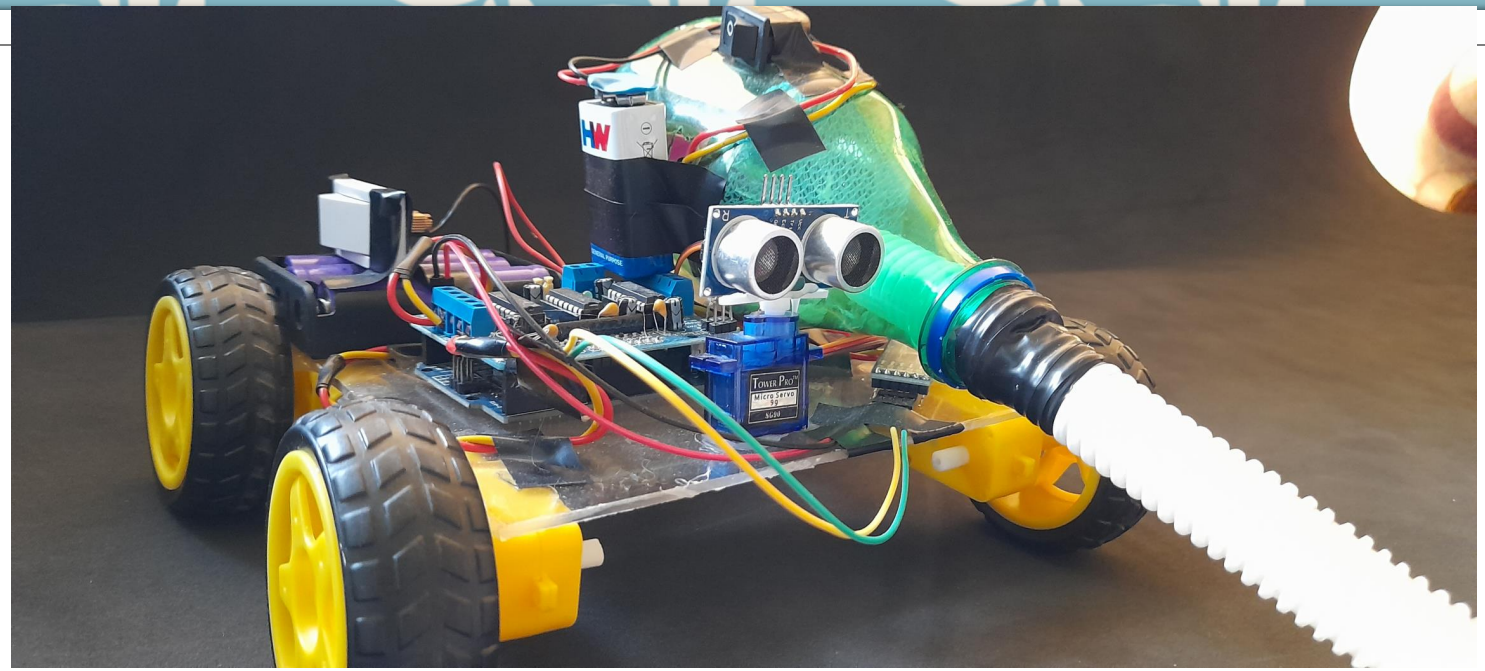

AUTOMATED VACUUM CLEANER

BY TEAM 22

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Abstract and Motivation

- In daily life, aspects of a clean house is very important to every individual among the community. Nowadays, some of individuals think that is difficult for them to make sure their house is always in clean conditions. This is because, they are too busy in their daily routine and do not have time to clean their house. Besides that, most of them also consider that all the cleaning jobs will take a long time and use a lot of energy. All this can be changed using ‘ Automated Vacuum Cleaner’. With the creation of this project, cleaning job becomes more easier compared to before. We do have some vacuum cleaners available in the market, but they are very expensive averaging from 15-30k which an average household cannot afford. Also, despite being so expensive these devices are not fully automated i.e., they still need a lot of manual effort for them to function. To tackle and resolve this problem our group has produced an automated vacuum cleaner. Our Automated Vacuum Cleaner is designed to make cleaning process easier and cheaper. The main objective of this project is to design and implement an automated vacuum cleaner by using Arduino Uno, Motor Shield, Gear Motors, Ultrasonic Sensor, a plastic bottle, and a HC-05 Bluetooth Module and to achieve the goal of this project the whole circuit powered by a 11.1V lithium battery. This vacuum cleaner will have several criteria that are user-friendly.

