Outreach Paper for
Team *Save It, Build It, Run It*

Team Members

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Today, many people still wonder what currently lurks in our solar system and whether other planetary bodies could possibly support life. Space Exploration has always been something that has inspired countless amounts of fellow men and women to pursue a career in which they can contribute to science. In order to explore the vast bodies of space, we need the technology to build robotic space probes to gather information and data. In order to inspire people to pursue a career in making algorithms for artificially intelligent robots, the National Aeronautics and Space Administration has a competition called the NASA Swarmathon in which various colleges across the United States have the chance to compete in a competition in which students program either physical or virtual Mars Rovers to find resources and return them to a central location.

Montgomery College is a Community College located in Montgomery County Maryland which has a large enrolment of students, many of whom are currently pursuing a career in the STEM field. The NASA Swarmathon competition is a great way for people in the STEM field to get an experience programming robots and working with artificial intelligence. Our Swarmathon team “Save It, Build It, Run It” includes twelve students from Montgomery College who are all pursuing degrees in various STEM fields, particularly Computer Science, Engineering and Math. We were all determined to do our best and come up with the most efficient algorithm possible while also developing a great outreach plan.

Introduction and Purpose: As first time competitors of the NASA Swarmathon virtual competition our team decided that we would go all out for our outreach project and build a robot from scratch using the Arduino circuit board as the base and the Arduino IDE to program it. We will present our robot to a class of high school students since they are on the verge of going to college. We decided that building a robot would be a great idea because it would expose the students to both hardware and software in a cool way that could potentially inspire them to major in engineering or computer science when they go to college.

