$1.56	$1.85



IR Receiver Selection

	TSOP4838	TSOP38238	GP1UM271RKVF	IRM2638
Manufacturer	Vishay Electronics	Vishay Electronics	Sharp Microelectronics	Everlight
Supply Voltage	3.3 V/5 V	3.3 V/5 V	5 V	5 V
Current Usage	0.45 mA	0.45 mA	0.5 mA	1.1 mA
Maximum Transmission Distance	24 meters	30 meters	8.5 meters	12 meters
Cost	$1.17	$0.99	$0.604	$0.239

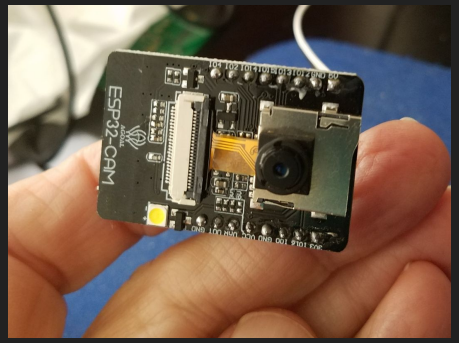
Motor Driver IC Selection

	DRV8835DSSR	TB6612FNG	STSPIN948	MTS2916A
Manufacturer	Texas Instruments	Toshiba	STMicroelectronics	Microchip Technology
Max. Motor Voltage Input	11 V	15 V	58 V	40 V
Logic Voltage	3.3 V/5 V	3.3 V/5 V	3.3 V	5 V
Max. Output Current	1.5 A	1.2 A	4.5 A	0.75 A
Cost	$1.58	$1.97	$5.02	$1.29

