An-Najah National University Faculty of Engineering

Electrical Engineering Department

Graduation project 2

Solar vacuum cleaner

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To our parents: Thank you for always encouraging us, for sending up prayers and hope when we needed them, and for teaching us how to say our name when they heard it for the first time. We will continue to learn from them when we graduate.

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ABSTRACT

مع الجدول الزمني المتسارع الحالي، يصبح تنظيف المنازل والحي أكثر صعوبة. هناك بالفعل مكانس كهربائية متوفرة في السوق تتطلب مساعدة بشرية. لذلك فإن تشغيل المكنسة الكهربائية الآلية أمر بالغ الأهمية. نتج عن هذا المشروع تطبيق طريقة تنظيف فعالة. من خلال تنظيف المواقع الخطرة، يمكن أن تقلل هذه المكنسة الكهربائية من المخاطر على الأفراد. يتم ذلك عن طريق إنشاء نظام مستقل. هنا، يتم استخدام سيارة تعمل بالتحكم عن بعد مع مكنسة كهربائية مدمجة. يساعد المستشعر بالموجات فوق الصوتية في هذا النظام على تجنب العقبات الرئيسية مثل الجدران والطاولات والكراسي وغيرها من الأثاث. باستخدام هذا المستشعر لتحديد المسافة، يمكن للسيارة أن تبتعد عن العوائق بالذهاب في الاتجاه حيث توجد فجوة أكبر بينهما. يتم توصيل أنبوب في فم الزجاجة ويتم تضمين مروحة وحدة المعالجة المركزية في تصميم المكنسة الكهربائية. تعمل البطاريات والخلايا الكهروضوئية على تشغيل النظام بأكمله.

With the current hurried schedule, cleaning houses and the neighborhood becomes more and more difficult. There are already vacuum cleaners available on the market that require human assistance. The operation of an automated vacuum cleaner is therefore crucial. This project has resulted in the implementation of an efficient cleaning method. By cleaning up hazardous locations, this vacuum cleaner can reduce the risks to individuals. This is done by putting in place an autonomous system. Here, a remote-control automobile with a built-in vacuum cleaner is used. The ultrasonic sensor in this system helps it avoid major obstacles like walls, tables, chairs, and other furniture. Using this sensor to determine the distance, the automobile may steer itself away from impediments by going in the direction where there is a greater gap between them. A pipe is hooked to the bottle's mouth and a CPU fan is included into the vacuum cleaner's design. The batteries and PV cells power the entire system.

1 CHAPTER 1. INTRODUCTION

1.1 OVERVIEW

The maintenance of a clean environment is one of the main duties of each and every person. A larger space will require more workers to clean it. Cleaning some places could have a big detrimental effect on one's health since they are so unclean. Vacuum cleaners are beneficial for cleaning carpets, automobiles, floors, and other household goods since dust is present. The room's size makes it ideal for collegiate use. Because the Arduino can be programmed to cover certain regions, which is possible due to the car carrying it, the vacuum cleaner may be driven in the desired direction and the time necessary for the same can be decreased. The latest generation of handheld vacuum cleaners Cleaners are now offered on the market. Smart vacuum cleaners will represent a big industrial development as automation develops. An automatic vacuum cleaner is created in this project. It consists of an RC car that is connected to a vacuum cleaner. If an impediment is identified, an ultrasonic sensor attached to the front of the car measures the distance. The vehicle alters its course in accordance with the code, for instance, if there is a barrier. The CPU Fan in a vacuum cleaner is powered by a battery. The front of the cleaner has a hose attached that will gather the dust from the floor. The cleaner has space to store the dust. It has to be manually removed and cleaned as soon as it is full. The Arduino's programming decides the direction the wheels will move, and the RC vehicle will be utilized to transport a vacuum cleaner.

1.2 EXISTING PROBLEMS

In areas like programming, microprocess construction and architecture, and communication technologies, technology is advancing incredibly swiftly today. So, in order to maximize the advantages of the newest technology, we have a pressing need to upgrade our hardware system.

And during this pandemic, we have an additional requirement to create a system that can be employed in atypical circumstances and has the qualities of being inexpensive, simple to use, and very effective.

1.3 AIMS AND OBJECTIVES

Human supply is the main objective of this endeavor. Cleaning up the neighborhood and residences takes extra work. There are already vacuum cleaners available on the market that require human assistance. The deployment of an automated vacuum cleaner is therefore essential. This endeavor has resulted in the implementation of an efficient cleaning method. By cleaning up hazardous locations, this vacuum cleaner helps to reduce the hazards to humans. This is done by implementing an autonomous system..

