Trinity College Dublin
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2E10 Interim Report (Part B)

Group Y1

Creating systems that can navigate and control effectively can be crucial in development of robotics. The primary objective of the buggy project is to use a micro controller Arduino Uno R4 Wifi to make an adaptable vehicle which can traverse on a track while being controlled using the Wifi component. This report provides a comprehensive overview of the electrical system of the buggy.

Block Diagrams:

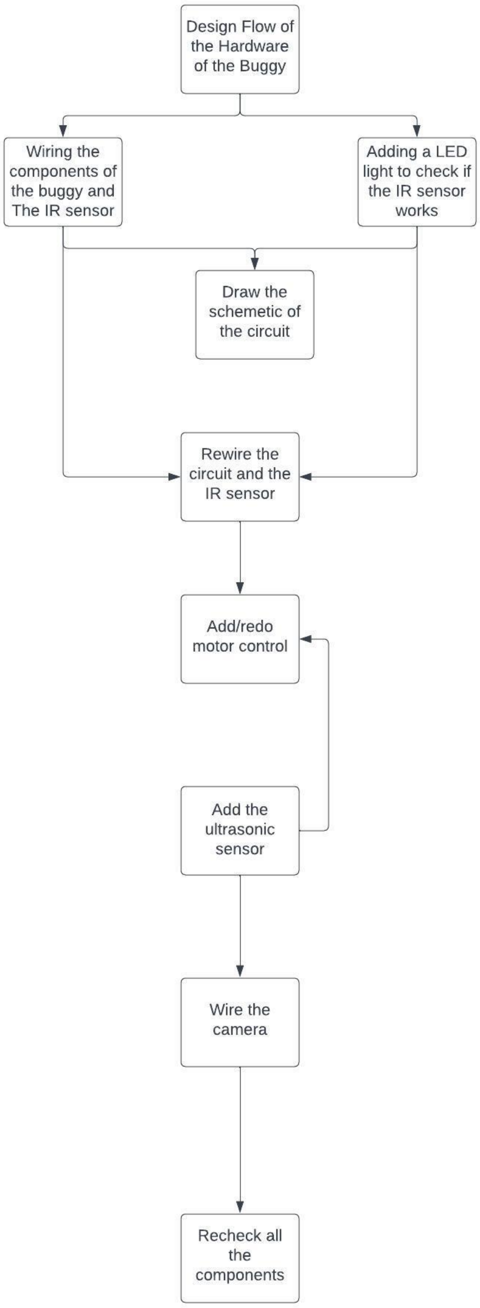

Fig.1: Block Diagram Components/ Tasks

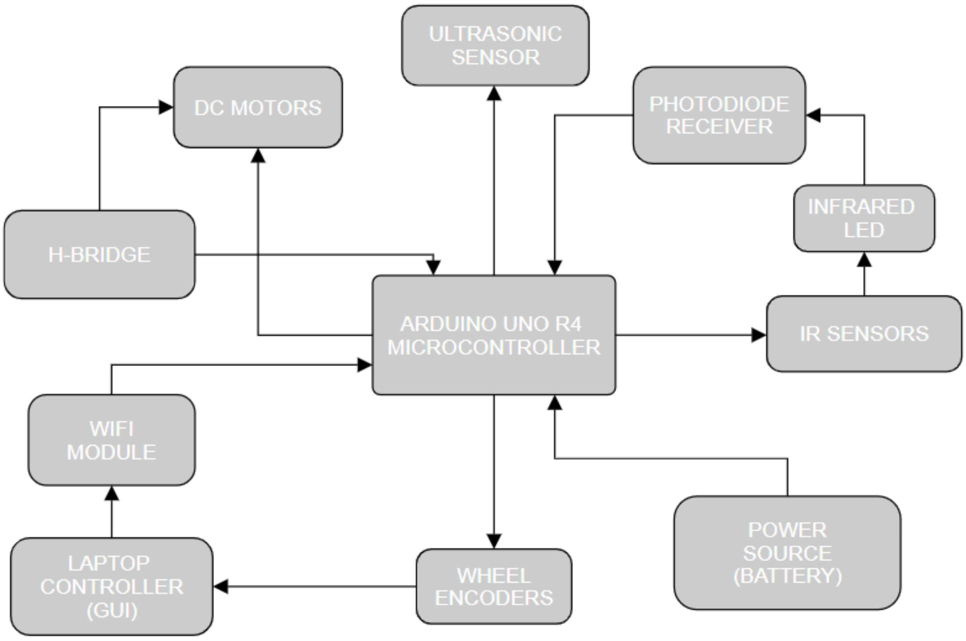

Fig.2: Block Diagram of the Buggy Components

Schematic of the Buggy:

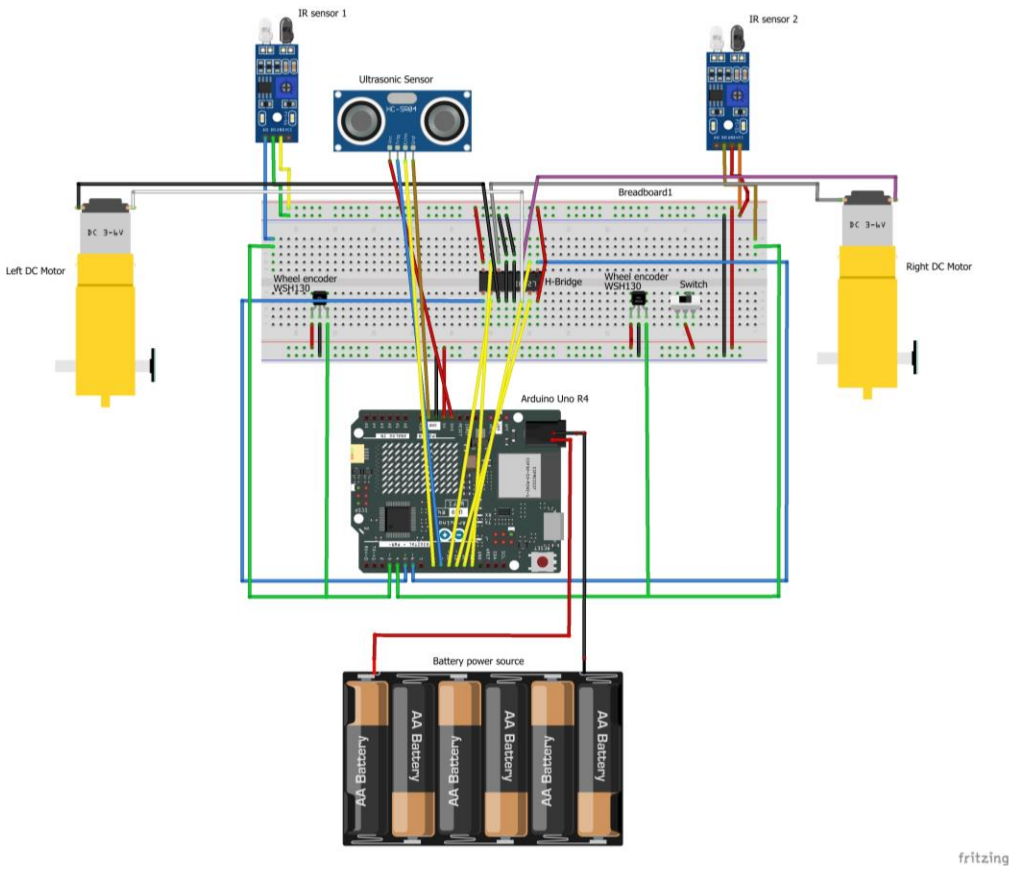

Fig.3: Wiring of the Buggy

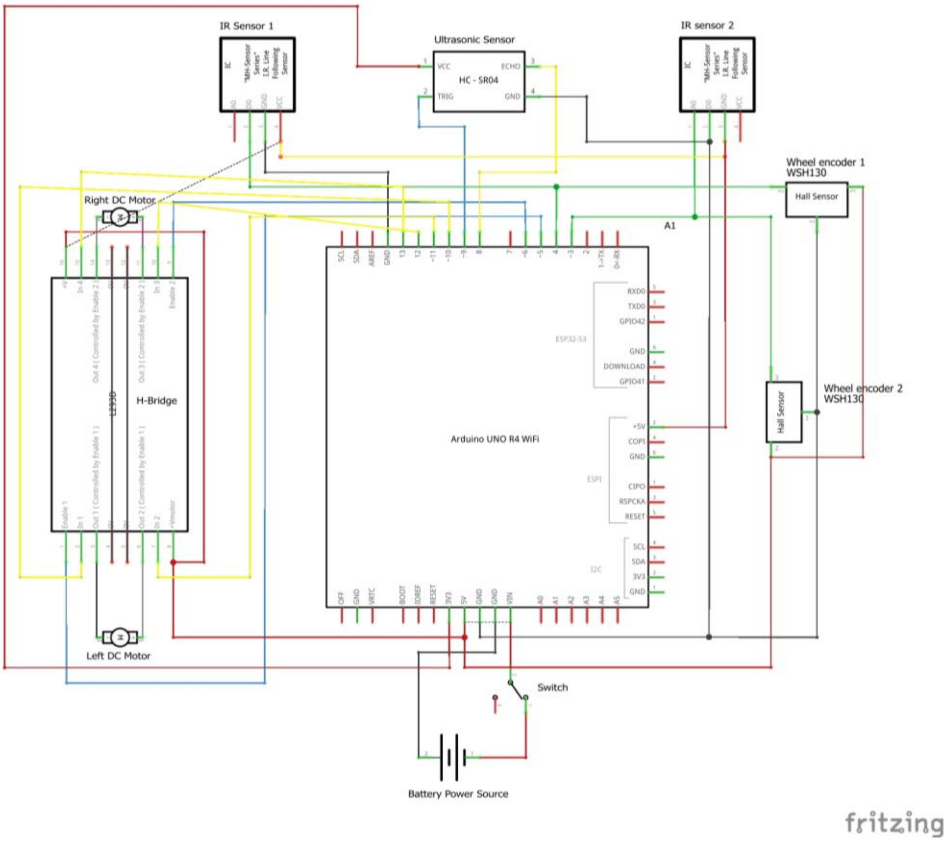

Fig.4: Schematic of the Buggy Wiring from Fritzing Software

Circuit :

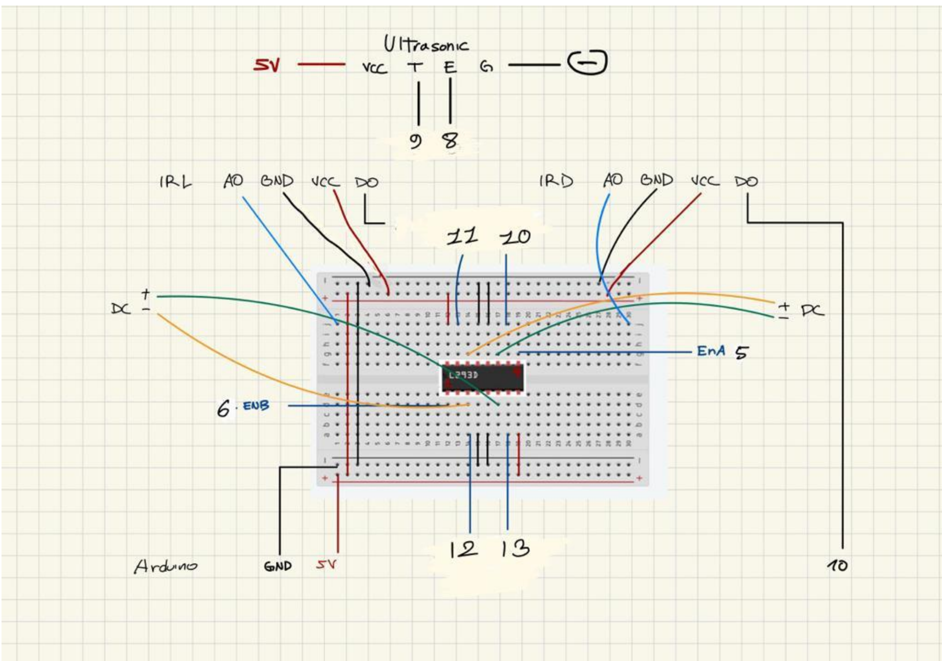

Fig.5: Wired Circuit Breadboard

The circuit is comprised of two IR (Infrared) Sensors, one ultrasonic sensor, two motors, two wheel-encoders and a H-bridge. These sensors and components work together to ensure a smooth traverse around the track using the WiFi control.

IR Sensors:
The two IR sensors play a crucial role in the functionality of our buggy. These sensors use an infrared emitter (IR LED) to transmit infrared waves towards a surface.A photodiode receiver is then used to detect the reflected waves. By continuously monitoring sensor readings, we can implement a series of instruction loops to adjust the position of our buggy by detecting a difference in the reflected waves when it crosses the white track. This allows us to ensure that the buggy remains on the track and executes turns effectively.