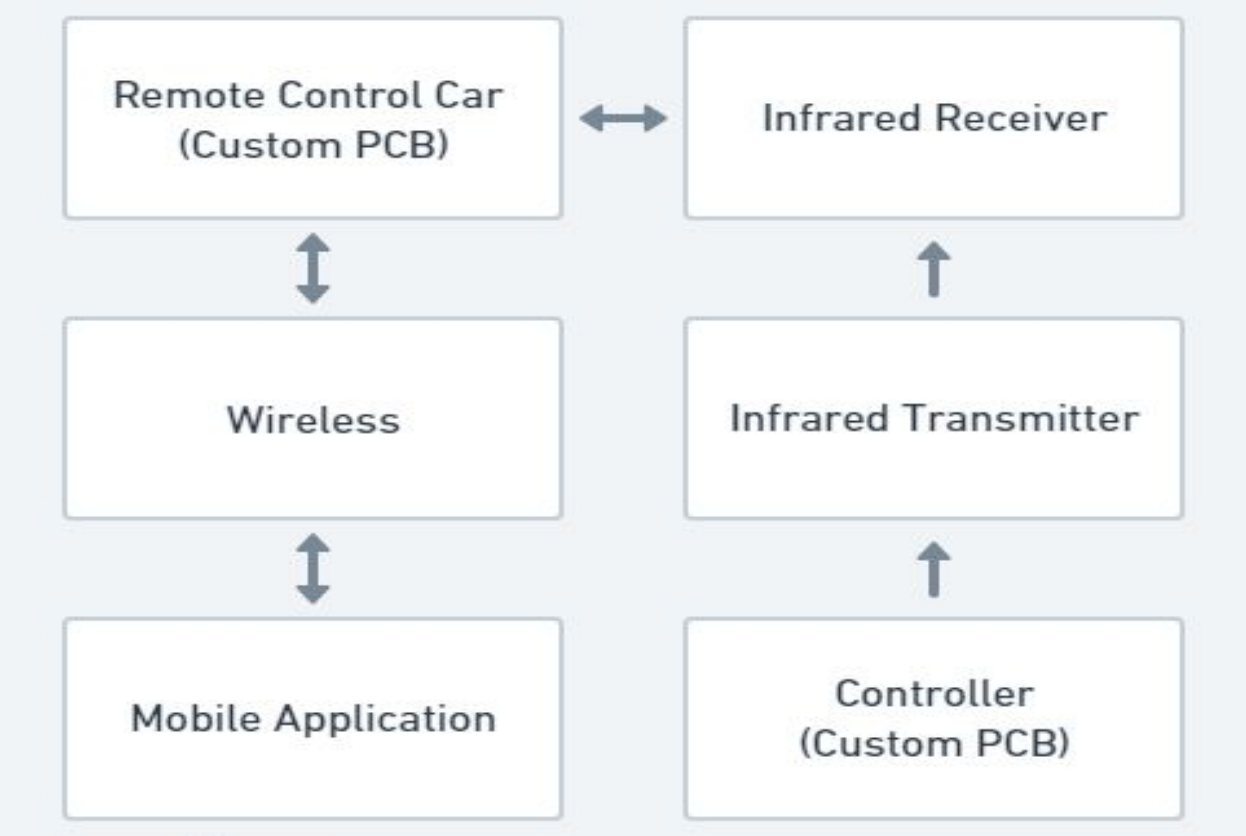
Camera Module Selection

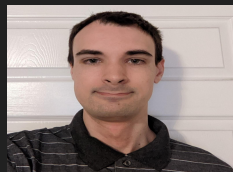
ESP32-WROVER Camera-V1.5

ESP32-CAM

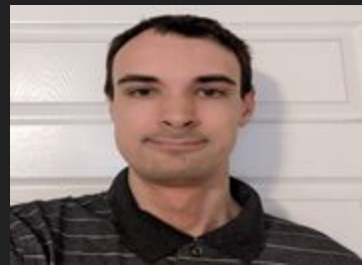


Final Hardware Design



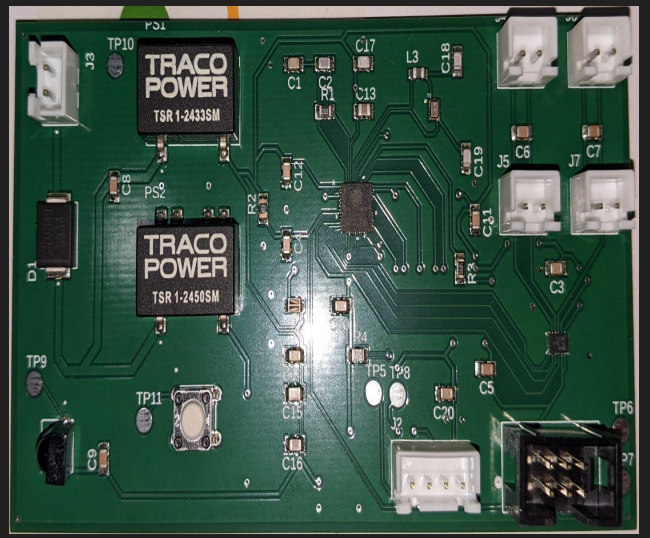


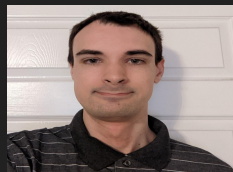
PCB Design



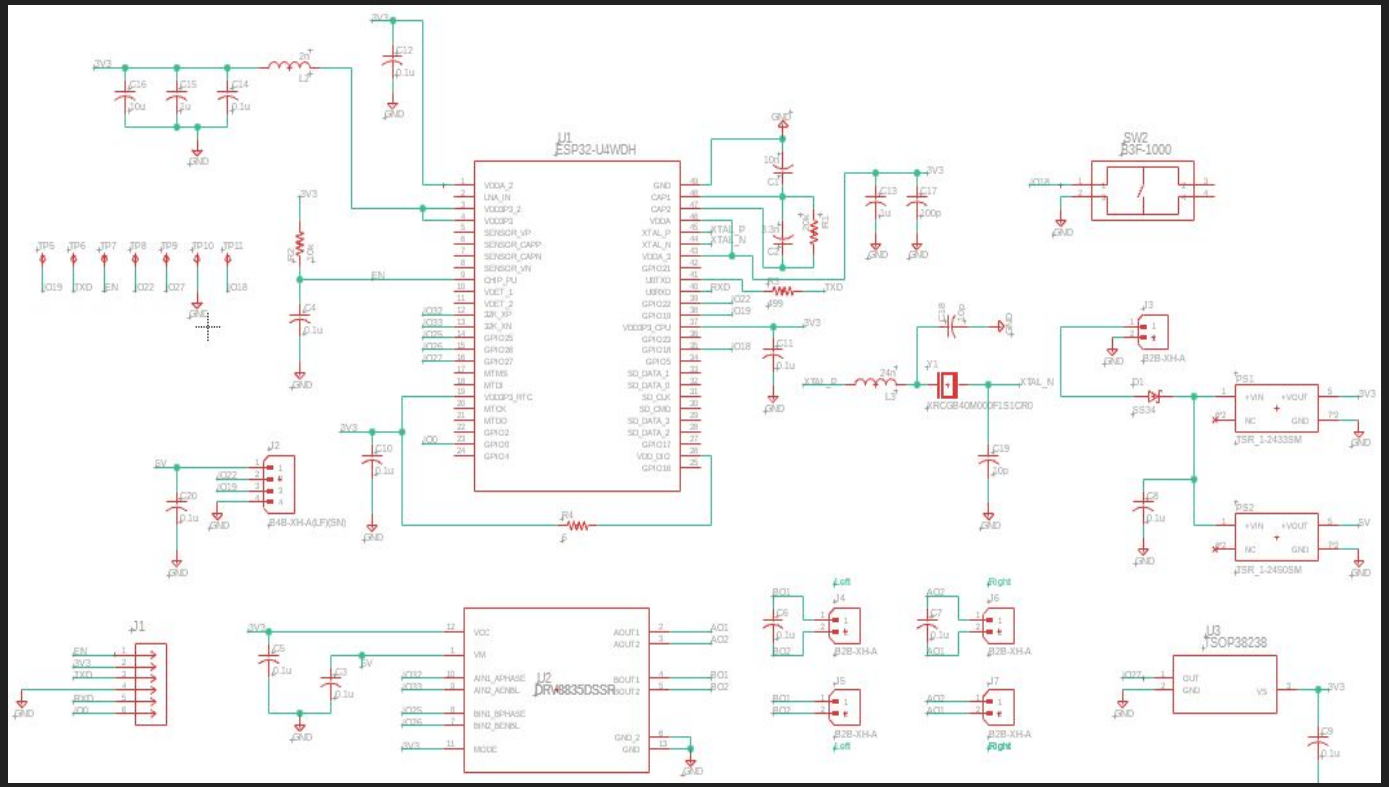
PCB #1: Car PCB

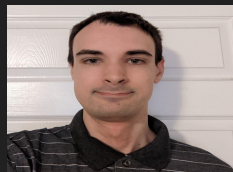
- This PCB will be used to control the remote control car’s peripherals.
- This PCB consists of:
  - Connector For 7.4V Battery
  - 5V Step-Down Converter
  - 3.3V Step-Down Converter
  - ESP32 MCU
  - IR Receiver
  - Connector For Ultrasonic Sensor
  - Connector For Camera
  - Connectors For DC Motors





