Building an Autonomous Car

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Abstract:

In this report, we will be discussing the importance of problem solving and what the process of creating a prototype looks like. The specific problem we were tasked to solve was an issue of sustainability. We must find a way to make cities more sustainable. We must find a way to live a life utilizing renewable resources. We have created a safer, sustainable form of transportation. In this report we will go through the extensive research we conducted about the problem. We will also discuss the criteria that we created for our solution to the problem. Sketching designs before they are created is really important and we have a few iterations on that. We will also go through the program we wrote to have our design complete tasks that are necessary to accomplish the task, which is also the solution.

Introduction:

Many vehicles today have technologies that seem to be doing a lot to make commuting safe. Unfortunately, this is not the case. Car Crashes are the leading cause of death to a healthy United States citizen. According to the National Highway Traffic Safety Administration (NHTSA), over 37,000 people die in road crashes each year; 2.35 million people are injured or have become disabled; Crashes cause the US over 230 billion dollars every year.

Vehicle safety is a huge area of concern. It is sad to say that safety is not the only problematic thing with current vehicle technology. Global warming is the greatest threat to humankind, and combustion engines in everyday vehicles contribute to this matter more than people think. According to the United States Environmental Protection Agency, transportation is responsible for over 50% of NO_x (nitrogen oxides) total emissions inventory in the U.S alone, more than 30% of VOCs (volatile organic compounds) emissions in the U.S, and over 20% of PM (particulate matter) emissions in the U.S. All of these pollutants contribute to very poor air quality for all living, breathing organisms.

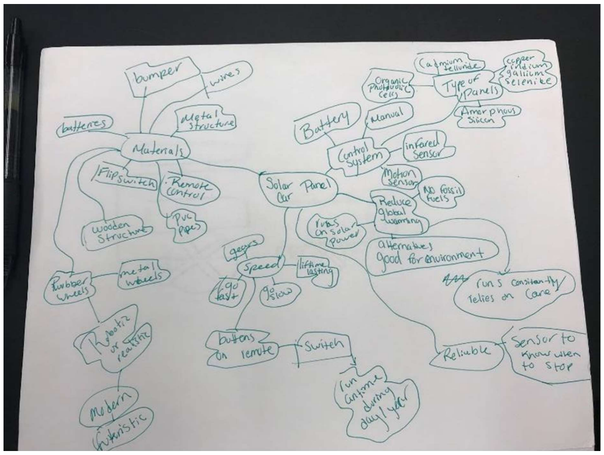
This problem is clearly very important to solve. With this project, we have set out to solve many problems such as safer commuting, less tedious traffic, and, of course, the greatest threat to humans: Global Warming. We believe that by improving the vehicles we drive nowadays can solve many problems, including the ones previously listed.

So what solution have we come up with? We sincerely believe that electric, automated vehicles have the potential of drastically reducing traffic, road accidents and road fatality rates, and pollutants that contribute to Global warming.

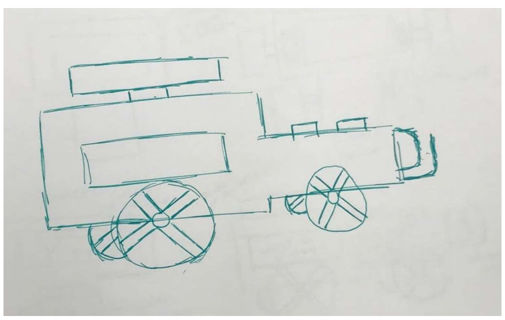
Design:

So how did we create this sustainable, self-driving vehicle independent of fossil fuels? Well, like many products out in the market, it first started off with a design criterion. Our specifications were as follows:

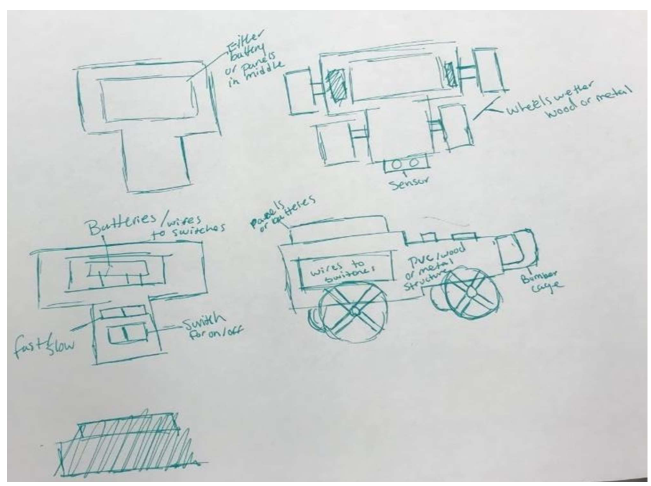
- It must be 100% electric. Not a hybrid. No combustion engine.
- It must be 100% autonomous.
- It must avoid obstacles, and reroute to the next best path.



To begin this development, we had to brainstorm. Anything useful that came to our heads, we wrote it down. We linked all the ideas together and created this web diagram. We made it all relevant.