1.4 SCOPE OF THE WORK

1.4.1 GENERAL OVERVIEW

The robot has a battery that is always being replenished by a solar panel as the motors drain it. When exposed to sunlight, this extends the battery life. A vacuum cleaner with an ultrasonic sensor for obstacle detection makes up the system.

- Quick and simple cleaning
- Vacuuming to remove dust
- Wet cleaning with a water tank and brush
- Solar power for long battery life

- Self-control operation

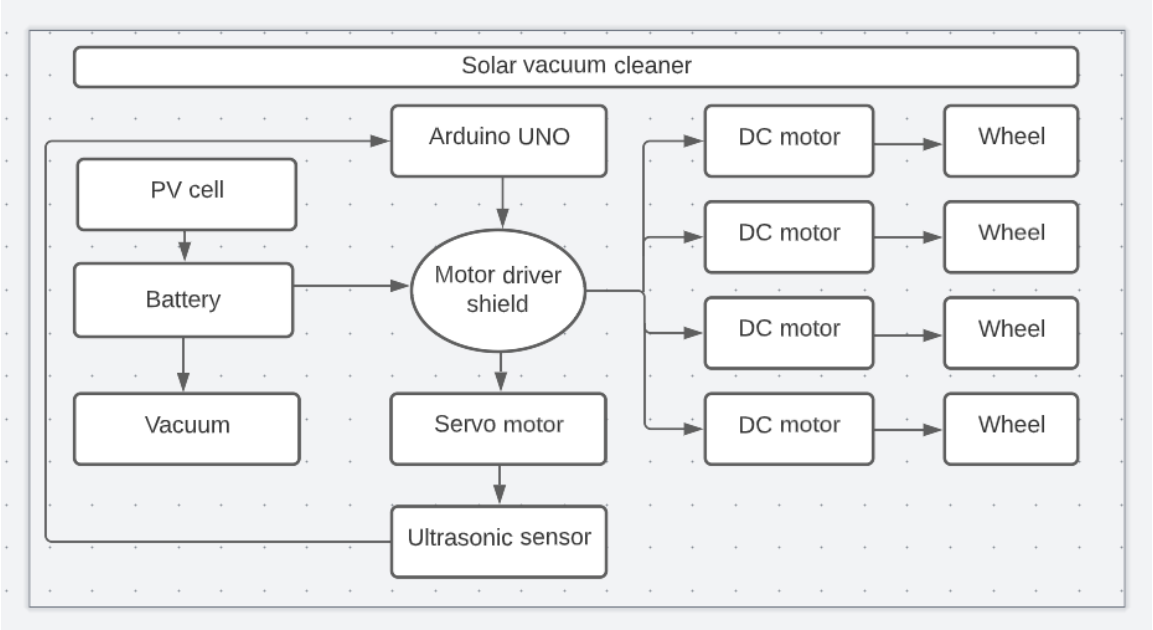

Figure 1-4-1-1 Shows High Level Overview of solar vacuum cleaner (block diagram system)

1.4.2 HARDWARE OVERVIEW

- Arduino UNO.
- Cleaning Brush.
- Vacuum for Clean (CPU fan).
- DC motors main parts for the vehicle to get motion on the surface through a motor driver for speed and direction control.
- Servo motors and ultra-sonic sensor that could help our project to avoid crack.
- Lithium battery to feed all circuits and motors.

1.4.3 SOFTWARE OVERVIEW

the Arduino is object- oriented programming language that mean the real-time tasks for the sequential reading and sending of each communication with ultrasonic sensor and for motors controls.

These two pieces can be opened from laptop and controlled with some software like ARDUINO-1.8.16 that allow access to the two pieces from laptop.

Also, there are software overviews explanations found later in this report to get access to final solar vacuum cleaner project.

1.5 IMPORTANCE OF THE WORK

This project is significant because it has numerous applications that assist people who are fatigued, afraid of falling, or choking hazards. For instance, you can use it in limited spaces to make tasks less dangerous and allow for different methods in addition to the conventional one. It has industrial uses and can be used for cleaning.

2 CHAPTER2. Theoretical Background and Previous Work

2.1 LITERATURE REVIEW

A hoover is a machine that uses an air pump to create a partial vacuum to suck up dust and grime, primarily from floors, and is frequently referred to as a vacuum cleaner. The dirt is either collected in a dust bag or a cyclone for subsequent disposal. There are many different types and sizes of vacuum cleaners, which are used in both households and businesses. These range from tiny battery-operated hand-held units to enormous stationary industrial machines that can hold several hundred liters of dust before needing to be emptied..