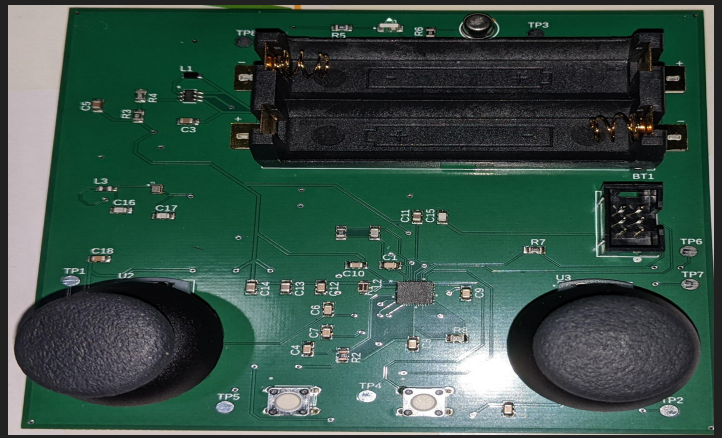
PCB #1 Schematic

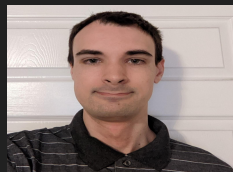




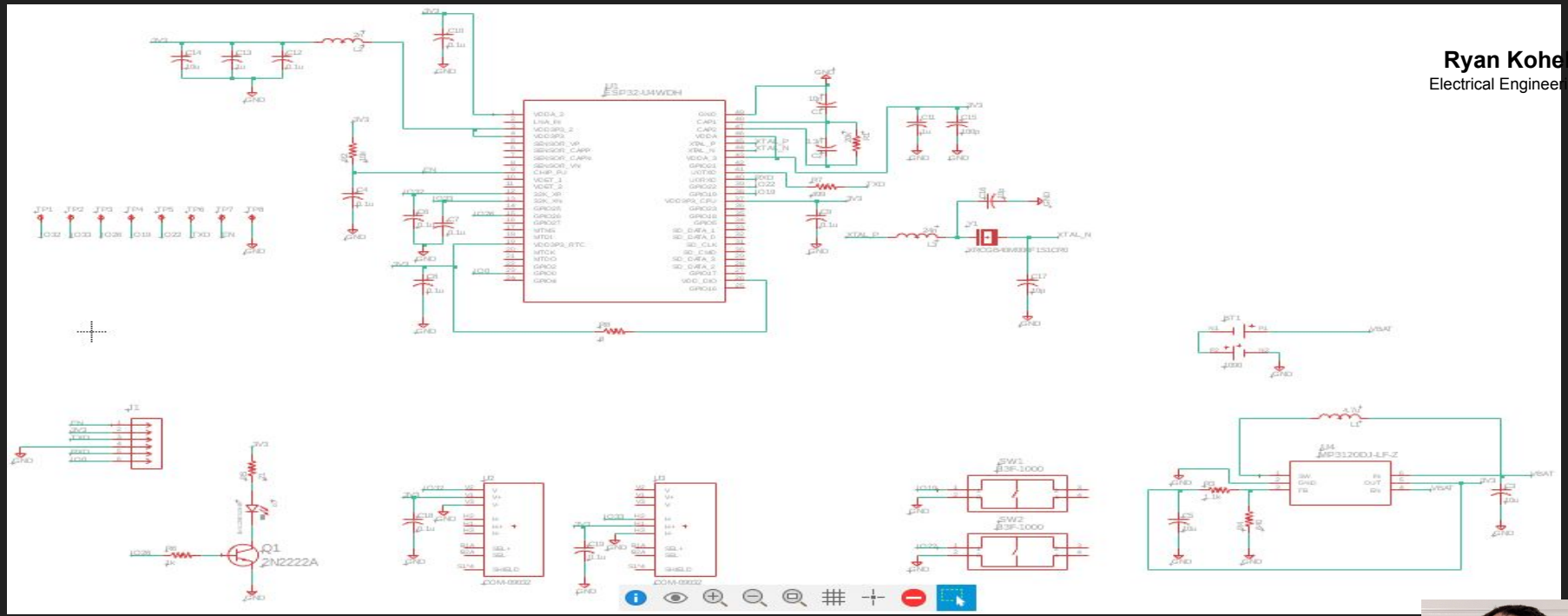
PCB #2: Remote Controller PCB

- This PCB will be used to send commands via IR transmission to the remote control car to steer the remote control car.
- This PCB consists of:
  - AA Battery Holder
  - 3.3V Step-Up Converter
  - ESP32 MCU
  - Buttons
  - Analog Sticks
  - IR Transmitter