The power (Vcc) and ground of the sensors are connected to the power and ground rail of the breadboard while the input pins are connected to the digital pin 3 and 4 on the Arduino Uno R4 microcontroller.

This sensor uses a polling mechanism to continue the instruction (code) loop ands make decisions based on the sensor reading. When the sensor reads a dark or black surface, it overrides the signals to ensure staying on track. The functions startMoving(),stopMoving() and checkTurn() enable the override signal in the circuit.

Ultrasonic Sensor
The Ultrasonic sensor is equipped with 4 different pins, such as, ground (GND), power(Vcc), echo and trigger (Trig). Upon activation, the trigger pin emits ultrasonic waves for a specific duration (10 ms) while the pin is set to LOW. The echo pin then detects the reflected waves and calculates the distance to the obstructionusing the speed of sound (343 m/s) and the time taken for the wave to return. Whenever the echo pin detects an obstacle within 10 cm of the sensor, it sends an override signal to the Arduino to stop the buggy to avoid collision. The function checkObstruction() enables the override of the signal.

The power (Vcc) of the sensor is connected to the 5V pin on the arduino and the ground is connected to the ground pin of the Arduino. Trig and echo are connected to digital pin 9 and 8 respectively.

DC Motors
The DC motor uses the fundamentals of electromagnetism to operate. As the armature rotates, it generates torque within the components, resulting in power generation. The maximum power supply of the DC motor used in the project is 6V.

The positive and negative end are connected to the input and output pins of the H-bridge to ensure speed and bi-directional control of the buggy.

H-Bridge
A H-bridge serves as a power amplifier, facilitating the control of the buggy's speed and enabling bi-directional movement. It also ensures efficient power supply to the motors. The H-bridge is comprised of four switches and uses PWM (Pulse Width Modulation) and digital logic circuits to control the motors. The first pins on both ends are called the enablers, which are connected to the Arduino digital pins 5 and 6. The next pins are the input pins which are connected to the Arduino digital pins 11 and 12. Then the positive terminals of the motors are connected to the H-bridge on both sides. The ground pins are the 4th and 5th pins of the H-bridge. After that, the 6th pins are connected to the negative terminals of the motor. Finally, the last pin onone side

is connected to the Cable Mount DC Jack Socket, ensuring efficient power supply by bypassing the power directly to the H-bridge.

Challenges:

One of the primary challenges that we faced was implementing the IR sensors and controlling the speed of the buggy during the turns on the track. The under sensitivity of the IR sensors was an issue as it presented some difficulties such as detecting the difference between the white track and black surface. This hindered the buggys ability to stay on the track as our buggy would overshoot the bend and run off the track. This situation occured as the buggy approached the turn with too much speed and the IR sensors weren't able to respond in time for the instruction loops to reposition the buggy. We overcame this challenge by slowing down the speed of the buggy to 130 and we also discovered that moving the IR sensors slightly closer together resulted in the buggy having more control on the track.

Furthermore, while implementing the ultrasonic sensor, we discovered that there was a problem with our ultrasonic sensor as it was continuously outputting the same number nonstop even when we adjusted the rebound distances. We knew that this was a hardware issue in our apparatus as we rewired and recoded the sensor multiple times and the same error still occured in the output data. We decided to replace the ultrasonic sensor with a new one and rewired it. The new ultrasonic sensor worked perfectly, and the output numbers varied accordingly as we adjusted the triggering distance of the sensor. Overcoming this challenge allowed us to continue to make progression in preparation for the bronze challenge.

Moreover, testing and debugging the hardware prototype was a time-consuming process. Identifying and resolving problems with sensor calibration, signal interference, or mechanical components needed patience and perseverance. Thorough testing of the buggy under different situations was crucial to confirm the reliability and performance of the buggy's hardware.

Our group approached the difficulties with persistence and teamwork, utilising our combined experience and problem-solving talents to overcome them. By making constant improvements, and staying committed to our project objectives, we effectively turned our project into a fully operational buggy.

The process of transforming our project into functional hardware was filled with obstacles such as sensor integration, debugging and hardware constraints. Embracing hurdles as opportunities for growth and learning, we successfully navigated the complexities of hardware development to create a prototype ready for the further challenges.

In conclusion, the Arduino UNO R4 WiFi-based buggy project has successfully demonstrated the integration of modern electronics and programming to enable autonomous navigation and remote-control capabilities. Working on this project was a learning curve and however,with team collaboration, innovation, and determination, we have successfully reached our project objectives for the bronze challenge.