ECE-5780 Final Project Proposal

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General Description:

Our rover will be powered by a 9V battery, which will be split into a 5V and 3.3V signal to power the various components. For sensing, we will use ultrasonic sensors and flex resistors to detect obstacles in the rover's path. The ultrasonic sensors should help us know where to go to avoid distant objects and the flex resistors will be used in case we need to get close to objects on the side of our rover. If the flex resistor is bent enough we will have the rover stop automatically. The rover will be controlled via a UART connection, allowing us to guide it around any obstacles it encounters. Motion will be achieved using two wheels, each driven by a separate motor with motor drivers. We expect the ultrasonic sensor and the flex resistors to give us enough information to complete the course safely.

- Component selection and a bill of materials.

Short Description	Quantity	Price	Manufacturer	Link	Description	Datasheet
Chassy	2	Total: $19.90 Price Per Unit: $9.95	adafruit	Anodized Aluminum Metal Chasis for a Mini Robot Rover : ID 2943 : $9.95 : Adafruit Industries, Unique & fun DIY electronics and kits	Anodized Aluminum Metal Chasis For A Mini Robot Rover	Dimensions: 156mm x 74mm x 25mm Weight: 47.3g
Wheels	4	Total: $10.00 Price Per Unit: $2.50	adafruit	Wheel for Micro Continuous Rotation FS90R Servo : ID 2744 :	Wheel for Micro Continuous Rotation FS90R Servo	Microsoft Word - FS90R-wheel (1).doc (adafruit.com)

				$2.50 : Adafruit Industries, Unique & fun DIY electronics and kits		
Bearing Wheel	2	Total: Unknown Price Per Unit: Unknown	Home Depot	Supporting Swivel Caster Wheel - 1.3 Diameter : ID 2942 : $1.95 : Adafruit Industries, Unique & fun DIY electronics and kits	Supporting Swivel Caster Wheel - 1.3” Diameter	Wheel Diameter: 32.4mm / 1.3” Wheel Thickness: 14.2mm / 0.56” Bottom Plate: 32mm x 38mm / 1.26” x 1.5” Height: 42mm / 1.65” Mounting Holes Distance: 30mm x 24.3mm / 1.2” x 0.96” Weight: 45.7g
Motor	4	Total: $23.80 Price Per Unit: 5.95	adafruit	https://www.adafruit.com/product/3802	TT Motor All-Metal Gearbox - 1:90 Gear Ratio	Dimensions (excluding shaft): 69.5 x 22 x 20.7mm Product Weight: 39.4g / 1.4oz
Motor Driver	1	Total: $12.88 Price Per Unit: $12.88	Teyleten	Amazon.com: Teyleten Robot TB6612FNG Dual DC Stepper Motor Driver Module 1.2A Peak 3.2A Better Than L298N(Pack of 3) : Industrial & Scientific	Teyleten Robot TB6612FNG Dual DC Stepper Motor Driver Module 1.2A Peak 3.2A Better Than L298N (Pack of 3)	Amazon.com: Teyleten Robot TB6612FNG Dual DC Stepper Motor Driver Module 1.2A Peak 3.2A Better Than L298N(Pack of 3) : Industrial & Scientific

Ultrasonic Sensor	2	Total: $7.90 Price Per Unit: $3.95	adafruit	HC-SR04 Ultrasonic Sonar Distance Sensor + 2 x 10K resistors : ID 3942 : $3.95 : Adafruit Industries, Unique & fun DIY electronics and kits	Ultrasonic Sensor - HC-SR04	HC-SR04 (sparkfun.com)
Flex Resistor	4	Total: $15.9 Price Per Unit: $31.80	Adafruit	Short Flex Sensor : ID 1070 : $7.95 : Adafruit Industries, Unique & fun DIY electronics and kits	Short Flex Sensor	FLEX SENSOR DATA SHEET '10 (SPARKFUN KIT).ai (adafruit.com)
Power Supply Module	1	Already Own	Elegoo	$6.49 - Breadboard Power Supply Module 3.3V & 5V (Arduino & Raspberry Pi Compatible) - Tinkersphere	Breadboard Power Supply Module	73-4538_v1.pdf (rapidonline.com)
Discovery Board	1	Already Own	STMicroelectronics	STM32F072RB - Mainstream Arm Cortex-M0 USB line MCU with 128 Kbytes of Flash memory, 48 MHz CPU, USB, CAN and CEC functions - STMicroelectronics	Mainstream Arm Coretx-M0 USB line MCU with 128 Kbytes of Flash memory, 48MHz CPU, USB, CAN and CEC functions	Datasheet - STM32F078CB STM32F078RB STM32F078VB - Arm®-based 32-bit MCU, 128 KB Flash, crystal-less USB FS 2.0, 12 timers, ADC, DAC and comm. interfaces,