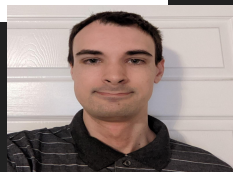




PCB #2 Schematic



Ryan Kohel
Electrical Engineering



Software Design

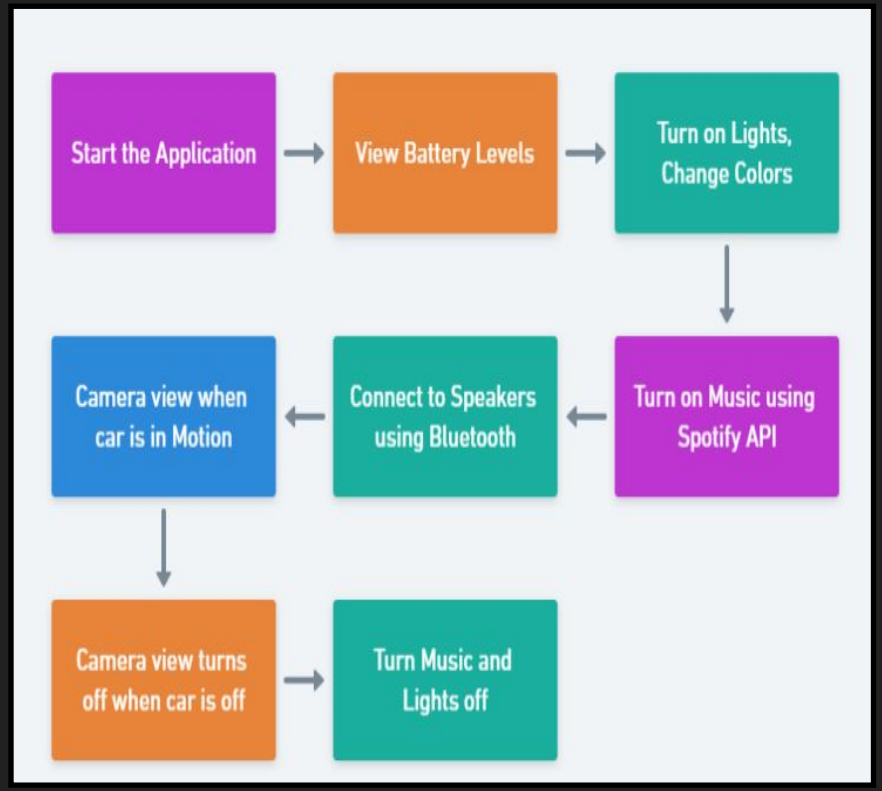
Software Selection

Tool	Ease of Use	Popularity	Complexity
Arduino IDE	4/5 - User-friendly for beginners	5/5 - Highly popular in the maker community	3/5 - Straightforward for basics, complex for advanced
BLE	3/5 - Moderately challenging for beginners	4/5 - Widely used in IoT and mobile apps	4/5 - Complex due to pairing, security, and compatibility
MIT App Inventor	5/5 - Visual drag-and-drop interface	4/5 - Popular among educators and hobbyists	2/5 - Lacks flexibility for complex projects
Blynk	4/5 - Intuitive with drag-and-drop widgets	4/5 - Popular in IoT community	3/5 - Requires technical expertise for advanced features

