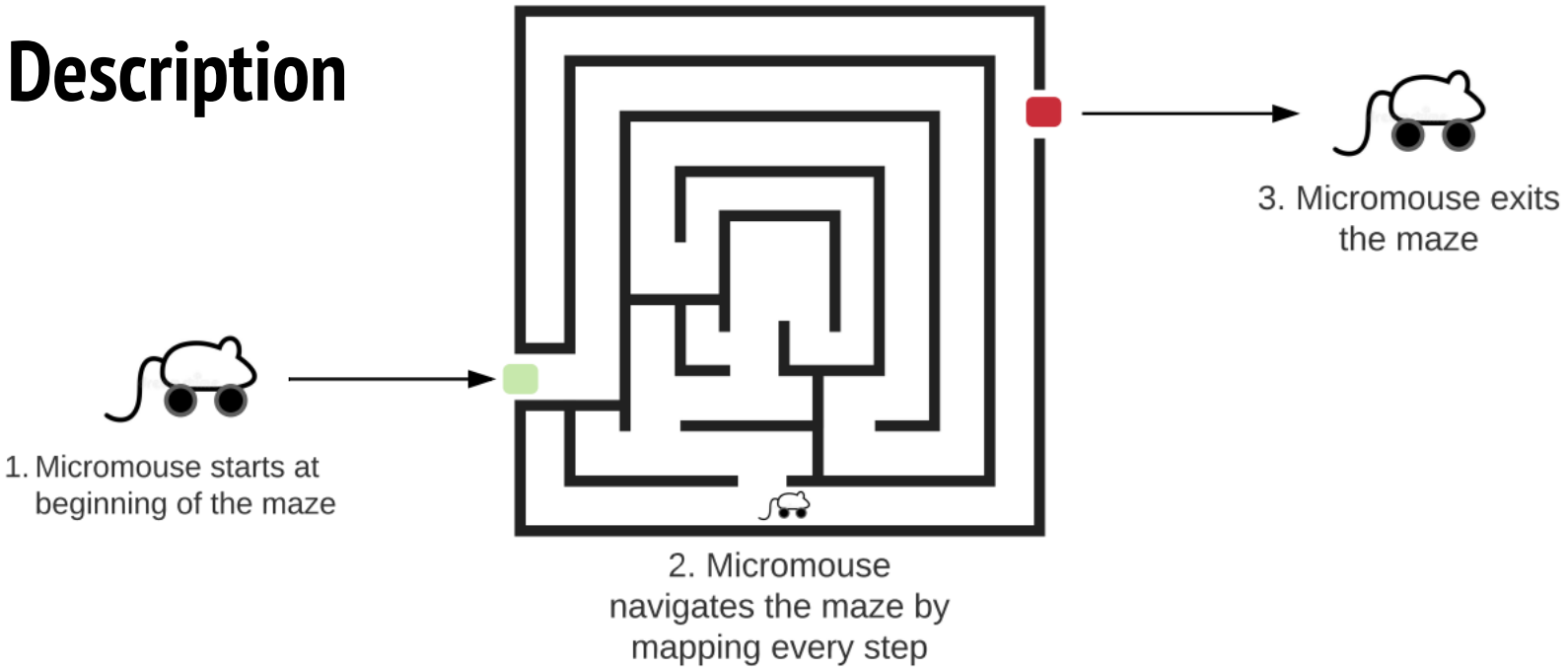
Critical Design Review

Team MMXVB: Abid Niaz, Alex Gomes, Ryan Hagler, Pranav Papali

Project Description

Mission Scenario Diagram



Purpose: The team is tasked with designing and constructing an autonomous robot that is able to navigate through a maze while following restrictions imposed by IEEE [1] and the customer.

SRS Compliance

Functional Requirements	
The Micromouse shall utilize no more than four sensors for navigating the maze environment.	✔
The Micromouse shall record and measure its position in the maze.	✔
The Micromouse shall move left, right, forward, and shall be capable of a zero point, 360-degree rotation.	✔
The equipped controller shall have sufficient energy supplied to last a minimum of 15 minutes.	✔

Design Requirements	
The Micromouse shall use a programmable microcontroller that has at least 2 Kb of SRAM and at least 32 Kb of flash memory.	✔
The final Micromouse dimensions shall not exceed a 12cm x 12cm footprint	✔
The Micromouse shall contain a chassis that provides a foundation for the components.	—
The chosen microcontroller shall be programmable using C/C++ or Python.	✔