Ives W. McGaffey created the "Whirlwind," the first manually driven vacuum cleaner, in Chicago, USA, in 1868. The device was small and light, but it required turning a hand crank in addition to pushing it over the floor, making it challenging to use. The American Carpet Cleaning Co. of Boston was engaged by McGaffey to assist with public relations. $25 was paid for it. Since the majority of the Whirlwinds were sold in Chicago and Boston and it is likely that many of them perished in the Great Chicago Fire of 1871, it is difficult to gauge how popular they were. Only two are known to have endured, with one being found in the Hoover Historical Collection. Centre McGaffey was only one of the numerous 19th-century inventors in the US and Europe that created manual vacuum cleaners.

2.2 PROBLEM IDENTIFICATION: LITERATURE REVIEW

Although many machines have been successfully produced, there are still a lot of urban issues that can be solved, such as flooding and traffic jams. A sustainable machine that uses green energy is needed, as developing labor in these situations may be very risky and time-consuming.

3 CHAPTER 3. METHODOLOGY

3.1 SOFTWARE IMPLEMENTATION

The software used in this project, Arduino IDE. This is an application written in C and C++. Programs can be written and uploaded to Arduino boards. In this project we will use 2.0.1 version

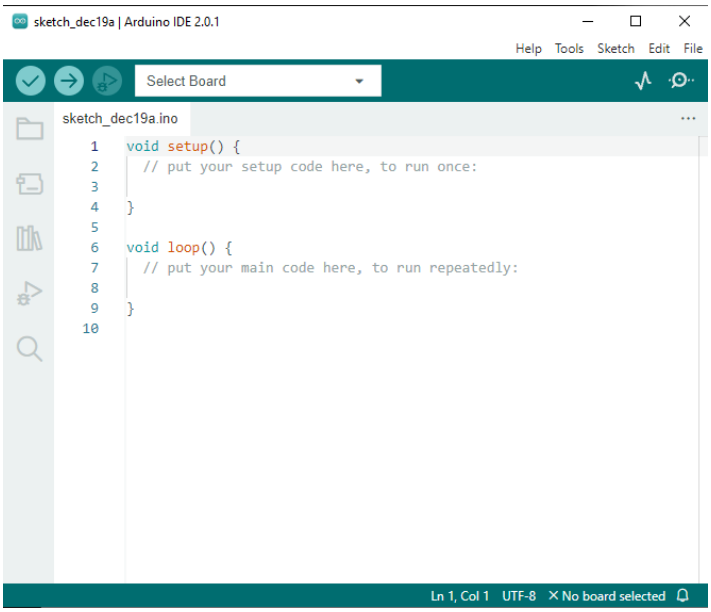

Figure 33-1-1 Arduino IDE

3.1.1 ARDUINO LANGUEAGE

Arduino programming language can be divided in three main parts: functions, values (variables and constants), and structure.

Functions: For controlling the Arduino board and performing computations.

Variables: Arduino data types and constants.

Structure: The elements of Arduino (C++) code.

3.1.2 C++ language

Arduino code is written in C++ with an addition of special methods and functions, C++ is a human-readable programming language. When you create a 'sketch' (the name given to Arduino code files), it is processed and compiled to machine language.

3.2 SOFTWARE DESIGN

3.2.1 SCHEMATIC

The figures 1.4.1.1 displays all process that send data from Arduino to motor driver to servo motor and ultrasonic sensor

3.2.2 MOVING CONTROL IN ALL DIRECTIONS

The flow chart of this process:

Figure shows the flowchart of the proposed model. Here, once the car is started, the distance is measured and moves forward. If distance is less than 20cm, it turns left and right respectively to measure distance and the prototype moves where the distance is greater. The same process repeats.