Sanya Wadhwa, Computer Engineering

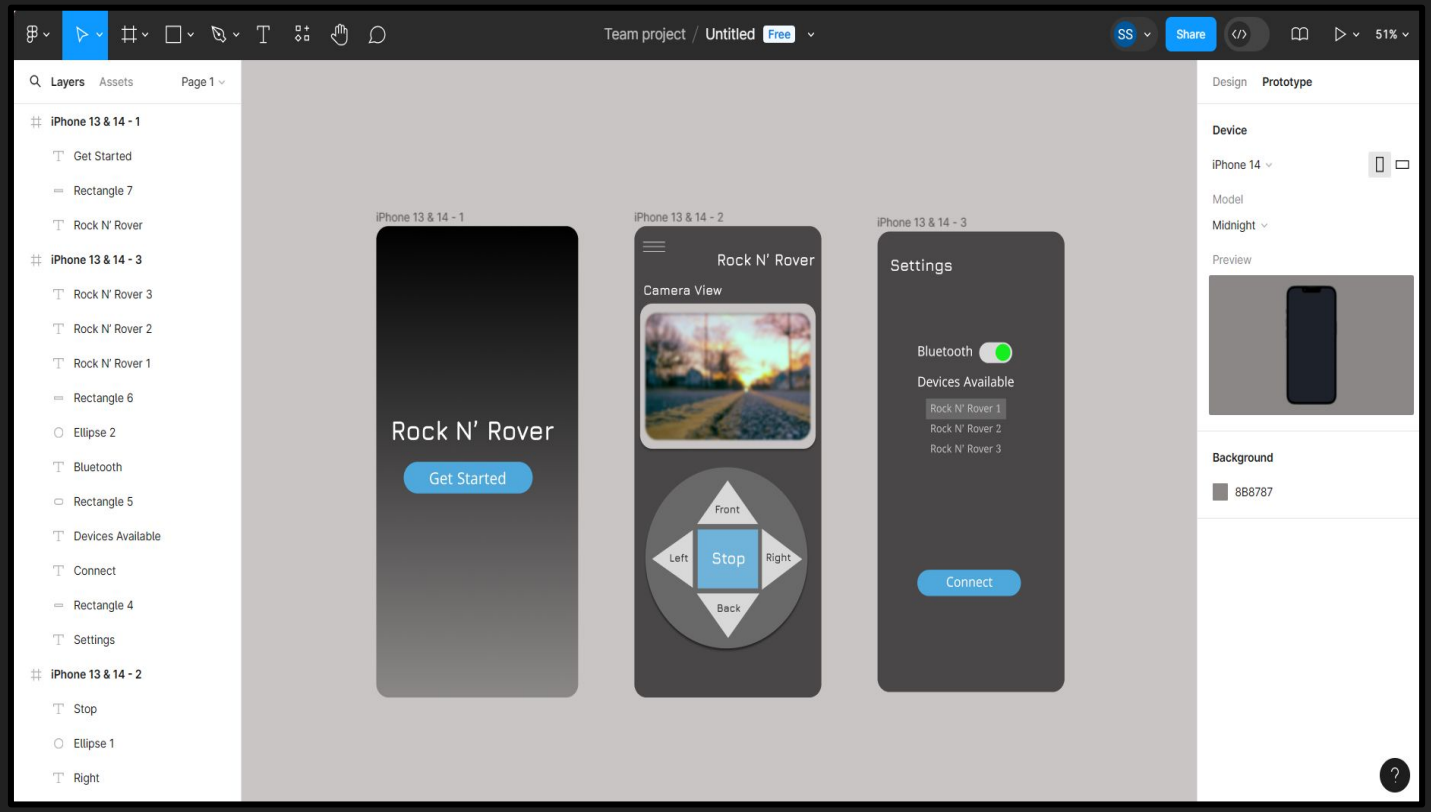
A Companion App for the Rock ‘N’ Rover

- Directional Control
- Live Camera Streaming
- Sensor Monitoring
- Bluetooth Connectivity
- Nice-to-Haves
  - Volume Control
  - LED Light Control
  - Music Streaming



Sanya Wadhwa, Computer Engineering

Software Prototyping



Sanya Wadhwa, Computer Engineering

Testing

- Do the kit components work?
- How bright are the headlights?
- How far can the IR Tx/Rx go?

- Software testing:
  - Driving the car
  - Getting the video to show up on the app
  - Sending controls from the controller to the car