Proof of Concept

After brainstorming and designing a few concepts and ideas, a concept, suitable for the stated mission, the chosen target group and which can encounter these problems, was found. Our Automated Vacuum Cleaner(AVC) is the idea resulting from the research carried by our team. The AVC is entirely remote sensing device which requires no manual effort but to use your phone. The AVC works via Bluetooth and is controlled on your phone via Bluetooth RC Controller. The fan installed inside the AVC is run by a 6V motor which with the help of a suction pipe installed at the opening of the bottle neck help suck in all the dust and dirt particles present on ground efficiently. The device can navigate into the tightest and narrowest of spaces which make it a great cleaning tool. The dirt collected can also be removed from the bottle easily by just emptying the bottle via both its back and frontside which allows our device to have a smaller dustbin inside, and therefore have more available space for a stronger battery and motor. With a larger, more sufficient motor, the vacuum power will improve.

A larger battery will ensure the power for the larger motor. The overall development of the AVC has been done to make it more user-friendly as it only requires a phone to be able to control it. Having a vacuum cleaner which is automated and controlled by one's phone is something which is unheard of until now and that is why we see immense potential in the AVC. Last is the marketing aspect of the new product. In the marketing decisions we focused on two main aspects: The user-friendly nature of our product and the cleaning performance. To focus on these two aspects, people can be convinced that the product is different and better than products from competitors. The first year a push strategy will be used to convince the customers and stores to buy the product. After the first year, the people will be familiar with the product and the strategy will be switched to a pull strategy.

Methodology Adopted

We focused on designing a proof-of-concept for an automatic vacuum cleaner. The methodologies followed in conducting this thesis are listed below

1. Defining objective – The first step for the initiation of any project or research is defining its objective. The topic Automatic Vacuum Cleaner" involves a vast set of concepts, tools, theories, methods, and problems. It can be narrowed down only based on the project requirements. The idea of vacuum cleaner is good but an automated one was something we sought to build . This motivated to design a proof of concept to an automated vacuum cleaner. Hence, the idea of collaborative implementation of automated vacuum cleaner was generated.

2. Background study – The background study concentrated on reviewing and comparing the existing key technologies and recent developments related to the topic. A lot of books, journal articles, conference proceedings, product reports, and pre-existing material related to the topic was reviewed. The customer feedback on existing market products was extensively studied to understand the drawbacks of the present cleaning technology and methods.

- 3. Development of a proof of concept – basic calculation for the AVC was done with the help of research material made by research scholars of different reputed colleges around the world and some YouTube videos. Our professors had a big role in this as they helped us with their experience by presenting various suggestions to further strengthen our proof of concept which led us to build a fully functioning cleaner.
- 4. Navigation techniques – The biggest difficulty we faced was that of the navigation of the AVC. To have an automated one we needed it to move in a way that it senses various obstacles and can move swiftly without breakdowns. For that we later used an HC-05 Bluetooth Module and an Ultrasonic sensor which solved the problem.
- 5. Efficiency of the Air Sucker – Once we had made the vehicle on which our vacuum cleaner was about to be mounted it was time for us to think about the suction and efficiency of the vacuum cleaner itself. To be able to do that we used a plastic bottle of appropriate area and volume. We were using a 6V motor to power the fan inside the vacuum cleaner and in order to make the pressure gradient enough for being able to suck in dirt we had to follow the Bernoulli's equation and reduce the bottle area so that we can increase the air flow velocity.

- 6. Testing – After the model of the AVC was ready, we needed to test the efficiency and its ability to do the desired work. We carried out various tests of our device over various surfaces, over an incline and at different places. The AVC quite amazingly did very well in all the tests which led is to our conclusion of it being a successful machine.

Important Observations

When we started this project there was a lot to do and a lot to notice and observe. The different observation were made at 3 stages.

- Stage 1:This was the Week 1-2. At this stage we were collecting ideas and information regarding the project and its feasibility. While doing that we made observations about the ability of our AVC that how will it navigate and how it will be able to generate enough suction and its utility i.e. how it will be used by people and how it might help them in different ways. Observations on the already existing vacuum cleaners were made and how ours will be different to the pre-existing ones was also figured out.
- Stage 2: This was between Week 3-4. When the parts arrived, we were then busy looking into different elements of our device like the Arduino, the motor shied, the gear motor etc. We had to observe each part carefully and understand its function. The most stand out observation while doing this was the compatibility of Arduino UNO with many other devices and how it can be used to create so many different machines

With the help of Arduino, we were able to create our vehicle setup first using an acrylic sheet as the base and then mounting the Arduino and motor shied on it. Then we were looking forward to setting up an ultrasonic sensor using the servo motor. The ultrasonic sensor helped us in avoiding obstacles. The efficiency of the Ultrasonic Sensor is also a fascinating. And then we worked on the HC 05 Bluetooth Module and the Bluetooth RC Controller.