						1.8 V

Milestones:

March 3rd

- Initial design proposals due. Milestone 0. Source control

March 7th - March 10th

- Proposal feedback returned. Order components once you have finalized your design.

March 11th - March 17th

- Milestone 1 : Begin Code Framework, finite state machine implementation
  - Framework will expand with each milestone, dedicated to specific task

March 18th - March 24th

- Milestone 2 Platform ready. All components must be on hand and ideally assembled.
- Setting up Serial Connection with computers/ Controlling from computer and continue to work on finite state machine

March 25th - March 31st

- Milestone 3 : Work with controlling the wheel and setting up PID?/Turning, straight line

April 1st - April 7th

- Milestone 4 : Getting environment information: Getting Ultrasonic and Flex sensor working

April 8th - April 14th

- Milestone 5 : Finish code development and begin testing rover

April 15th - April 21st

- Milestone 6 : Finalizing Code and Testing/Debugging

April 16nd - April 22th

- Final week to debug and fix

April 27th

- The rally 1:00-3:00 PM

Risks, Unknowns, and Potential Problems:

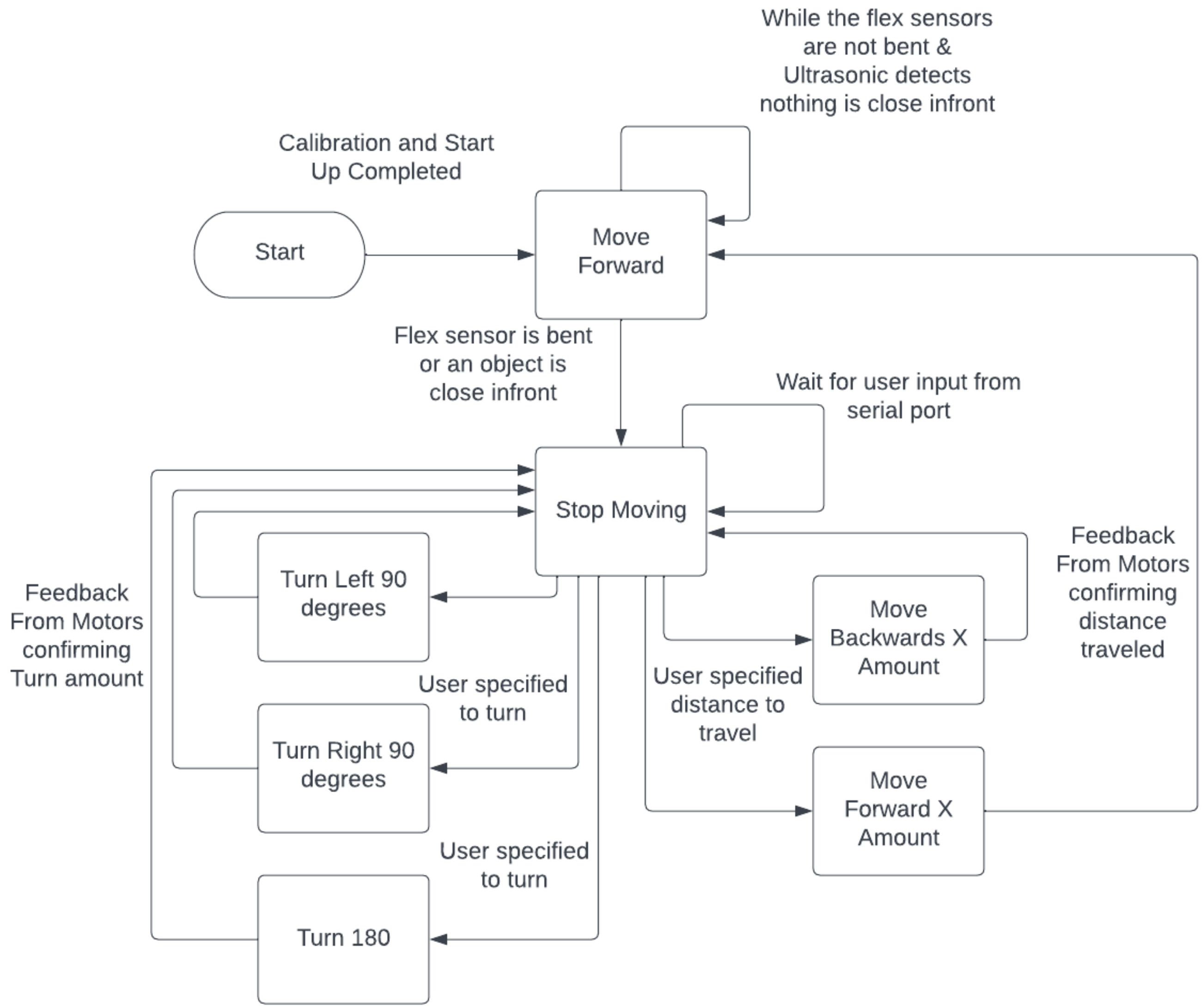
- Ultrasonic Sensor have a blindspot directly in front of the sensors, about 1 to 2 cm
- Flex sensors positioning, too far out extended, not sticking out enough, not secured
- Rover to stopping in time prevent collision