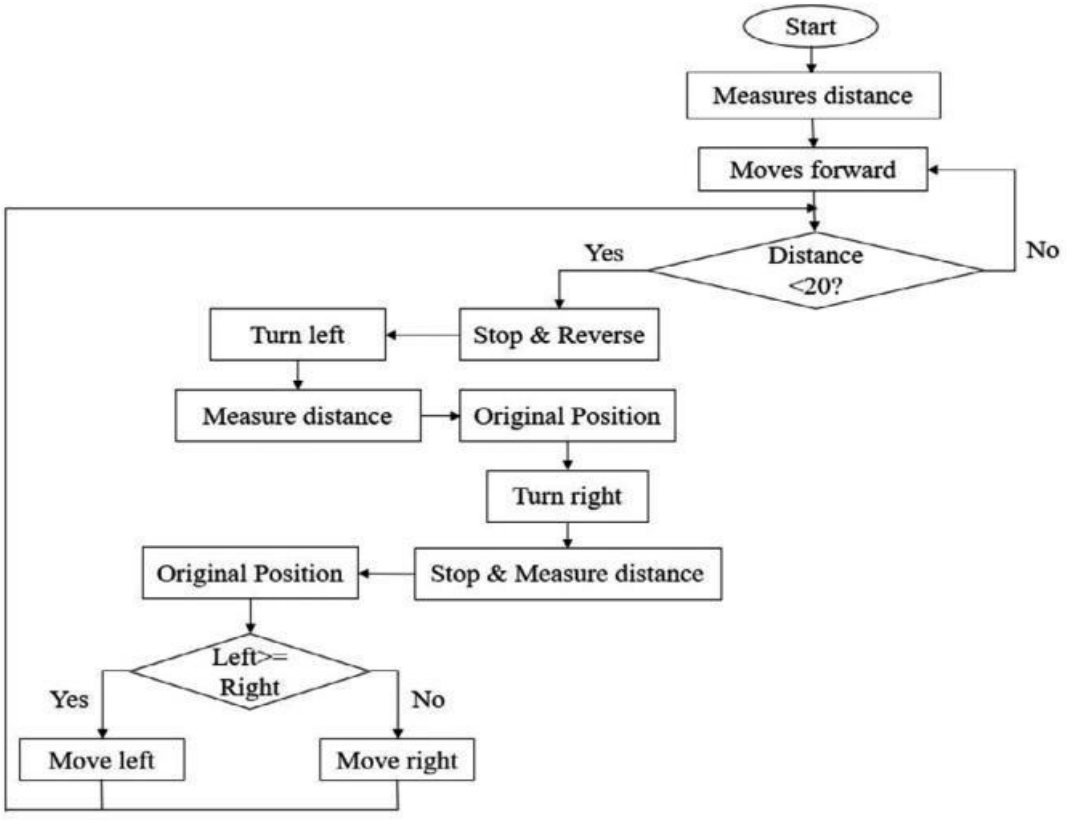

Figure 33-2-2-1 Shows the flow chart of the moves of project

3.2.3 ARDUINO CODE

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

#define TRIG_PIN A0
#define ECHO_PIN A1
#define MAX_DISTANCE 200
#define MAX_SPEED 190 // sets speed of DC motors
#define MAX_SPEED_OFFSET 20

NewPing sonar(TRIG_PIN, ECHO_PIN, MAX_DISTANCE);

AF_DCMotor motor1(1, MOTOR12_1KHZ);
AF_DCMotor motor2(2, MOTOR12_1KHZ);
AF_DCMotor motor3(3, MOTOR34_1KHZ);
AF_DCMotor motor4(4, MOTOR34_1KHZ);
Servo myservo;

boolean goesForward=false;
int distance = 100;
int speedSet = 0;

void setup() {

  myservo.attach(10);
  myservo.write(115);
  delay(2000);
  distance = readPing();
  delay(100);
  distance = readPing();
  delay(100);
  distance = readPing();
  delay(100);
  distance = readPing();
  delay(100);
}
```

```
void loop() {
 int distanceR = 0;
 int distanceL =  0;
 delay(40);

 if(distance<=15)
 {
  moveStop();
  delay(100);
  moveBackward();
  delay(300);
  moveStop();
  delay(200);
  distanceR = lookRight();
  delay(200);
  distanceL = lookLeft();
  delay(200);

  if(distanceR>=distanceL)
  {
    turnRight();
    moveStop();
  }else
  {
    turnLeft();
    moveStop();
  }
 }else
 {
  moveForward();
 }
 distance = readPing();
}

int lookRight()
{
    myservo.write(50);
    delay(500);
    int distance = readPing();
    delay(100);
    myservo.write(115);
    return distance;
}

int lookLeft()
```

```
{
    myservo.write(170);
    delay(500);
    int distance = readPing();
    delay(100);
    myservo.write(115);
    return distance;
    delay(100);
}

int readPing() {
  delay(70);
  int cm = sonar.ping_cm();
  if(cm==0)
  {
    cm = 250;
  }
  return cm;
}

