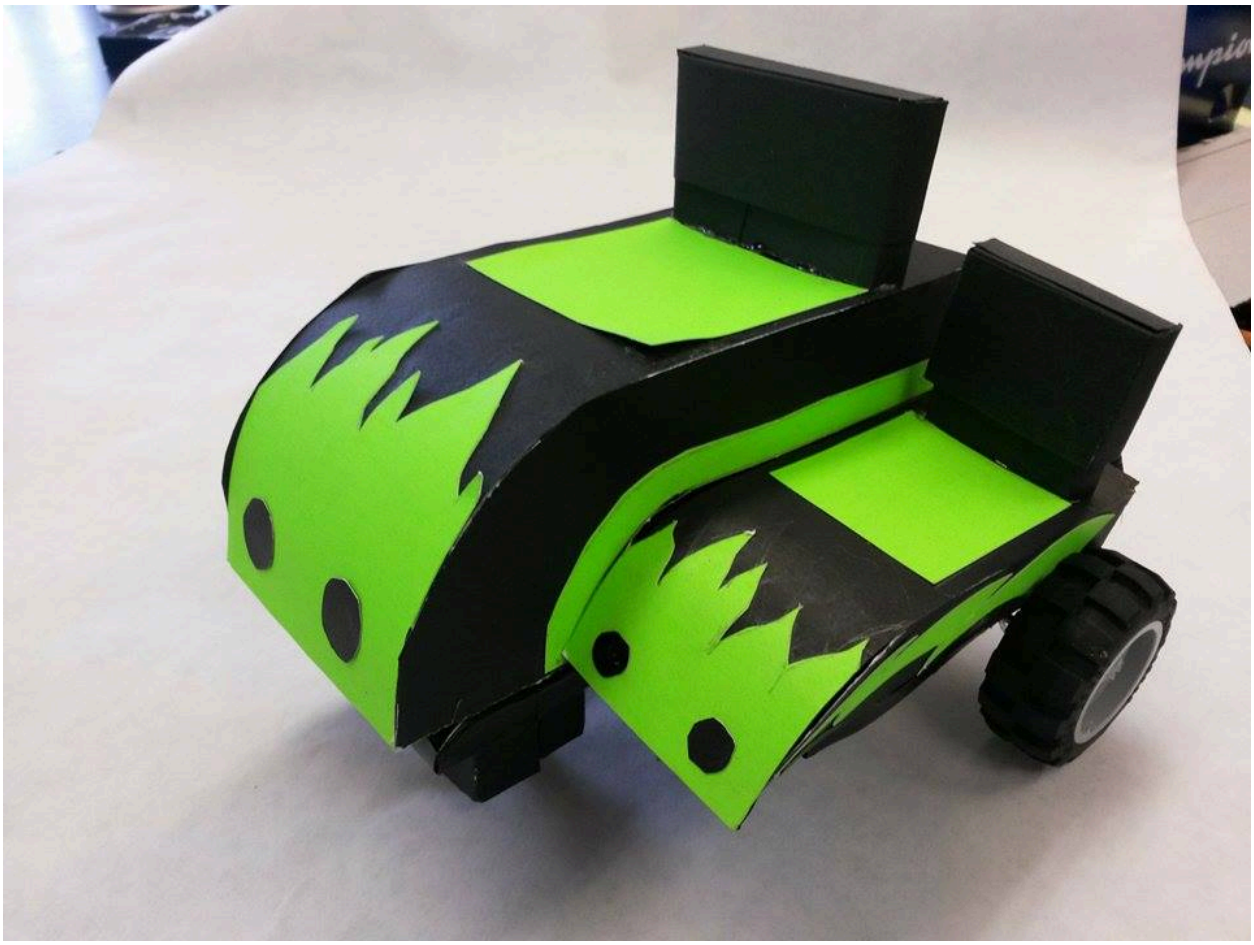
Intelligent iCar

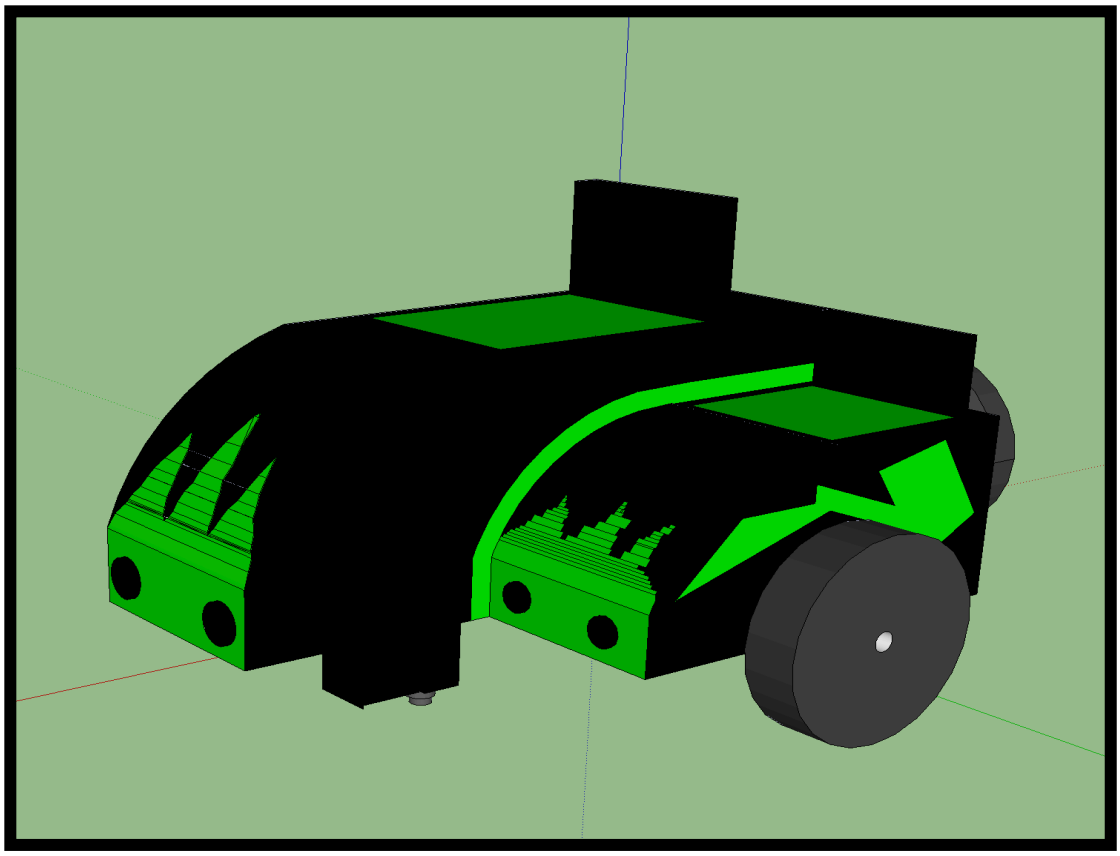


Richard Dang, Horatiu