- Stage 3: The most important observations come once we finished our product. This was the last week of our project. Right after the HC 05 Bluetooth Module was delivered, we were able to write its code on and upload it on the Arduino IDE. After this, the device was fully functional and we were able to run it. The AVC is such that it is very user - friendly and anyone with almost no experience in technology and stuff will be able to run it as without any effort. The efficiency of the vacuum cleaner is also great as it can suck in almost all dirt particles and paper scraps that are put in front of it. These very things make our AVC not only compatible in the domestic households but also in schools and hospitals where there is a lot of waste being thrown carelessly.

Conclusions and Future Scope

- After all the work which was done it is confident to say that this Automated Vacuum Cleaner gives a lot benefits not to just us , but also to the environment in general . Plus , with the convenience and user-friendly nature that the AVC offers to the people , it helps immensely especially in process of cleaning in the house be it on any sort of surface. We believe that our project has immense potential for the future. We can hopefully make more upgradations to the AVC such as adding more Ultrasonic sensors enabling it to detect obstacles from all sides and thus making it multi directional. We also look to increase the storage tank and the size of the entire model such that it can be used at a large scale. All the upgrades and improvements will be made so that this project could give more benefits and advantages . Hence, hope that this project could expand even more throughout all the upcoming generations.

Credits and Responsibilities

Every team member has been instrumental and crucial to the overall success of the project and every member did fulfill their role well.

1. KAISAR IMTYAZ: He has been instrumental in the project. He is responsible for preparing weekly ppts and the final presentation, report writing and has also played a key role in code development of our project.

2. HARSH SHARMA and AJAY KUMAR: They have been extremely pivotal for the project. They were assigned with the task of assembling the hardware and then going on to do all the hardware work and completing the project. Both members hail from the same place and both were essential for our project. Ajay Kumar also deserves the credit for his immense contribution in the software and code development of our project. Harsh has also simultaneously done the video editing.

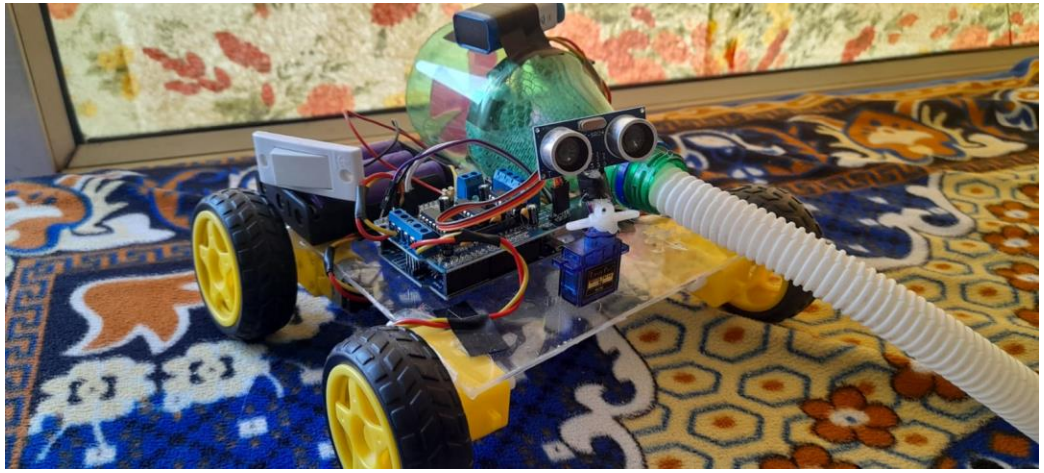
3. SUMAT MIDYA CHOWDHRUI: Sumat also has been key in our group project as without his expertise and sources in research we would not have been able to finish the project. He was responsible for going through various articles published on the given topic and collecting material available on the internet. He has also helped in the circuit designing.

References

- We have took the help of various research papers present on the internet and some videos available on the You Tube the links of which are shared below.
- 1. https://www.ijert.org/research/arduino-based-cleaner-robot-IJERTCONV5IS01145.pdf
- 2. https://www.researchgate.net/publication/328948615_Development_of_a_vacuum_cleaner_robot
- 3. https://ekosuunnittelu.info/wp-content/uploads/2019/05/Vacuum-cleaner-review_Draft-final-report-_Nov-2018.pdf