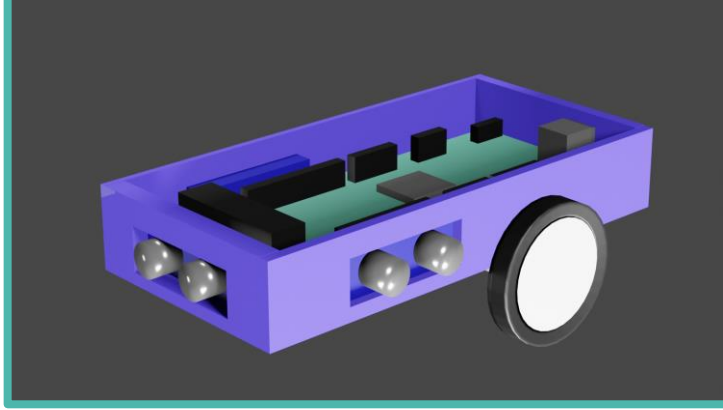
SRS Compliance (Cont.)

Performance Requirements	
The Micromouse shall move at a base speed of four cm per second.	✔
The Micromouse shall rotate at a rate of 90 degrees per second (¼ of a full rotation).	✔
The Micromouse shall be able to detect a wall from at least 36 cm away.	✔

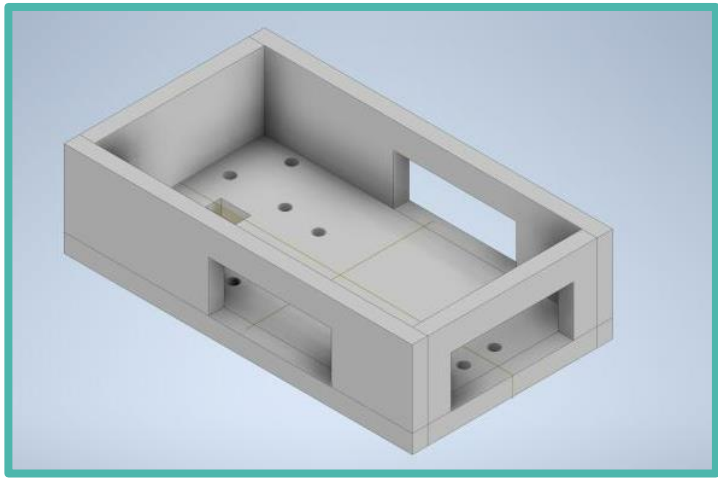
Interface Requirements	
The microcontroller pins shall be capable of outputting at five Volts and 15 mA.	✔
The microcontroller shall be programmable via USB.	✔

Micromouse Design

- Three ultrasonic sensors
- Front sensor for detecting upcoming wall, side sensors to correct errors in centering & spot corridors for turning
- Magnetic encoders that uses rotational position information
    - Attached to motors