void moveStop() {
  motor1.run(RELEASE);
  motor2.run(RELEASE);
  motor3.run(RELEASE);
  motor4.run(RELEASE);
  }

void moveForward() {

 if(!goesForward)
  {
    goesForward=true;
    motor1.run(FORWARD);
    motor2.run(FORWARD);
    motor3.run(FORWARD);
    motor4.run(FORWARD);
   for (speedSet = 0; speedSet < MAX_SPEED; speedSet +=2) // slowly bring
the speed up to avoid loading down the batteries too quickly
   {
    motor1.setSpeed(speedSet);
    motor2.setSpeed(speedSet);
    motor3.setSpeed(speedSet);
    motor4.setSpeed(speedSet);
    delay(5);
   }
```

```
  }
}

void moveBackward() {
    goesForward=false;
    motor1.run(BACKWARD);
    motor2.run(BACKWARD);
    motor3.run(BACKWARD);
    motor4.run(BACKWARD);
  for (speedSet = 0; speedSet < MAX_SPEED; speedSet +=2) // slowly bring
the speed up to avoid loading down the batteries too quickly
  {
    motor1.setSpeed(speedSet);
    motor2.setSpeed(speedSet);
    motor3.setSpeed(speedSet);
    motor4.setSpeed(speedSet);
    delay(5);
  }
}

void turnRight() {
  motor1.run(FORWARD);
  motor2.run(FORWARD);
  motor3.run(BACKWARD);
  motor4.run(BACKWARD);
  delay(500);
  motor1.run(FORWARD);
  motor2.run(FORWARD);
  motor3.run(FORWARD);
  motor4.run(FORWARD);
}