https://www.youtube.com/watch?v=bMZ2VfOfehU

HERE IS OUR VIDEO



APPENDIX 1: CODE DEVELOPED FOR THE PROJECT

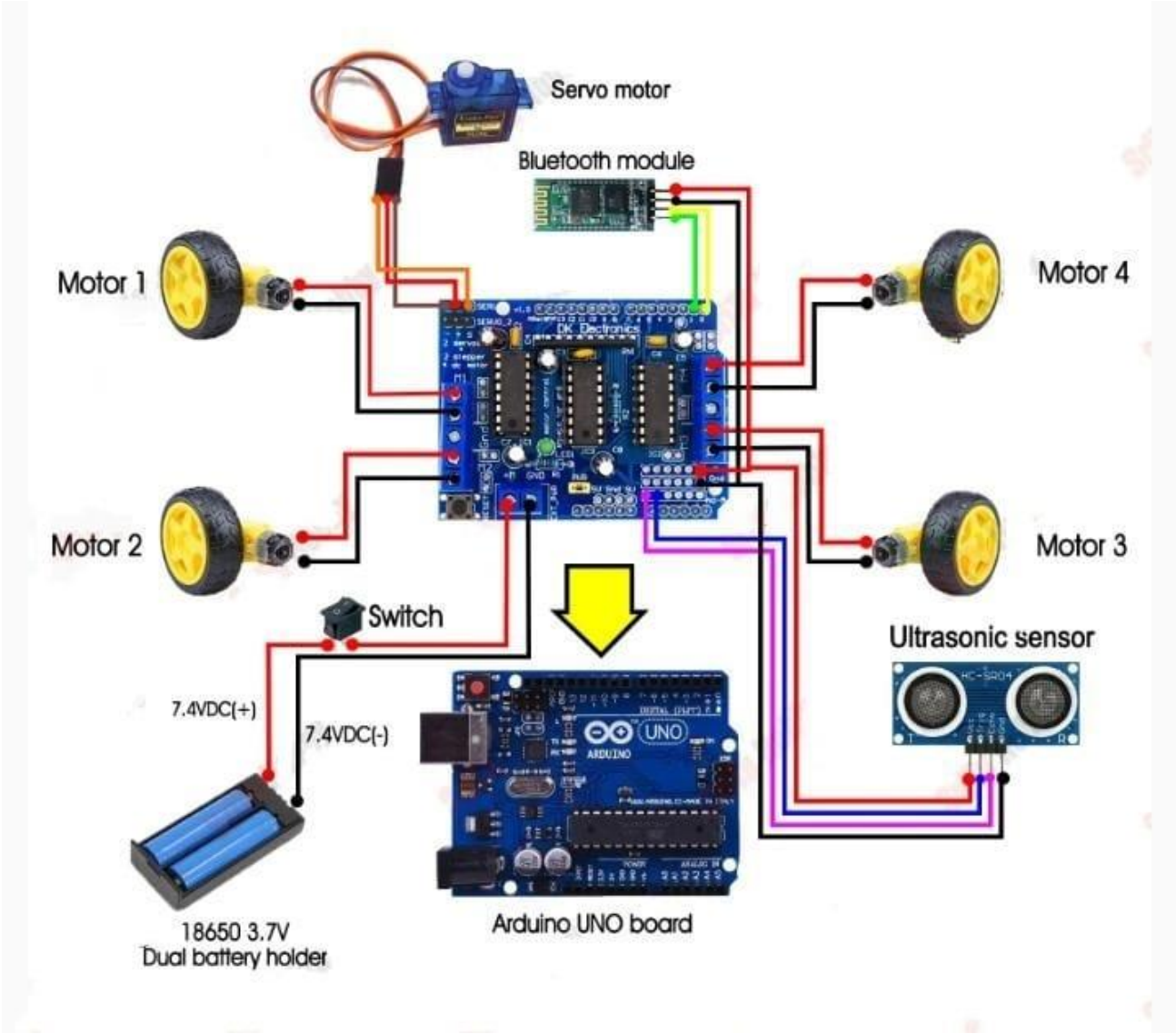
```
#include <Servo.h>
#include <AFMotor.h>

#define Echo A0
#define Trig A1
#define motor 10
#define Speed 170
#define spoint 103

char value;
int distance;
int Left;
int Right;
int L = 0;
int R = 0;
int L1 = 0;
int R1 = 0;

Servo servo;
AF_DCMotor M1(1);
AF_DCMotor M2(2);
AF_DCMotor M3(3);
AF_DCMotor M4(4);

void setup() {
  Serial.begin(9600);
  pinMode(Trig, OUTPUT);
  pinMode(Echo, INPUT);
  servo.attach(motor);
  M1.setSpeed(Speed);
  M2.setSpeed(Speed);
  M3.setSpeed(Speed);
  M4.setSpeed(Speed);
}
void loop() {
  //Obstacle();
  Bluetoothcontrol();
  //voicecontrol();
}

void Bluetoothcontrol() {
  if (Serial.available() > 0) {
    value = Serial.read();
    Serial.println(value);
  }
  if (value == 'F') {
    forward();
  } else if (value == 'B') {
    backward();
  } else if (value == 'L') {
    left();
  } else if (value == 'R') {
    right();
  } else if (value == 'S') {
    Stop();
  }
}

void Obstacle() {
  distance = ultrasonic();
  if (distance <= 12) {
    Stop();
    backward();
    delay(100);
    Stop();
    L = leftsee();
    servo.write(spoint);
    delay(800);
    R = rightsee();
    servo.write(spoint);
    if (L < R) {
      right();
      delay(500);
      Stop();
      delay(200);
    } else if (L > R) {
      left();
      delay(500);
      Stop();
      delay(200);
    }
  } else {
    forward();
  }

}

void voicecontrol() {
  if (Serial.available() > 0) {
    value = Serial.read();
    Serial.println(value);
    if (value == '^') {
      forward();
    } else if (value == '-') {
      backward();
    } else if (value == '<') {
      L = leftsee();
      servo.write(spoint);
      if (L >= 10 ) {
        left();
        delay(500);
        Stop();
      } else if (L < 10) {
        Stop();
      }
    } else if (value == '>') {
      R = rightsee();
      servo.write(spoint);
```