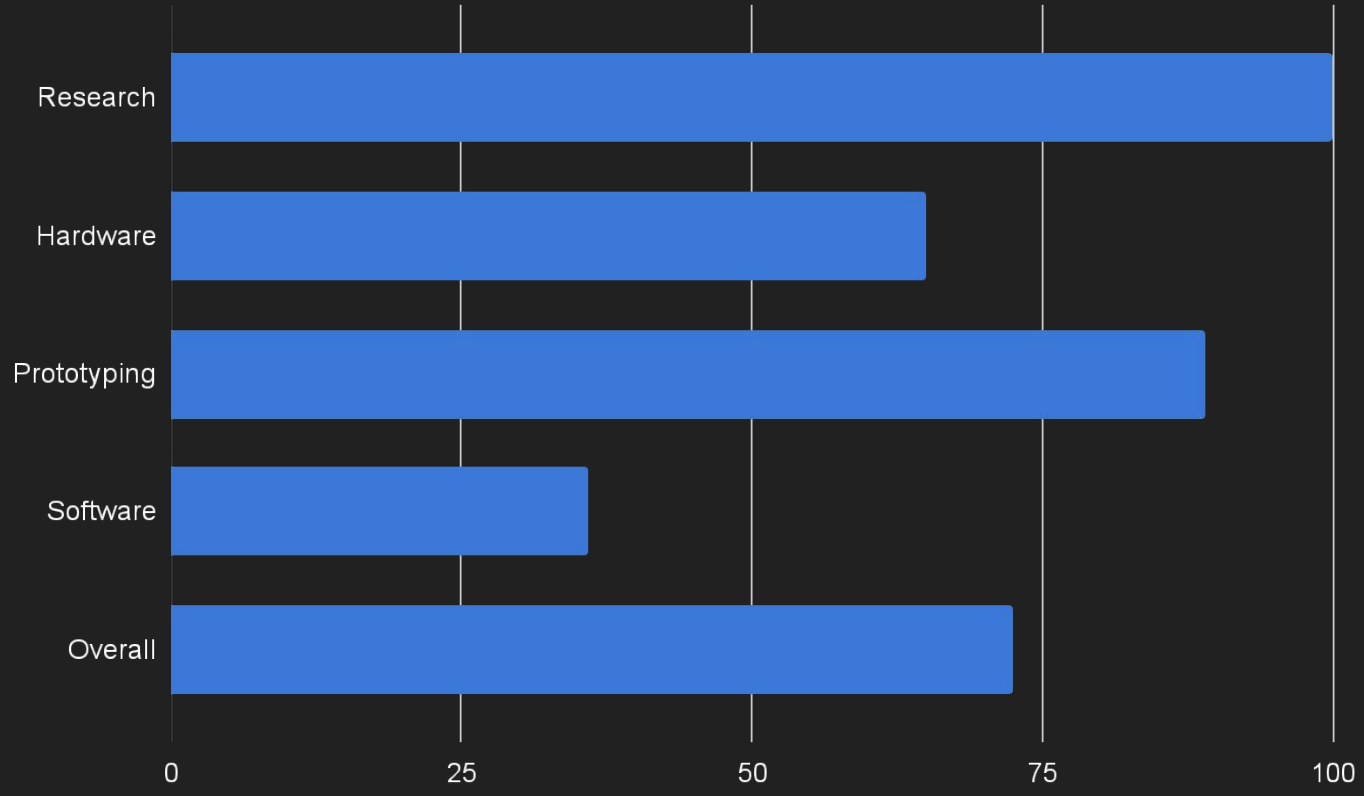
RC Car Demonstration

Project Management

Budget

Component	Estimated Cost
Car Kit	$68.15
Car Kit	$68.15
PCB and Assembly (Version 1)	$300.00
USB to Serial	$20.00
USB to Serial	$20.00
IR Kit	$5.00
MCU	$5.00
Miscellaneous	$25.00
Total	$511.30

Project Completion (%)



Progression Plan

- Refine Protype
- Module Integration
- UI and App Development
- User Feedback Integration
- System Testing
- Software Optimization and Final Assembly

Progression Plan Schedule

	Senior Design II
Week	**Description and Due Dates**
1	Address any issues identified
2	Continue refining prototype
3	Begin integrating different modules for comprehensive system test
4-5	User interface and mobile app development
6	Implement customizable settings based on user feedback
7	Conduct extensive system testing to ensure all components work
8-10	Optimize software algorithms for enhanced performance, finalize assembly of the robotic machine, conduct testing
11-12	Prepare a comprehensive final presentation and documentation and submit and present the final project documentation

Work Distribution

Name	IR Transmitter	PCB Design	Mobile Application	Connectivity
Ryan Kohel	X	X		
Michael Patalano	X	X		
Sanya Wadhwa			X	X
Laila El Banna			X	X

Conclusion

Rock N' Rover along with its companion app represents a significant advancement in remote rover control technology. Its robust features, intuitive interface, and seamless functionality make it an exciting project for rover enthusiasts.

Citations

Technology, Hexalitics. “Why Having a Mobile App Is Beneficial for Your Business?” *Medium*, Medium, 29 Sept. 2021, medium.com/@hexalitics/why-having-a-mobile-app-is-beneficial-for-your-business-3b64578095bb