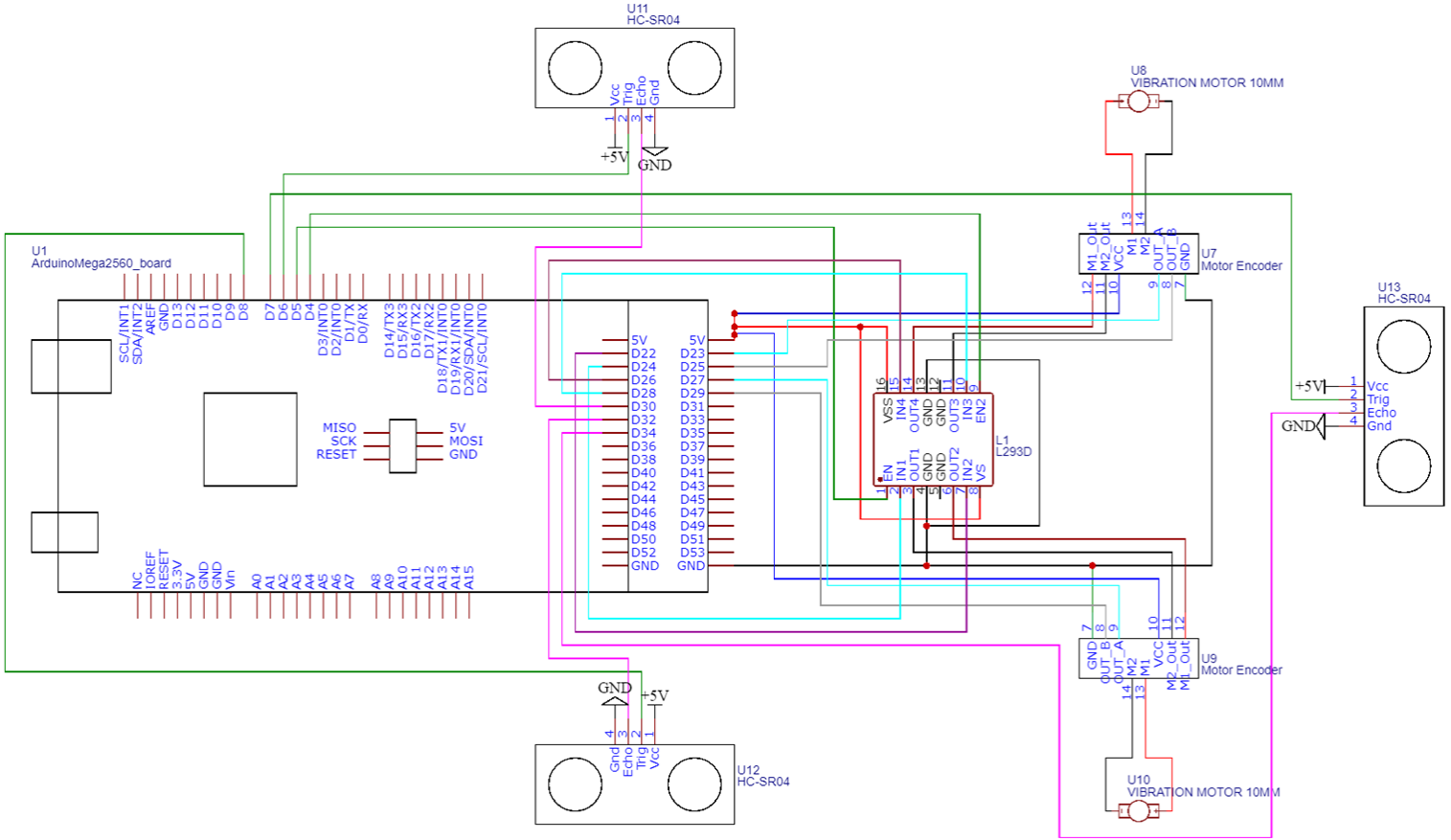


Rendered Mock-Up of Full Design

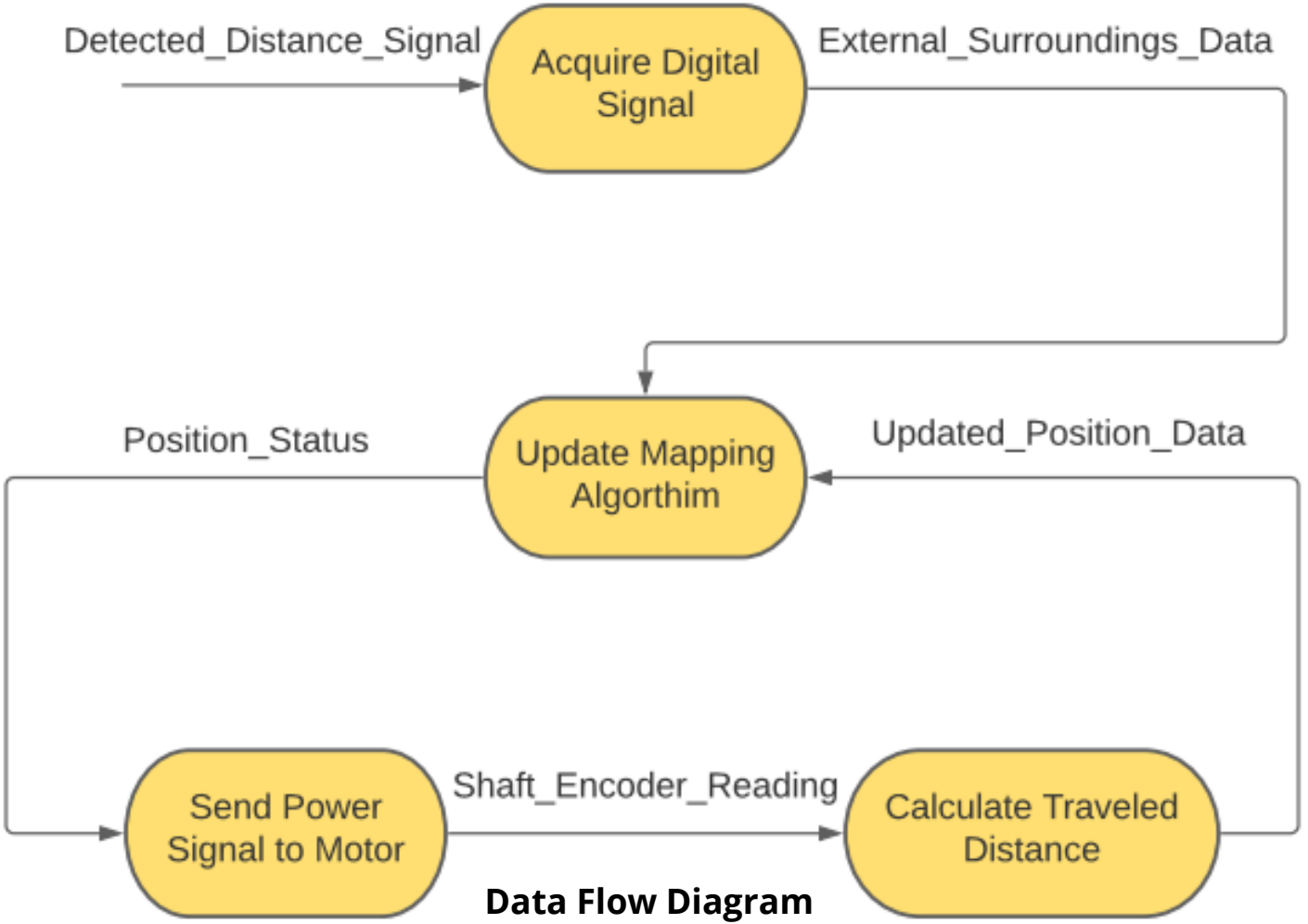


3D Chassis Model for Print

Hardware Schematic



System Interfacing



Data Flow Diagram

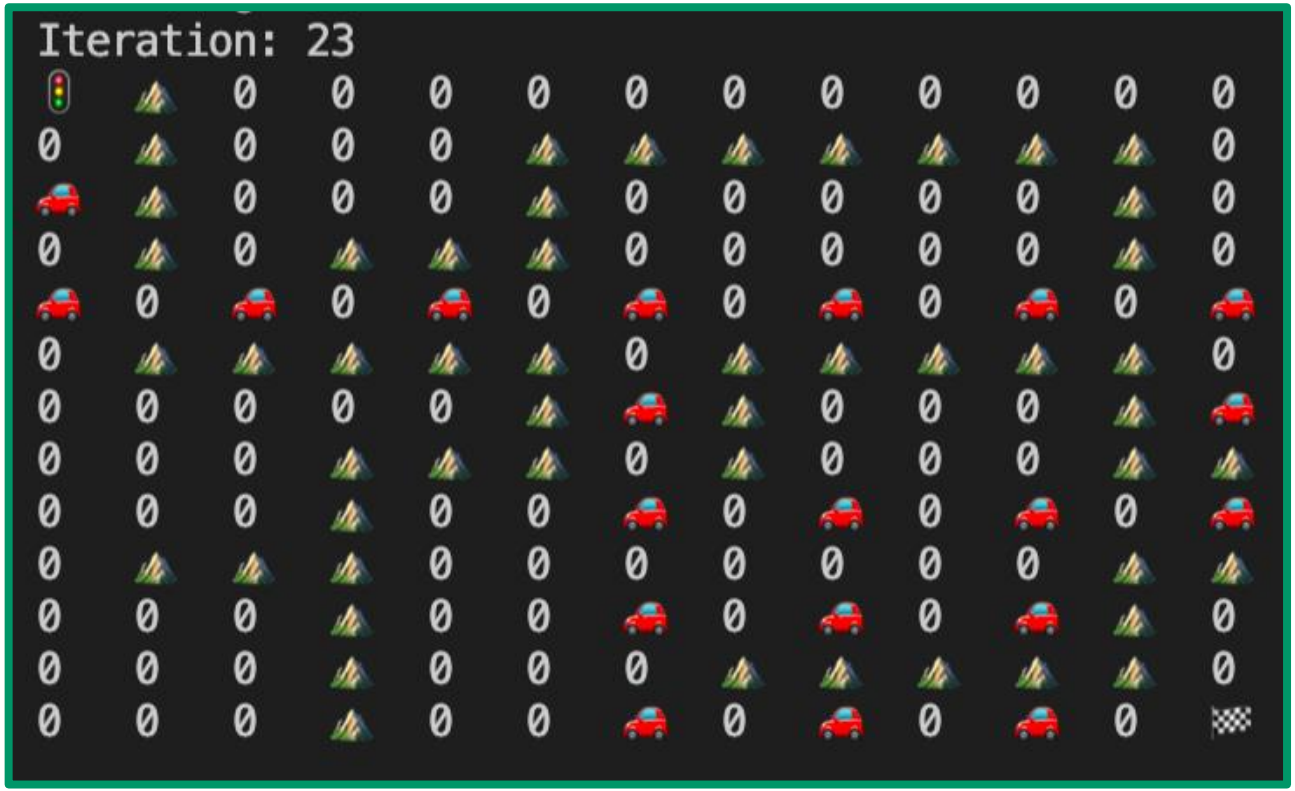
Software Implementation

- Acquisition and handling of
  - Sensor signals
  - Encoder signals
- The map stored as a 2D array in SRAM
- A* Search

f(n) = g(n) + h(n)
n: next node
g(n): cost from start node to n