void turnLeft() {
  motor1.run(BACKWARD);
  motor2.run(BACKWARD);
  motor3.run(FORWARD);
  motor4.run(FORWARD);
  delay(500);
  motor1.run(FORWARD);
  motor2.run(FORWARD);
  motor3.run(FORWARD);
  motor4.run(FORWARD);
}
```

3.3 HARDWARE DESIGN

3.3.1.1 Arduino UNO

The key hardware of the prototype, Arduino Uno is shown in figure 3-3-1. This is a microcontroller which is used for interfacing hardware and software. To do the same, USB cable is required. Once the board is embedded with the code, it can be operated by a battery supply without using any PC or laptop.

Figure 33-3-1-1 Arduino UNO

3.3.1.2 Batteries

Figure 3-3-2 shows the heart of the prototype, 3.7V batteries. These are rectangular in shape and have positive and negative terminals at the top which supplies 3.7 V so as to make the prototype run.

Figure 33-3-1-2 Batteries

3.3.1.3 CPU fan

Figure 3-3-3 shows the CPU fan used in the prototype. This is used in the vacuum cleaner which has a rating of 12 volts. It rotates at maximum of 200 rpm. As the voltage increases, rpm increases until the value reached up to 200. The least rpm will be 12V.

Figure 33-3-1-3 CPU fan

3.3.1.4 DC motor

Figure 33-3-4 shows one of the DC Motors used in the prototype. These motors essentially are the key components in this prototype. To make the machine move, these are required. As the voltage increases, rpm also increases. The least rpm will be at 6V and maximum at 12V.

Figure 33-3-1-4 DC motor

3.3.1.5 Motor driver shield

Figure 3-3-5 shows the Motor Driver Shield. This is used to run different types of motors. L293D IC is the main IC present in this shield. The direction and speed of motors depends on the motor shield, as the shield is embedded on Arduino UNO board and the speed and direction can be controlled by coding in Arduino IDE.

Figure 3-3-1-5 Motor driver shield

3.3.1.6 Ultrasonic sensor

Figure 33-3-6 shows the Ultrasonic sensor used in the prototype. This HCSR04 sensor is used for measuring distance. It uses sound waves to calculate the same. There are 4 pins – Echo, Ground, Trigger and VCC. External controller is triggered by Trigger pin that sends ultrasonic waves whereas echo pin sends ultrasonic waves and duration it takes to travel decides the distance between the car and obstacle. VCC will take up to 5V and gives the voltage so that the sensor can run.

Figure 33-3-1-6 Ultrasonic sensor

3.3.1.7 Wheels

Figure 3-3-7 shows the wheels which are responsible for the movement of RC car. These are used to move in any specified direction. Wheels are run by a DC Motor with a pre-defined RPM. Wheels rotate in the same direction as DC Motor.

Figure 33-3-1-7 Wheels

3.3.1.8 PV cell

The rating of the prototype solar panel is 12V, the panel is attached to the battery solar panel has numerous photovoltaic (solar) cells arranged in an order. When the sunlight is incident on the surface of the photovoltaic cell, the energy is transformed by this cell into electrical potential across the terminals, i.e., electrical power. The absorbed energy makes the electrons jump from one energy level, i.e., orbit to another energy level inside the atom, thus releasing energy.

Figure 33-3-1-8 PV cell

3.3.1.9 Servo motor

Rotating the servo motor is done using a PWM signal provided to the motor's control pin. The controller generates the PWM signal. Servo motors are classified in 2 variants, which are DC Servo motors and AC servo motors. In this project, the type of motors used is the DC Servo motor as massive torque is not required. The servo motors used have a range of 0-180°.

Figure 33-3-1-9 Servo motor

3.3.2 Design

3.3.2.1 RC car

The designed RC car is depicted in Figure. The RC car's construction is as follows. The motor is fitted to these locations using nuts and bolts, and motors are attached with wheels. Positive and negative wires are soldered onto motors.

Four DC motors are used to build the RC vehicle, and they operate at the speed specified in the Arduino IDE code. The RC car employs a motor shield to move in the required direction and speed. A remote control car's ultrasonic sensor measures the distance to obstacles in front of it. Therefore, the direction of the remote-controlled car carrying the vacuum cleaner changes anytime it comes into contact with any impediments like walls, tables, chairs, or other large objects that are not believed to be trash or dust. in order to prevent a crash and self-destruction. When an obstruction is recognized, the code provided to the Arduino runs constantly and the cycle repeats at regular intervals. The wooden base is positioned over the batteries.

Figure 38-3-2-1-1 Solar vacuum cleaner

3.3.2.2 Vacuum

Vacuum cleaner is made up of 1.25L water bottle, CPU fan, pipe, tape, gauze bandage, batteries and switch.