Lazu & Eric Tseng
TEJ 4M3 - Mr Wong
Tuesday, June 9th, 2015

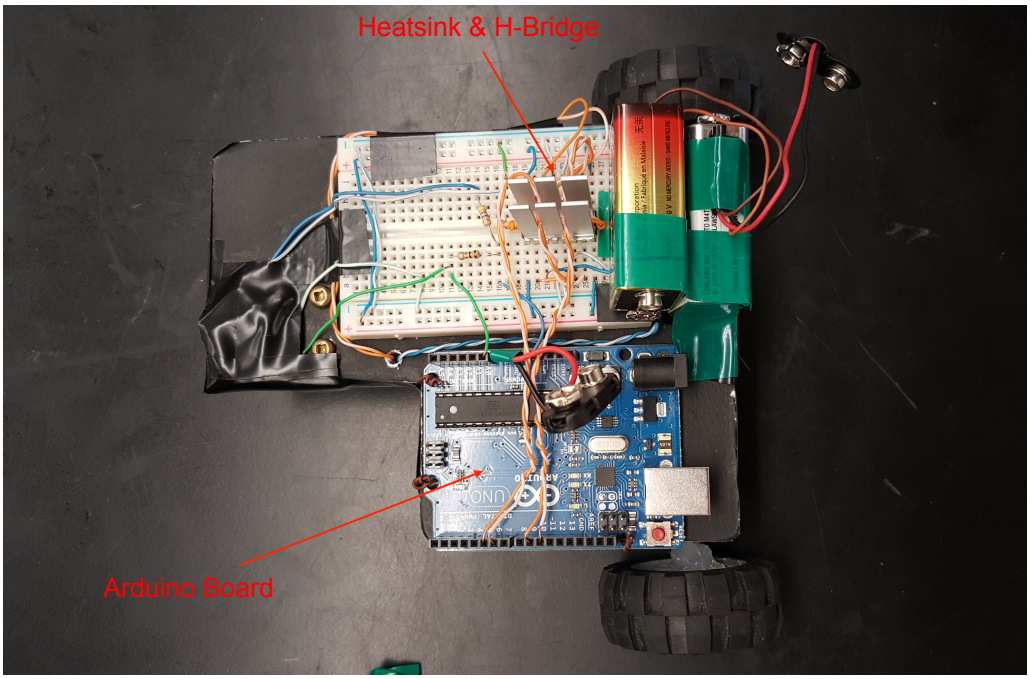
Introduction:

The purpose of this project is for a group of students to build a vehicle (iCar) that will be able to traverse a maze that is composed of black lines on white paper in a timely manner. The vehicle will go through the maze and then return to where it started. For the project we will develop a motorcycle with a sidecar. The vehicle will be constructed with wheels, a gearbox, powered by an Arduino with batteries, and a sensor which will be able to identify if it is on a black or white line. We will create this project to stimulate our critical thinking skills, to learn more and practice our skills in coding, building and using Arduino. Will also practice our skills in management, as this group project is to be completed within a given time limit. The ISP will be created by three students, named Horatiu, Eric, and Richard. The materials used include wood for the platform, bristol board (black & green) for the case, tires (for the wheels), and electrical tape.

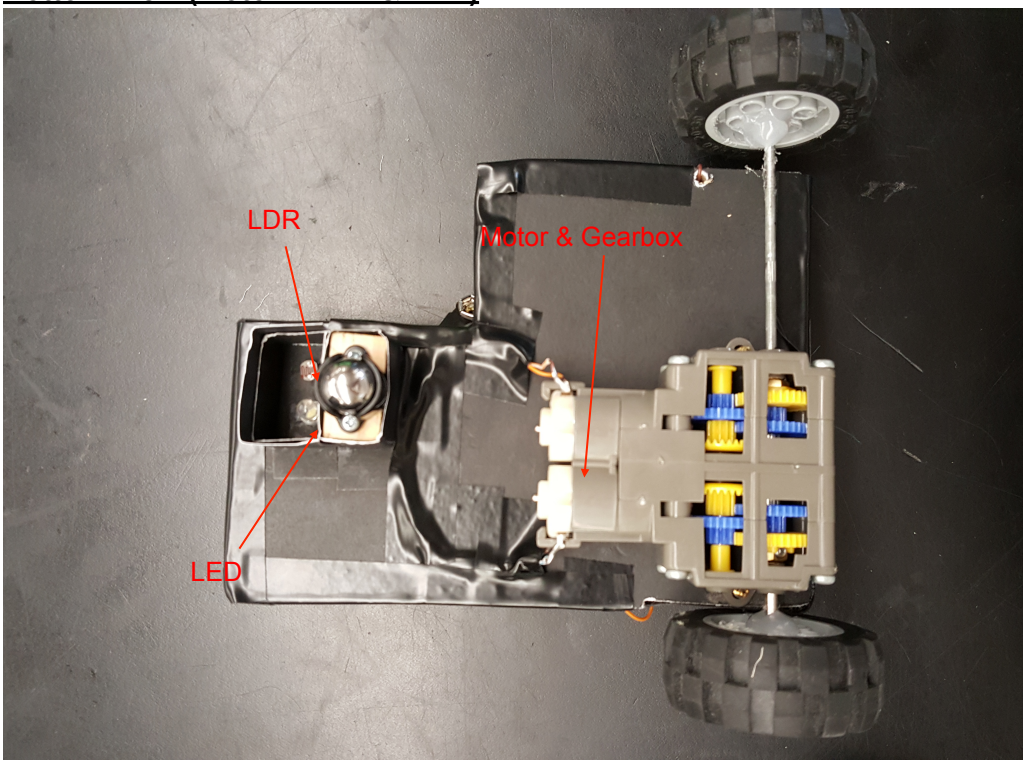
3D View of Car (Google Sketchup)



Internal View (Arduino & Breadboard)



Bottom View (Motor + LED & LDR)



Investigation:

The first step to constructing our vehicle was to plan out our design. Using the 3-D modeling program, Google Sketchup, we designed our vehicle, focusing on originality, the compactness of the car, and feasibility. Keeping these important three factors in mind, we designed a model of our vehicle and, after multiple revisions, were finally ready to proceed onto the next step of the construction.