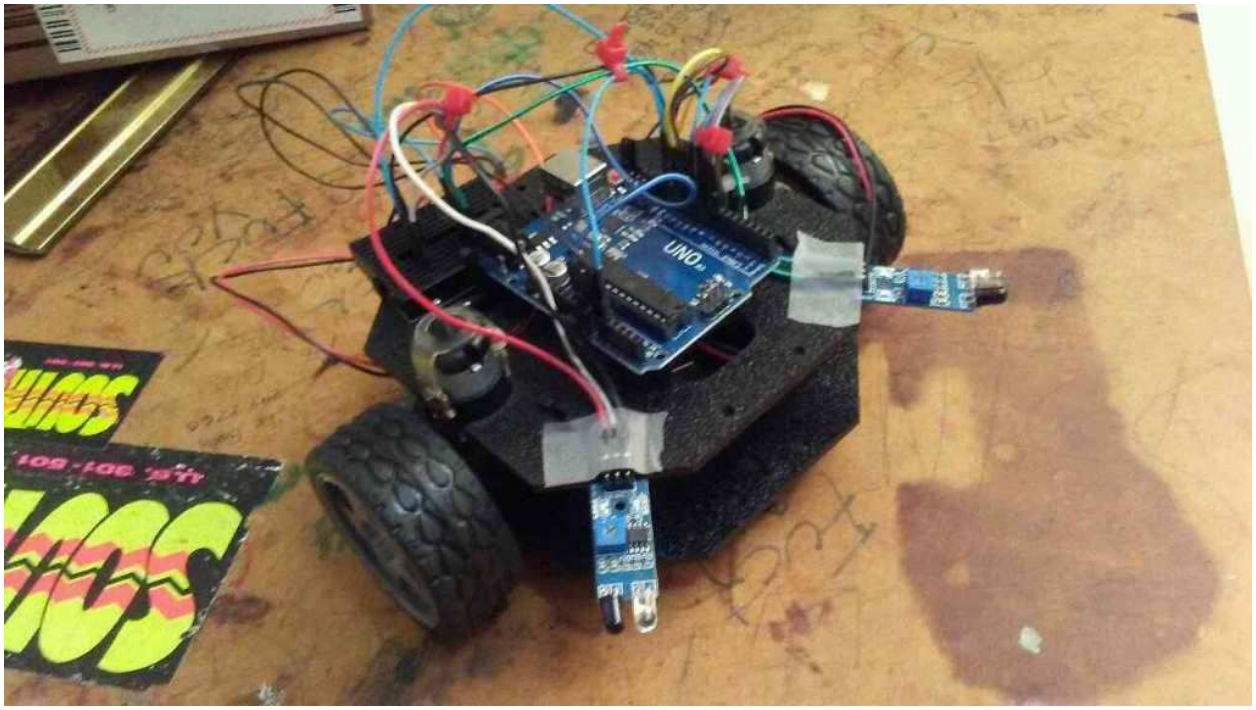
Design Process: Our outreach team decided to build our own rover that is capable of achieving two objectives, The first is being able to avoid obstacles using two infrared obstacle avoidance sensors attached diagonally on the front of each side of the robot. This is accomplished by programming the robot to turn 40 degrees the opposite direction when an obstacle is detected. As our base circuit board we decided to use Arduino since it is cheap open source hardware. here is the code used to program the Infrared obstacle avoidance sensors using Arduino`s free IDE.

```
/*************************************************
NASA Swarmathon Outreach Project Obstacel avoidence robot.
*************************************************/
const int ledPin = 1; //This number is irrelevant we can give this variable a value of anything.
void setup()
{
  Serial.begin(9600);
  pinMode(A0, INPUT);
  pinMode(A1, INPUT);

  //Right Motor setup.
  pinMode(7, OUTPUT);
  pinMode(8, OUTPUT);
  pinMode(9, OUTPUT);

  //Let Motor setup.
  pinMode(10, OUTPUT);
  pinMode(11, OUTPUT);
  pinMode(12, OUTPUT);
}


void loop()
{
  moveForward();
 if (analogRead(A0) < 500) // Sensor finds obstacle
  {
  Serial.println("TURN");
  turnRight();
  }


else if (analogRead(A1) < 500) // Sensor finds obstacle
{
  Serial.println("TURN");
  turnLeft();
}

delay(100);
}

 void moveForward(){
  //Move left motor forward.
  digitalWrite(8, HIGH);
  digitalWrite(7, LOW);
  analogWrite(9,80);

  //Move right motor forward.
  digitalWrite(11, HIGH);
  digitalWrite(12, LOW);
  analogWrite(10,80);
 }

 void moveBackward(){
  //Move left motor backward.
  digitalWrite(8, LOW);
  digitalWrite(7, HIGH);
  analogWrite(9,80);

  //Move right motor backward.
  digitalWrite(11, LOW);
  digitalWrite(12, HIGH);
  analogWrite(10,80);
 }
```

```
void turnRight(){
  //Move left motor forward.
 digitalWrite(8, HIGH);
 digitalWrite(7, LOW);
 analogWrite(9,80);

 //Move right motor backwards.
 digitalWrite(11, LOW);
 digitalWrite(12, HIGH);
 analogWrite(10,80);
}

void turnLeft(){
  //Move left motor forward.
 digitalWrite(8, LOW);
 digitalWrite(7, HIGH);
 analogWrite(9,80);

 //Move right motor backwards.
 digitalWrite(11, HIGH);
 digitalWrite(12, LOW);
 analogWrite(10,80);
}

void stopMoving(){
 analogWrite(9,0);
 analogWrite(10,0);
 delay(100);
}
```

The robot`s second objective is to pick up bright red objects with a maximum diameter of 4 inches using a color sensor attached to the front of it. When the sensor detects an object with this color it will use a claw powered by a servo mounted on the top to grab it just like the real swarmies. The arm was designed in a Creo, a 3D modeling software; then printed using a 3D printer provided by the Engineering Department at Montgomery College. We tried to make the rover similar to the swarmies used by NASA in the competition with the addition of a few variations. The rover is mounted on two wheels, and is balanced by two anchors attached to the bottom. To keep costs down we decided to order the parts for the robot through the school. Although this was a more realistic approach for our limited financial pool, it did have its own price of slowing our design, building, and implementation effort by two weeks (one week delay for it to be approved by the engineering department and another week for shipping during spring break).