At this point, the conical part with the gauze bandage is taped to the cylindrical half that was divided in step ii.

is described below.

Steps to create the vacuum cleaner:

1.25L water bottle is cut into half horizontally

Top portion has conical and cylindrical structure, the conical structure is cut

The bottle cap area is attached with a pipe as shown in the image.

The other end of conical structure is covered with a gauze bandage

to improve the vacuum.

Now, the cylindrical part which was separated in step ii is taped with

the conical part which has the gauze bandage. A CPU fan is attached to the other end of the cylinder.

For the purpose of creating the necessary vacuum, a 9V supply is provided.

On the side, switch is also mounted.

Figure 33-3-2-2-1 vacuum

3.4 Comparison

Table 1 shows the comparison between the manual mode of cleaning

and automatic mode. In manual cleaning, as the word says, human is required. Whereas, in automatic mode there is no human intervention. Automatic mode is helpful as it doesn't cause any health risks.

Table 1
Comparison between manual and automatic system.

Features	Manual	Automatic (Designed Prototype)
Human intervention	Yes	No
Economic	No	Yes

Table 2 shows the comparison between the existing and the designed algorithm. In the existing prototypes, through an application, there will be an interaction between the model and the user. However, in the designed prototype, it is run through batteries and there is no human intervention needed. The algorithm is simpler and is easier to debug as well.

Table 2
Comparison between algorithms.

Features	Existing	Designed Prototype
Simple	No	Yes
Accuracy	60%	75%

3.5 CONSTRAINS

- On economy: the budget limitation was the biggest economical constrain, due to the cut of salaries and covid-19 special situation it was pretty hard to obtain the needed amount of money which was pretty big because our market is restricted to two names of suppliers.
- On society: this project counted by many as a way to reach deeply in people's daily life.
- On Manufacturability: the design implemented physically but not as it meant to be due to lack of hardware components.

3.6 STANDARDS

Due to a shortage of information in studying standards and protocols, Palestinian projects primarily use IEEE standards. If we wanted to develop this concept into an industrial form, we would use the following protocols: The IEEE 802.15.4s-2018 standard, which outlines a protocol and procedures for In this revision to IEEE Std 802.15.4TM, definitions of MAC-related functions to enable spectrum resource management are covered. It details what follows: - Metrics of network performance and spectrum resource usage, such as packet error rate and delay. - Data structures and information components to record these measurements, - Methods for gathering and sharing information about measuring spectrum resources with higher layers or other devices

A standard called IEEE 802.15.4 defines the physical layer and Low-rate wireless personal area networks (LR-WPANs) media access control. The IEEE 802.15 working group looks after it. It serves as the foundation for the specifications for ZigBee, ISA100.11a, Wireless HART, and MI WI, all of which advance the standard by defining the upper layers not covered by IEEE 802.15.4. As an alternative, it can be utilized to create a wireless embedded Internet using 6LoWPAN and common Internet protocols.

IEEE P1828 - "Standard for Systems with Virtual Components"

HARDWARE SCHEMATICS (1)

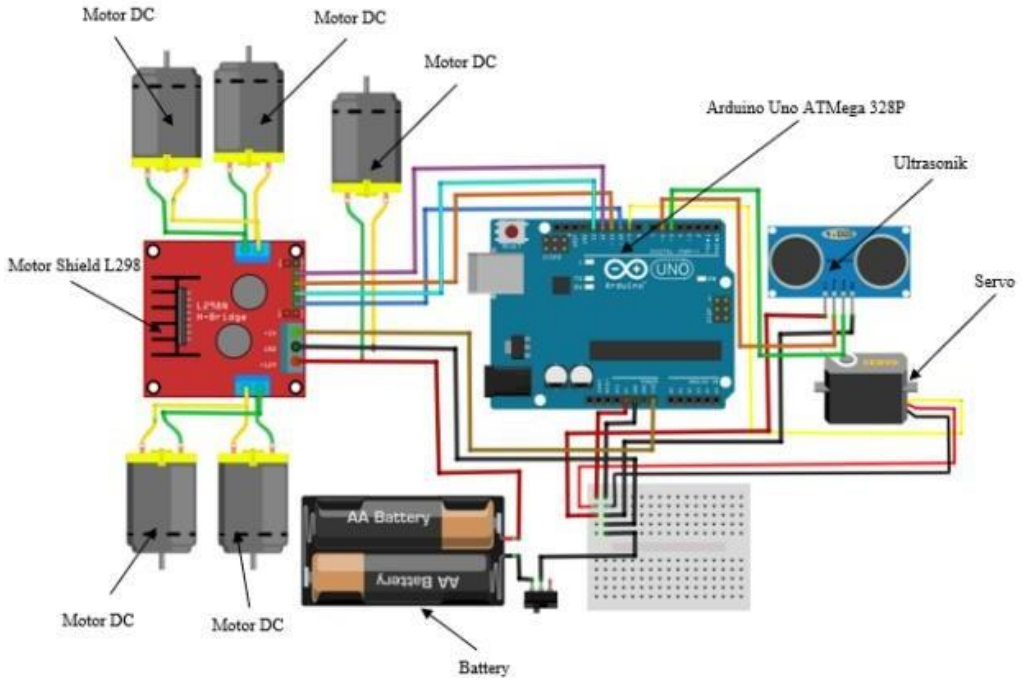

Figure 4-1 Hardware schematics (servo motor +Arduino UNO+ DC motors)

HARDWARE SCHEMATICS (2)

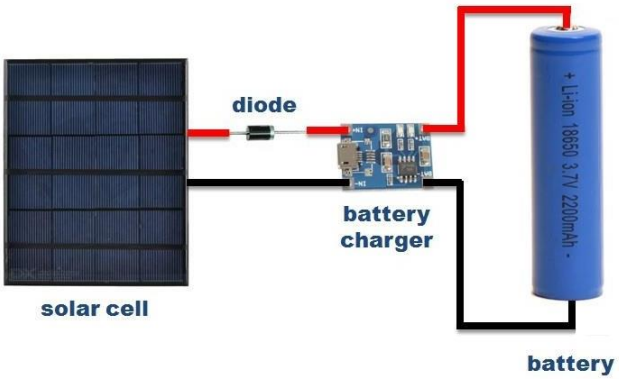

Figure 4-2 Hardware schematics (PV cell+Battery)

4 CHAPTER 4 Discussion

The RC car and vacuum cleaner will each receive a 9V supply, and once the car is running, it uses an ultrasonic sensor to calculate the distance between obstacles and the vehicle before moving ahead in accordance with the code in the Arduino IDE. If the distance is less than 20 cm, the remote-controlled car stops, briefly reverses, then moves to the left side to measure the distance once more before returning to its original location.

It then makes a quick right turn, pauses for a moment, and then resumes its original position. To avoid hitting any objects, the car moves in the direction of the bigger distance after measuring the two distances. Unless there are obstacles in its path it travels in It follows a straight path without turning until it comes upon an obstruction. Every time there is a barrier in the way, the procedure is repeated.

5 CHAPTER 5. Conclusions and Recommendation

5.1 TOTAL CONCLUSION