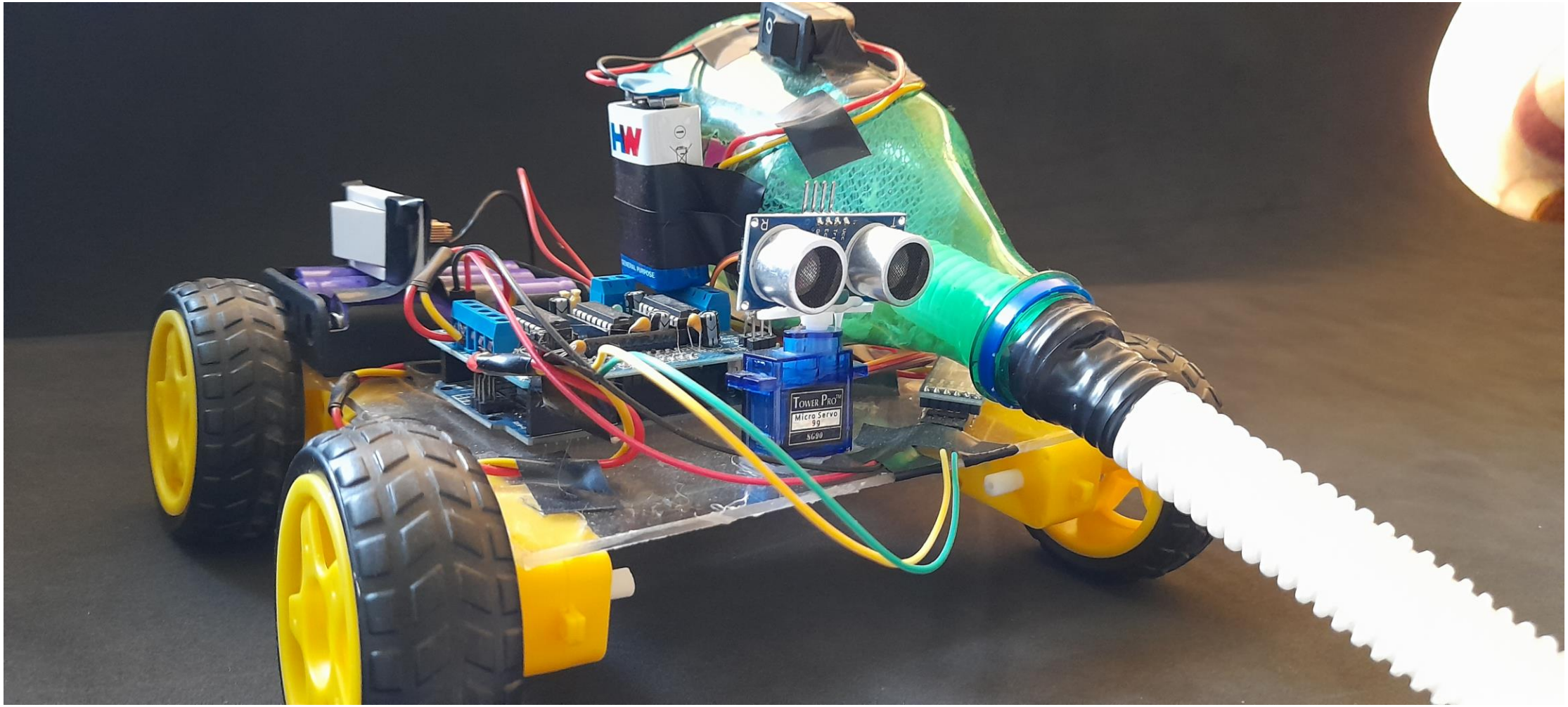
```
      if (R >= 10 ) {
        right();
        delay(500);
        Stop();
      } else if (R < 10) {
        Stop();
      }
    } else if (value == '*') {
      Stop();
    }
  }
}

int ultrasonic() {
  digitalWrite(Trig, LOW);
  delayMicroseconds(4);
  digitalWrite(Trig, HIGH);
  delayMicroseconds(10);
  digitalWrite(Trig, LOW);
  long t = pulseIn(Echo, HIGH);
  long cm = t / 29 / 2; //time convert distance
  return cm;
}

void forward() {
  M1.run(FORWARD);
  M2.run(FORWARD);
  M3.run(FORWARD);
  M4.run(FORWARD);
}
void backward() {
  M1.run(BACKWARD);
  M2.run(BACKWARD);
  M3.run(BACKWARD);
  M4.run(BACKWARD);
}
void right() {
  M1.run(BACKWARD);
  M2.run(BACKWARD);
  M3.run(FORWARD);
  M4.run(FORWARD);
}
void left() {
  M1.run(FORWARD);
  M2.run(FORWARD);
  M3.run(BACKWARD);
  M4.run(BACKWARD);
}
void Stop() {
  M1.run(RELEASE);
  M2.run(RELEASE);
  M3.run(RELEASE);
  M4.run(RELEASE);
}
```