Now that the model was complete, we began construction by figuring out the logic behind our vehicle, and the necessary wiring/coding to realize it. We began by testing out the LDR and the H-Bridge separately on a breadboard, to ensure basic functionality. After the basic functionality worked on the LDR and H-Bridge, we added a heat-sink to the H-bridge to help dissipate the buildup of heat created by the H-Bridge. We then proceeded to assemble the gearbox, choosing gear ratio “B”, because we found it was the optimal combination of speed and power along with control. Afterward, we constructed the base of the vehicle out of wood and attached the motor to it. We then assembled all of our LDR and H-Bridge wiring onto the final platform and placed the Arduino and breadboard into their appropriate places. The LDR and LED were then placed into a small box to remove the influence of outdoor lighting. Next, we took wheels from a Lego set, and attached the wheels to the motor axels. We had to extend an axle because of the design of the vehicle. We then fastened all of the different components onto the wooden base, which includes Arduino, breadboard, LED, LDR (enclosed in a paper box to ensure proper reading) - along with battery holders. After the H-bridge and the LDR got proper readings, we commenced with coding. In terms of coding the Arduino, we made a basic algorithm of tugging. Our concept was that if the robot is on black it turns left, and if it is on white then it turns right. That way it will always complete the maze in an accurate fashion and only one LDR is required. Our first attempt was a success, and several different tests ensured that all of the variables (regarding speed) and LDR value calibration were set. After the software and hardware were in sync, we focused on building the final casing, which was made for decorative purposes.

Our project has several design features. The primary design feature is a vehicle that is capable of traversing a maze by using an algorithm that hugs a wall. It works on the basis of turning left while it sees black, and turns right when it detects white. Additional features to make the vehicle traverse a maze include the ability to use an LDR to see if the robot is on the path, along with an LED enclosed in a box to emit a white light that permits the LDR to function

(based off of the light absorption properties of white / black surfaces). Another feature includes the H-bridge that allows the robot to reduce turning angles - by allowing the one wheel to move forward while the other moves back. In addition, the H-bridge permits adaptable speeds defined by the programmer to be executed by the motors.

Not many materials were required for our vehicle. For our baseboard, we chose to use a piece of wood that was neither too thick nor too thin, and had an appropriate weight that would not be too much of a burden for the gearbox. Where necessary, we drilled holes so that wires could be threaded through to connect the gearbox to the breadboard. To house all the hardware and wiring, we chose to create the design of our iCar with bristol board, since it gave us a variety of options in terms of colour, is lightweight, and is easy to manipulate. Additionally, we added a heat sink to our H-bridge to ensure that it does not overheat and burn out.

A few changes were applied to optimize and ensure our iCar's functionality. Originally, we had designed to place everything, including the gearbox, on the topside of the baseboard. However, realizing that our wheels would not have enough clearance to afford this, we decided to move the gearbox underneath the baseboard. Furthermore, when we attached the marble wheel as the front wheel, we discovered that the wheel was too low and, as a result, the gearbox would drag along the ground. To fix this, we raised the marble wheel with an additional piece of wood, placed between the wheel and the baseboard. Finally, we hot glued the wheels to the axles upon realizing that the axles were too thin to fit snugly with the wheel, and that the axles would turn without turning the wheels. We also changed the colour scheme of the robot, along with making the seats pop outwards instead of going inwards. We found that if the seats went inwards then we would not have sufficient place for internals. Finally, it is important to also note that we altered our gearbox to have a longer axle on one side for the wheels.

Evaluation:

We found that our project turned out very well. We managed to finish ahead of time on the project, and we found that we were able to distribute the work effectively such that someone always had something to work on. This allowed us to make great progress in all aspects of the project including, circuitry, coding, decorations and the written report. Our hardware worked perfectly, our design was appealing, and our software worked flawlessly which permitted our robot to succeed in all areas of testing.

If we were to do this project a second time, we would put far more effort into making a better plan at the very beginning so that team coordination would be a lot smoother. For example, by deciding on the vehicle's dimensions ahead of time, we could avoid issues such as building a casing that was slightly too big for the vehicle. Furthermore, by having an extensive plan, we would have more time for optimization of the hardware and software, making our vehicle more efficient and better. In addition, we could have taken into consideration the width of the vehicle because the wider design used in this vehicle made it difficult to navigate corners due to the wide turn radius. The final thing that more time could have been spent towards would definitely be the aesthetics of the vehicle. The main focus for us was the overall functionality of the vehicle so not as much time and effort was available for the construction of the covering. Otherwise, we had a terrific time constructing the vehicle and hope that all the requirements were fulfilled to the fullest of our abilities.