Smart vacuum cleaner has been used in this project. It operated using pre-written code that was placed into an Arduino UNO. When an impediment is encountered, the RC car always veers to the side where there is a greater gap. This invention uses a battery-powered vacuum cleaner to collect dust without the need for human intervention, lowering the risks to human health. This cleaner is easy to use and reasonably priced. However, having a detachable bag could be preferable because it makes dust removal easier.

In order to achieve the best design possible given the constraints of the market and the budget, self-learning courses and courses that electrical engineering students had never heard of (up until now) were utilised in this project. This demonstrated the team's openness to new technologies and their ability to integrate them into the courses they had taken while pursuing their bachelor's degree.

The main reason for choosing this project was to demonstrate how the internet of things can be used to improve other technologies. By using it, we can now better control and monitor systems, and this improvement can be seen in other systems, such as smart cities, power grids, and even brand-new elevators.

5.2 SECURITY

Since this project is online and hosted on a free server with no security, it is actually not completely secure. Without a cyber security protocol, anyone may easily attack the system and take control of it.

5.3 WHERE SUCH A PROJECT CAN BE USED

I. Applications for smart homes include a cleaning robot, a robot that moves objects, a garden coordinator, and others.

II. Smart cities: to keep the streets clean, plan the public gardens, and provide the government the ability to keep an eye on the streets at all times with the potential to flag unusual sounds or movements,

III. Disastrous: In times of public health emergencies, such as the CoVid-19 epidemic, we may use these robots to sanitize streets and public spaces, give commands to people, and ensure that there are no crowds. In areas with high levels of pollution, this robot can also save lives, money, and time.

5.4 RECOMMENDATIONS:

In our years in the university we studied different courses, and now as graduation project students we can tell that not all of that courses suit as in earlier jobs, our courses which focus on theories weren't very helpful in our project, not like that the practical and programming ones, after we suggest in this stage to use dual learning which connect both sides in more effective way, and to increase courses which help students to think properly using problem solving methods and the cognitive factors to help them in the self-learning courses and to solve problems like engineers.

I. Since our study is conducted in English, we became accustomed to producing quality reports and presentations, and the English courses assisted us in enhancing our skills.

II. Power electronics and drive, which we -liked- employed in our project as an idea on a modest scale, were concepts that electronics classes allowed us to comprehend.

III. The programming languages we studied in class and the online microcontroller course we completed aided in our ability to think clearly and construct our system as effectively as possible.

IV. Sensors and measurements gave us a better understanding of how our system should keep an eye on the environment around our project and whether or not our sensor systems can be constructed.

REFERENCES

[1] M.S Khan, M. Nagageetha, G. Babu, Bluetooth control cleaning robot using arduino,

Int. J. Innov. Technol. Explor. Eng. (IJITEE) 8 (11S2) (September 2019).

[2] M. Vijayalakshmi,G. Bhargavi Baljoshi.G. Lavanya G. Master Sushil, Smart Vacuum

Robot, Department of Computer Science and Engineering, KLE Technological Univeristy, Vidyanagar, Hubballi.

[3] G. Tambe, D. KanadeDhariwal, Guarav & Uzairqazi, Development of Driverless RC

Car, Department of Mechatronics Engineering, Terna Engineering College, Navi

Mumbai India, International Journal of Interdisciplinary Innovative Research & Development (IJIIRD), 2019.

[4] S. Yatmono, M. Khairudin, H.S. Pramono, A. Asmara, Development of Intelligent

Floor Cleaning Robot, Electrical Engineering Education Department, Universitas

Negeri Yogyakarta, Yogyakarta, Indonesia, 2019 ICE-ELINVO.

[5] S. Hossain, O. Doukhi, Y. Jo, D.-J. Lee, Deep reinforcement learning-based ROS-controlled RC car for autonomous path exploration in the unknown environment, 2020

20th International Conference on Control, Automation and Systems (ICCAS), 2020.

[6] R.J. Ong and KNFKu Azir, Low cost autonomous robot cleaner using mapping algorithm based on Internet of Things (IoT), IOP Conference Series: Materials Science

and Engineering.

[7] V. Anbumani, V. Geetha, V. Renugha, V. Praveenkumar, Development of ingenious

floor cleaner using ARDUINO, Int. J. Recent Technol. Eng. (IJRTE) 8 (4) (2019)

November.