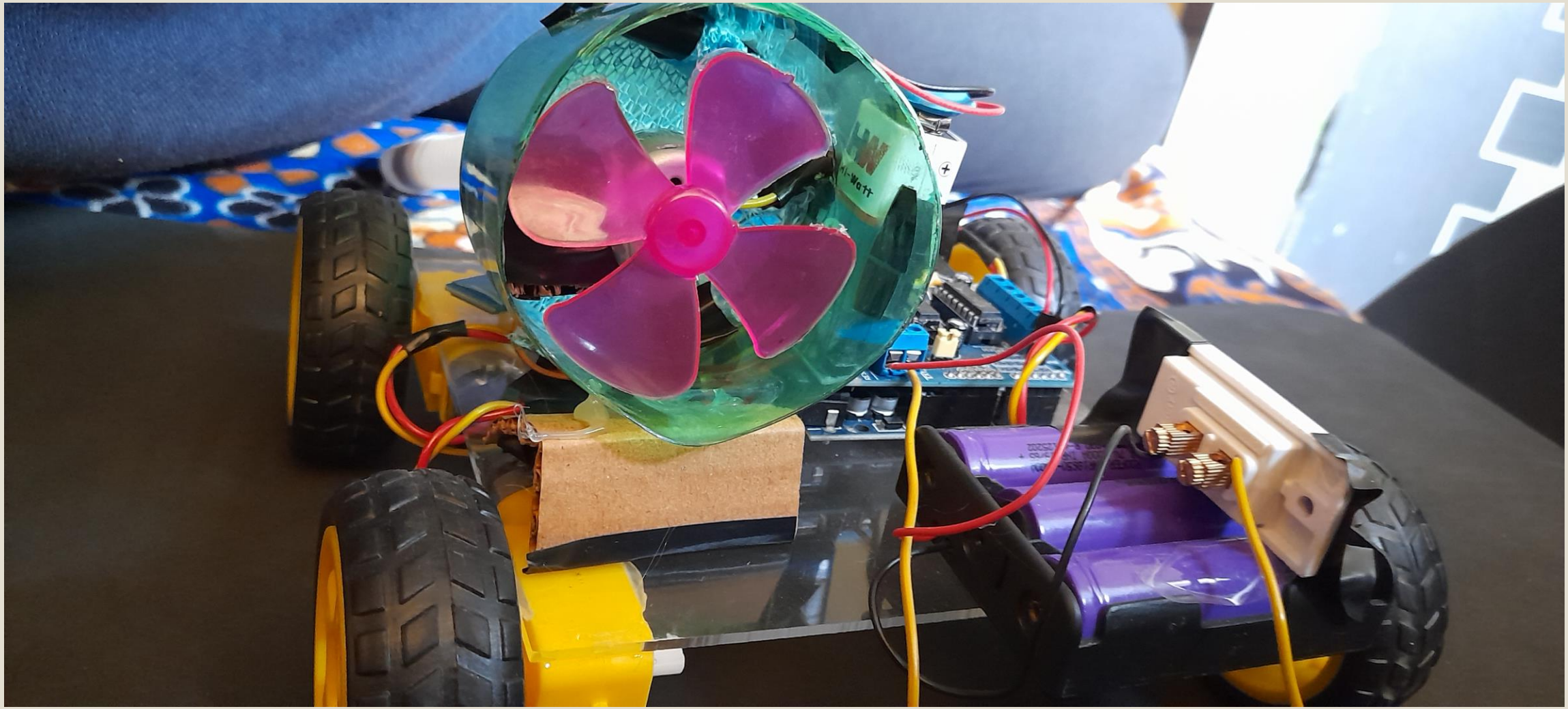
```
int rightsee() {
  servo.write(20);
  delay(800);
  Left = ultrasonic();
  return Left;
}

int leftsee() {
  servo.write(180);
  delay(800);
  Right = ultrasonic();
  return Right;
}
```