Presentation: We intend to take the robot to Walter Johnson High school and present it to the robotics club, by demonstrating the robot's functions and capabilities in a small arena. The robot will have to maneuver around various obstacles and detect bright red objects for pickup. We also intend on discussing how NASA is trying to develop miniature robots like the Swarmies to help further explore Mars and possibly gather resources in order to assist any future manned missions to the surface of the red planet. In addition to this, we will discuss our process in programming the Swarmathon competition, the Swarmies search algorithms, and give some insight into basic programming. We hope that this may be able to inspire the students to pursue a career in Computer Science and Engineering as well as boost their interest in opportunities with NASA.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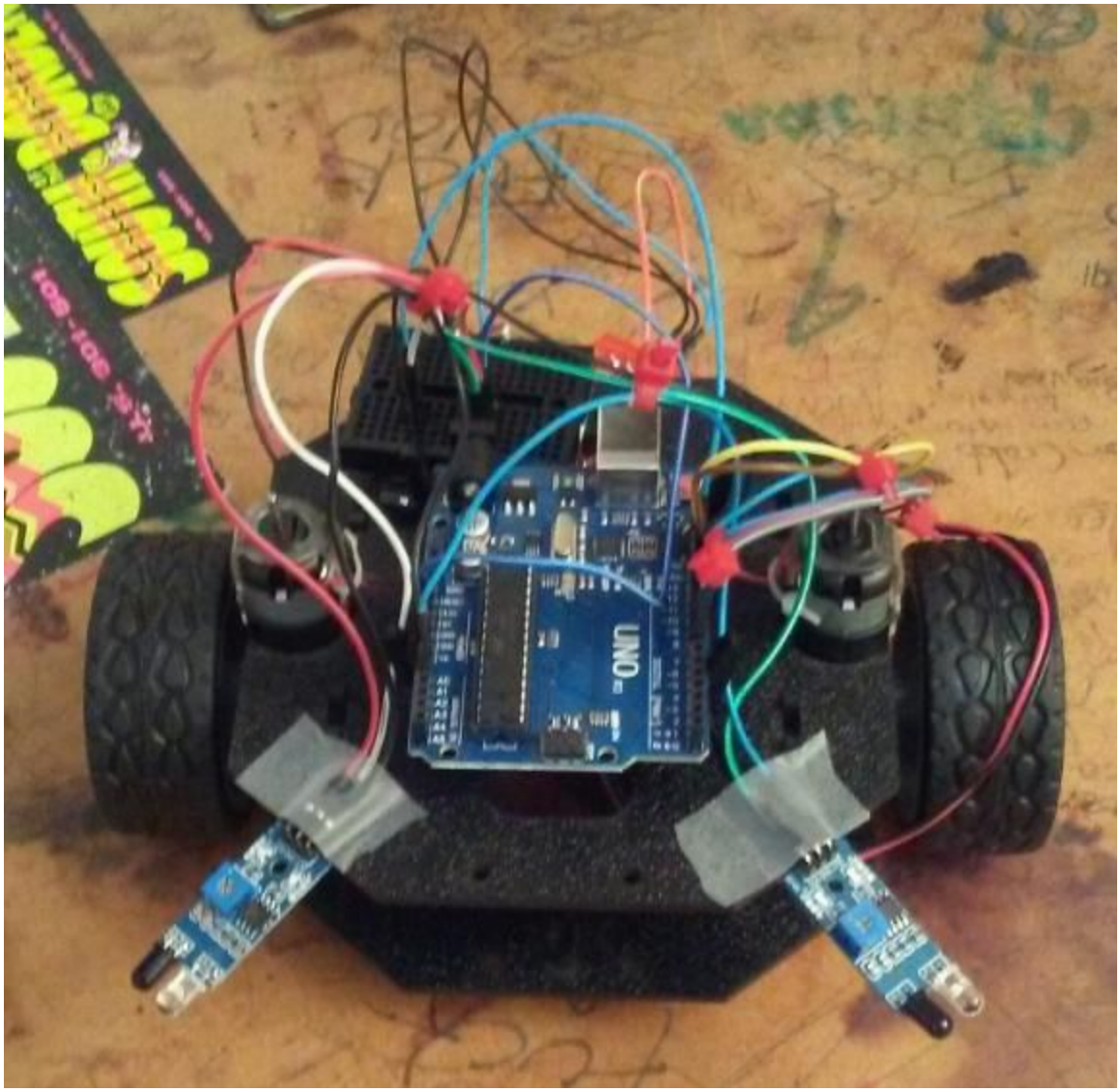
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