h(n): the cost of the cheapest path from *n* to the goal

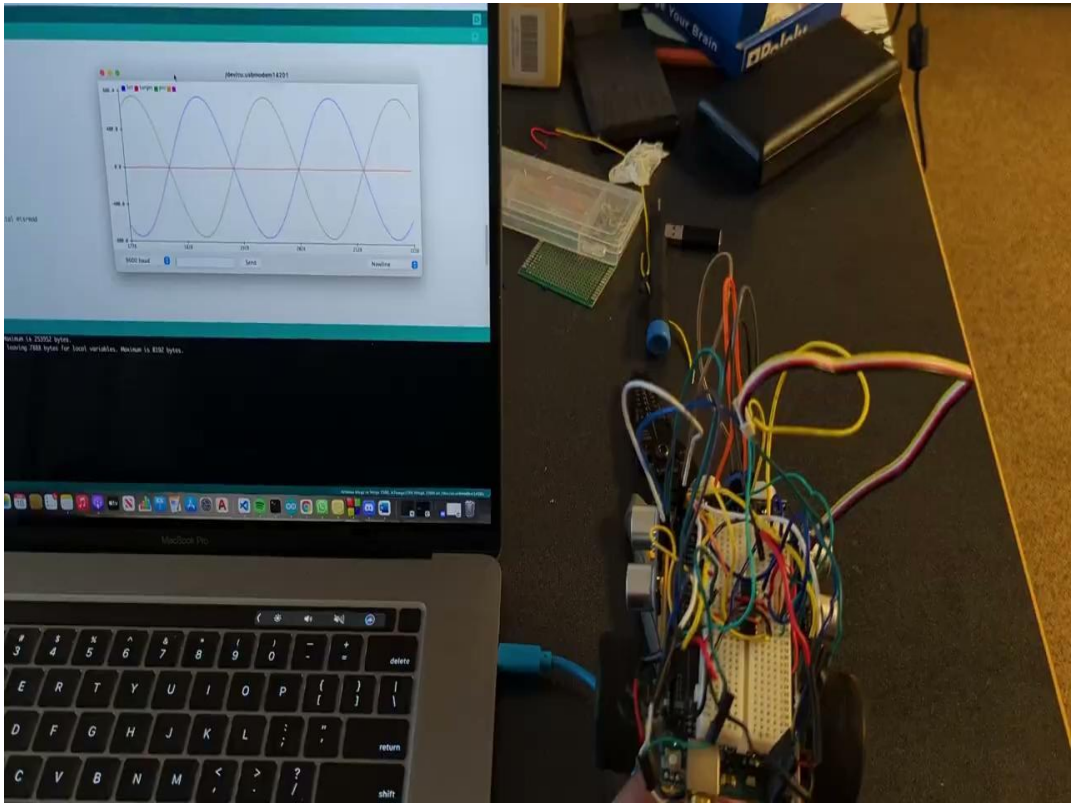
Visual Representation of 2D Array

Exploration Phase



Solution phase

Preliminary Testing



Technical Issues

- Motors have not been calibrated to operate smoothly.
  - We are planning to remedy this through software tuning.
- The device does not have any lane centering.
  - We are planning to implement this in the software so that the device is able to detect obstacles consistently.

Goals Moving Forward

- Coordinate functionality of map-solving algorithm with data received from hardware components to lead to a full implementation.
- Print the modeled chassis and transfer prototype build for permanent solution
    - Minor Issue - waiting for some parts to arrive

Questions?

References

[1] Misra, R. and Adler, R., 2021. *Micromouse Competition Rules*. Pittsburgh: University of Pittsburgh Micromouse.

[2] Dreamstime. *Mouse wild animal flat icon.* *dreamstime.com/mouse*