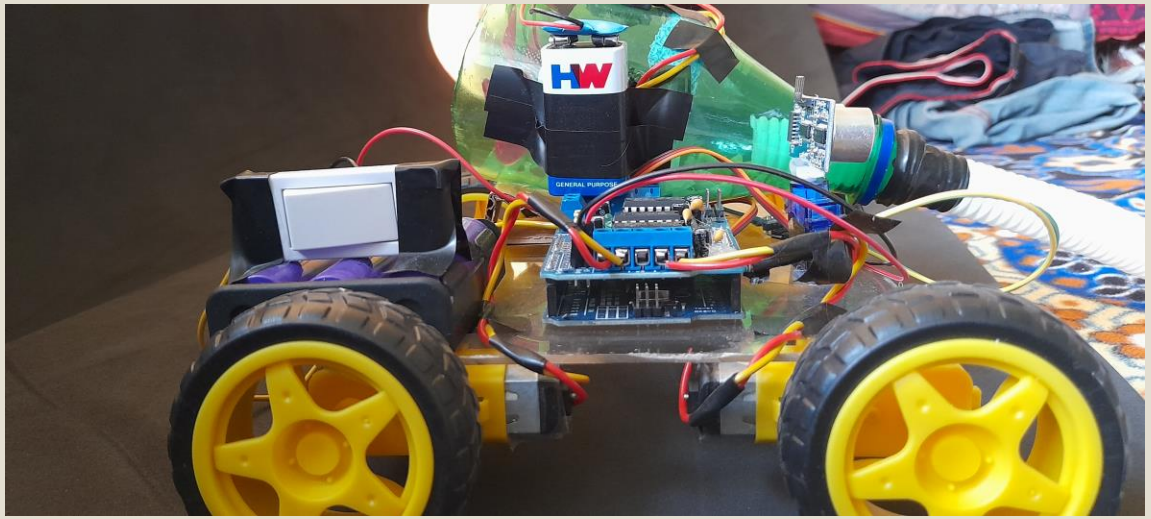
Appendix 2: Photos and Diagrams

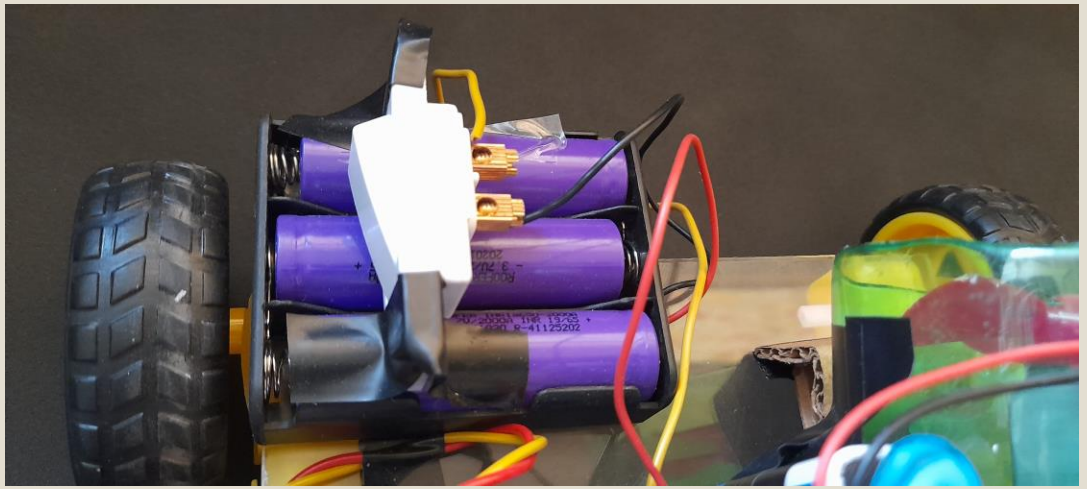
This is the schematic diagram of our circuit.