- Maintaining consistency between the multiple components
- Keeping track of where rover has been in cases of dead ends

Potential Solutions:

- For the blindspot, we can only hope that when the rover is first sent out there is at least more than 2 cm of space in front
- For Flex sensor it will be a form of trial and error, determining how far they should extend from the body of the rover and ensuring they are securely attached to the rover
- For prevent collisions we need to make sure that it is going at a safe speed for it to respond in time and ensure good position of flex sensor
- As for consistency between the multiple components we can test each component and calibrate the code such that it accounts for differences between the motors and distance measuring of the ultrasonic, along with determining how bent the resistor are
- In terms of keeping track of where the rover has been we are thinking about having the rover send us data and keeping track of that data with a pencil and paper and making choices accordingly.

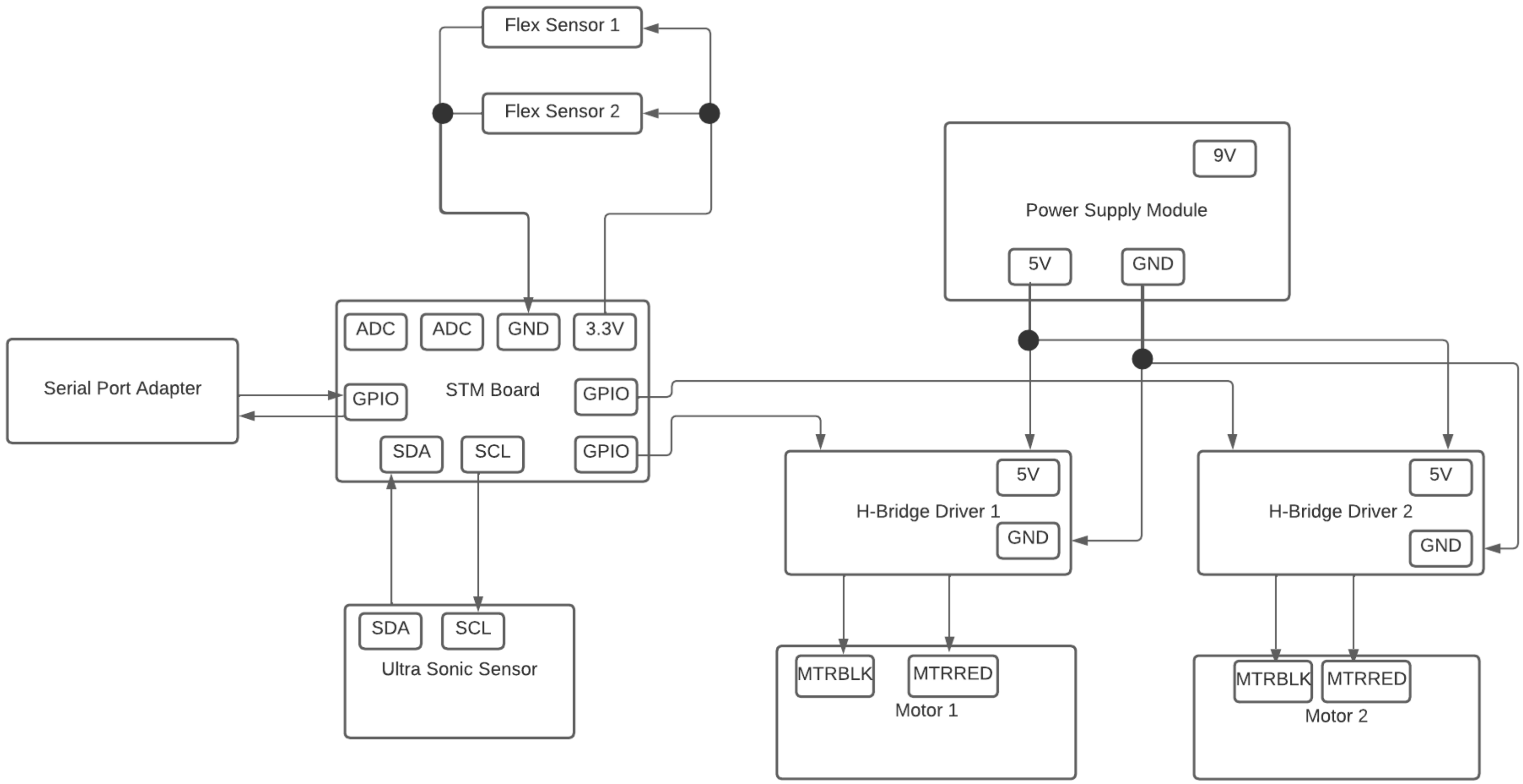
Finite State Machine Diagram:


While the flex sensors are not bent & Ultrasonic detects nothing is close infront
Calibration and Start Up Completed
Start