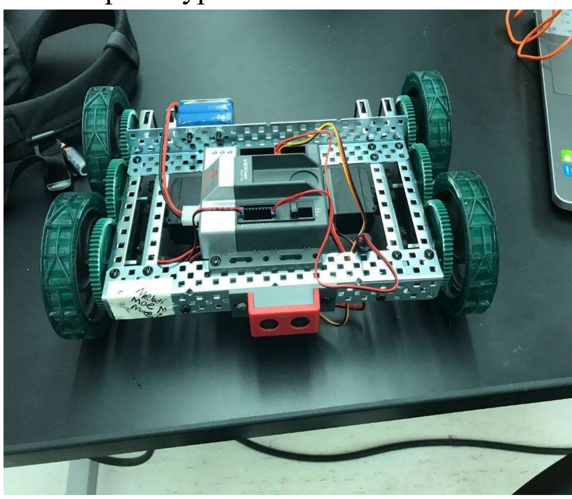
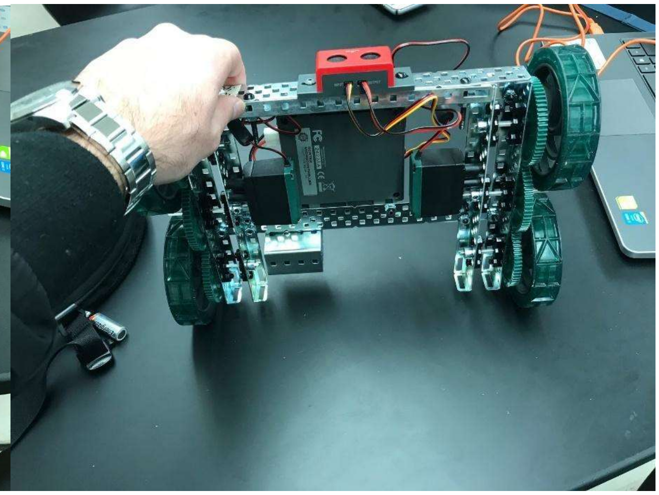
Then we began some sketches based on the web diagram. We eliminated parts that we thought were unnecessary or unrealistic for a prototype.



We were satisfied with our final iteration. It was simple and functional in theory.

Constructing and testing:

After researching the problem, creating a criterion, and sketching our design, we researched the best materials to use that will fulfill the conditions we set. Through many trials and errors, we built our prototype.

The materials we used for this prototype were very simple. We built the chassis out of buildable pieces of metal. We used four wheels. Both sides of the car had an electric motor to spin the gear clockwise and counter-clockwise. This vehicle used a 1:1 gear ratio. For the safety feature, we used an ultrasonic sensor. This sensor is programmed to give the motors directions if it detects an object near its path.

The program we wrote with a brief explanation:

```
#pragma config(Sensor, dgtl1,  range1,          sensorSONAR_cm)
#pragma config(Motor,  port1,           rightMotor,    tmotorVex393_HBridge, openLoop)
#pragma config(Motor,  port10,          leftMotor,     tmotorVex393_HBridge, openLoop)
//*!!Code automatically generated by 'ROBOTC' configuration wizard              !!*//

/*----------------------------------------------------------------------------------------------------*\
|*                              - Forward until Close Proximity -                                     *|
|*                                   ROBOTC on VEX 2.0 CORTEX                                         *|
|*                                                                 *|
|*  This program instructs the robot to drive forward at half speed until the Ultrasonic
Sensor       *|
|*  detects an obstruction within 20 inches of it.                                    *|
|*  There is a two second pause at the beginning of the program.                                *|
|*                                                                 *|
|*                                   ROBOT CONFIGURATION                                        *|
|*    NOTES:                                                            *|
```

```
|*    1)  Reversing 'rightMotor' (port 2) in the "Motors and Sensors Setup" is needed with
the        *|
|*        "Squarebot" mode, but may not be needed for all robot configurations.                          *|
|*    2)  The Ultrasonic Sensor returns a value of '-1' when it is out of range from the nearest      *|
|*        object.  The range is from 0 to 255 inches, so make sure that the robot is within this      *|
|*        range or it may never run.                                                             *|
|*                                                                                        *|
|*    MOTORS & SENSORS:                                                                       *|
|*    [I/O Port]          [Name]              [Type]                [Description]                   *|
|*    Motor   - Port 2    rightMotor          VEX 3-wire module     Right side motor                  *|
|*    Motor   - Port 3    leftMotor           VEX 3-wire module     Left side motor                  *|
|*    Digital - Port 9,10 sonarSensor         VEX Sonar Sensor      Front mounted, facing
forward     *|
\*---------------------------------------------------------------------------------------------4246-*/


//++++++++++++++++++++++++++++++++++++++++MAIN+++++++++++++++++++++++++++++
++++++++++++++++++
task main()
{
 while(0==0)
  {
motor[rightMotor] = 63;   // Motor on port2 is run at half (63) power forward
  motor[leftMotor]  = 63;
 if(SensorValue(range1) < 15 && SensorValue(range1) >0)  // Loop while robot's Ultrasonic
sensor is further than 20 inches away from an object
  {                                                         // || (or) it is '-1'.  (-1 is the value returned when
nothing is in its visible range)
  motor[rightMotor] = -63;   // Motor on port2 is run at half (63) power forward
  motor[leftMotor]  = -63;   // Motor on port3 is run at half (63) power forward
 wait1Msec(1500);
 motor[rightMotor] = 0;   // Motor on port2 is run at half (63) power forward
  motor[leftMotor]  = -63;   // Motor on port3 is run at half (63) power forward
 wait1Msec(1000);
   }
}
}
//+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
+++++++
```

Conclusion

Autonomous electric cars are a viable solution for a sustainable future. It is a sustainable future independent of fossil fuels. Object avoidance and rerouting is just one of many tasks we see in the future of transportation. It will solve many problems. More the ones listed in this report. Future technologies in full sized automobiles will hopefully be a lot more advanced. We recommend that big corporations subscribe to this idea of the future for it is cleaner, safer, and all around a cause for a greater humanity.

Works Cited

http://asirt.org/initiatives/informing-road-users/road-safety-facts/road-crash-statistics

https://www.epa.gov/air-pollution-transportation/smog-soot-and-local-air-pollution