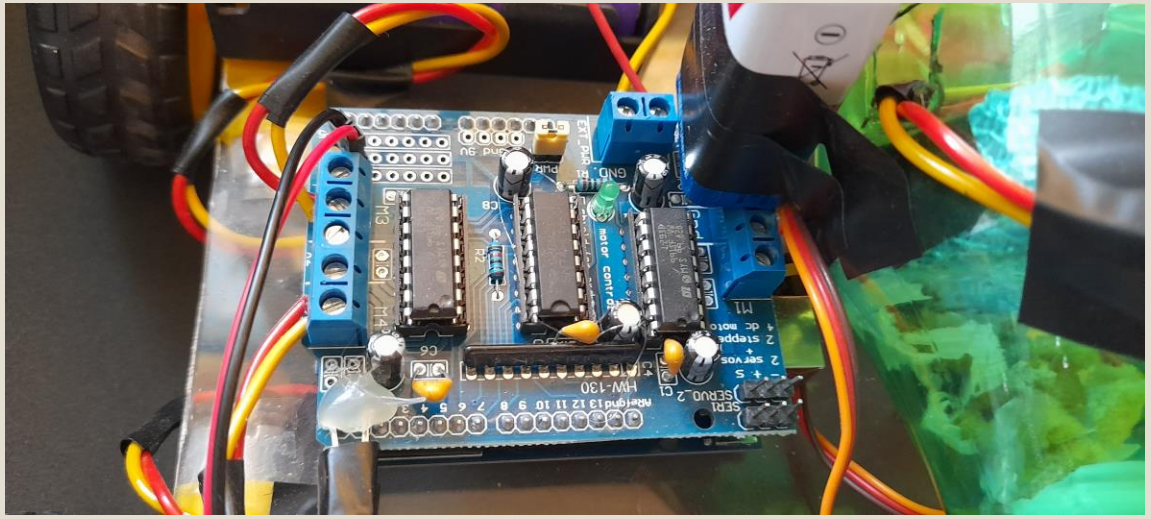


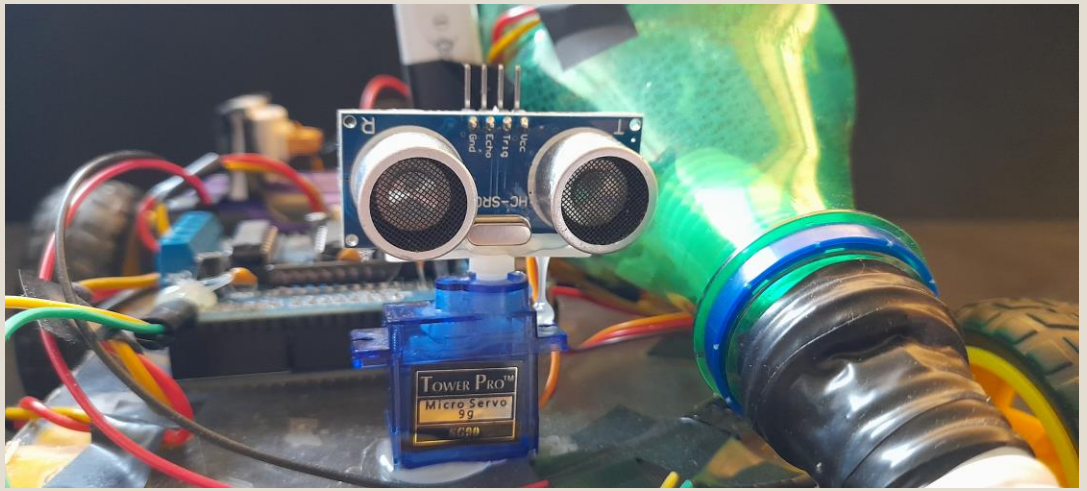

HW
TOWER PRO
Micro Servo
9g
SG90




HW
GENERAL PURPOSE




HW-130
SERVO_2.CJ
M1
M2


TOWER PRO
Micro Servo
99
Vcc
Trig
Echo
Gnd

Appendix 3: List of items and cost estimation

ITEM NAME	PRICE
ARUDUINO UNO	799
SERVO MOTOR	99
HC-05 BLUETOOTH	379
GEAR MOTOR+WHEELS	388
ACRYLIC SHEET	300
LITHIUM ION BATTERY	200
6V MOTOR	100
HC-SR04 ULTRASONIC SENSOR	150
MOTOR SHIELD	199
GLUE GUN	494
TOTAL PRICE	3108