Move Forward
Flex sensor is bent or an object is close infront
Wait for user input from serial port
Stop Moving
Turn Left 90 degrees
Feedback From Motors confirming Turn amount
User specified to turn
Turn Right 90 degrees
User specified to turn
Turn 180
Move Backwards X Amount
Feedback From Motors confirming distance traveled
User specified distance to travel
Move Forward X Amount

Finite State Machine Diagram Description:

We have a total of eight states. We have to start, move forward, stop moving, turn left 90 degrees, turn right 90 degrees, turn 180, move backwards x amount, and move forward x amount. Move Forward/Backward X Amount will mask the flex sensor interrupt, allowing it to move without them triggering a stop. The transitions for each state are shown in the diagram above. There isn't a path back to start as this is just the rover setup. After starting we go through each of the different transitions depending on what is happening in our surroundings.

Block Diagram:


Flex Sensor 1
Flex Sensor 2
Power Supply Module
9V
5V
GND
ADC
ADC
GND
3.3V
Serial Port Adapter
GPIO
STM Board
GPIO
SDA
SCL
GPIO
H-Bridge Driver 1
5V
GND
H-Bridge Driver 2
5V
GND
SDA
SCL
Ultra Sonic Sensor
MTRBLK
MTRRED
Motor 1
MTRBLK
MTRRED
Motor 2