Implementation of Smart Waste Management System

Report for Project Part-II (EC882)

Group no. 14

B. Tech in Electronics and Communication Engineering

B. P. Poddar Institute of Management & Technology

under

Maulana Abul Kalam Azad University of Technology

Under the supervision of

Ms. Banhi Das

Submitted by

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CERTIFICATE

This is to certify that the project work, entitled "Implementation Of Smart Waste Management System" submitted by Sayak Banerjee , Indraneel Roy , Samridh Vatsa , Subhradipta Deb has/have been prepared according to the regulation of the degree B. Tech in Electronics & Communication Engineering of the Maulana Abul Kalam Azad University of Technology, West Bengal. The candidate(s) has/have partially fulfilled the requirements for the submission of the project work.

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ACKNOWLEDGEMENTS

It is a great pleasure for me/us to express my/our earnest and great appreciation to Ms. Banhi Das, my project guide. I/We am/are very much grateful to him/her for his/her kind guidance, encouragement, valuable suggestions, innovative ideas, and supervision throughout this project work, without which the completion of the project work would have been difficult one.

I/We would like to express my/our thanks to the Head of the Department, Dr. Ivy Majumdar for his/her active support.

I/We also express my/our sincere thanks to all the teachers of the department for their precious help, encouragement, kind cooperation and suggestions throughout the development of the project work.

I/We would like to express my/our gratitude to the library staff and laboratory staff for providing me/us with a congenial working environment.

Date: 26.05.2023

(Full Signature of the Student(s))

B. Tech in Electronics & Comm. Engg.
Department of Electronics & Comm. Engg.
B.P.Poddar Institute of Management & Technology

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DEPARTMENTAL MISSION, VISION, PEO, PO, PSO:-

Departmental Vision:

To emerge as a premier department for studies in Electronics and Communication Engineering.

Departmental Mission:

- Imparting innovative educational program through laboratory and project-based teaching-learning process for meeting the growing challenges of industry and research.
- Providing an inspiring and conducive learning environment to prepare skilled and competent engineers and entrepreneurs for sustainable development of the society.
- Creating a knowledge center of advanced technologies committed to societal growth using environment-friendly technologies.

Program Educational Objectives (PEOs):

1. Graduates of Electronics and Communication Engineering will be able to use latest tools and techniques to analyze, design and develop novel systems and products to solve real life problems.
2. Graduates of Electronics and Communication Engineering will have strong domain knowledge, skills, and attitude toward employment in core and allied industries, higher studies and research or will become successful entrepreneurs.
3. Graduates of Electronics and Communication will exhibit ethical values, professionalism, leadership, communication and management skills, teamwork, and multi-disciplinary approach to adapt current trends in technology through life-long learning.

Program Outcomes (POs):

1. **Engineering Knowledge**: Apply the knowledge of Mathematics,

science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design / Development of Solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct Investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and Teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering

activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective

11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSO):

- Students will acquire knowledge in Advance Communication Engineering, Signal, and Image Processing, Embedded and VLSI System Design.
- Students will qualify in various competitive examinations for successful employment, higher studies, and research.

TITLE :

Implementation of Smart Waste Management System

PO& PSO MAPPING:

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P012	PSO1	PSO12
3	3	3	1	2	2	2	3	3	3	2	3	3	3

Note: Correlation levels are as defined: 1: Slight (Low) 2: Moderate (Medium)3: Substantial (High).If there is no correlation, put "-"

JUSTIFICATIONS OF MAPPING :

PO/PSO MAPPED	LEVEL OF MAPPING	JUSTIFICATION
PO1	3	Apply knowledge of engineering fundamentals, mathematics, science and an engineering specialization
PO2	3	Identify, formulate, review research literature and analyze complex engineering problems
PO3	3	The design solution for complex engineering problems that meet the specific needs with appropriate consideration for the public health and safety
PO5	2	Create, select and apply appropriate techniques, resources and modern engineering and IT tools to predict and model complex engineering activities with an understanding of the limitations
PO6	2	Apply to reason informed by the contextual knowledge to assess societal, health, safety and the consequent responsibilities relevant to the professional engineering practice
PO7	2	Understand the impact of professional engineering solutions and demonstrate the knowledge of, and need for sustainable development
PO8	3	Apply ethical principles and commit to professional ethics and responsibilities
PO9	3	Function effectively as an individual, and as a member or leader
PO10	3	Comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
PO11	2	Apply knowledge to one's own work, as a member or

		leader in a team, to manage projects
PO12	3	Recognize the need for, and have the preparation and ability to engage in independent and life long learning
PSO1	3	Acquire knowledge in MSP430 Processing and Interfacing
PSO2	3	Qualify in higher studies and research

ABSTRACT :

Rapid increase in population, has led to the improper waste management in cities resulting in increased pests and spreading of diseases. Nowadays, the Garbage Collecting Vehicle (GCV) collects the waste twice or thrice in a week. So, the problem is over flowing of wastages on the roads. Hence, to overcome this limitation, we have implemented a scheme on smart waste management system using Arduino UNO. The garbage bins are deployed with ultrasonic sensors and are networked . The sensors deployed in the garbage bins collect the data for every determined interval. Once the threshold is reached, it raises a request to the GCA (Garbage Collector Agent). This agent collects the requests of all the filled vehicles and communicate using IoT framework. The experimental simulation is done in proteus tool. A hardware prototype is developed for the proposed framework. Analysis of the proposed scheme provides better results in waste management. It also adds up the feature to distinguish between dry and wet waste. The Segregation of these wastes stands up as the major features in the project.

ACTIVITY CHART :-

7th Semester:-

JOB	1st-15th Sept	15th-30th Sept	1st -16th Oct	17th -24th Oct	25th - 30th Oct	1st-15th Nov	16th-30th Nov
0th Review	⟷						
Literature Survey		⟷					
Basic Understanding of the project (Overview)			⟷				
Mid-term preparation				⟷			
Studying related documents and research papers					⟷		
Components accumulation						⟷	
Recognizing the connections							⟷

8th Semester:-

JOB	23rd-19th Jan-Feb	20th-18th Feb-Mar	19th -2nd Mar-Apr	3rd – 9th Apr	9th - 30th Apr	1st-15th May	16th-30th May
Testing the model Using software simulation	⟷						
Understanding the algorithm & Program logic building		⟷					
Implementing the full circuit using the circuit simulation			⟷				
Mid-term report preparation				⟷			
Code implementation and Recognizing the connections					⟷		
Testing the actual model						⟷	
Final Report Writing and Presentation							⟷

INTRODUCTION :

The Embedded devices that are connected to Internet and sometimes these devices can be controlled from the internet is commonly called as Internet of Things. In our system, the Smart dustbins are connected to the internet to get the real time information of the smart dustbins. In the recent years, there was a rapid growth in population which leads to more waste disposal. So a proper waste management system is necessary to avoid spreading many diseases by managing the smart bins by monitoring the status of it and accordingly taking the decision. There are multiple dustbins that are located in the city or the Campus (Educational Institutions, Companies, Hospitals etc.). These dustbins are interfaced with micro controller based system with Ultrasonic Sensors and Wi-Fi modules. Where the Ultrasonic sensor detects the level of the waste in dustbin and sends the signals to micro controller the same signal are encoded and send through Wi-Fi Modular (ESP8266) and it is received by the end user. The data will be sent to the user through E-Mail i.e, a mail will be sent as notification that the dustbin is full so that the municipality van can come and empty the dustbin. In this Corona pandemic everything must be contactless, So we try to make a Contactless Dustbin called Smart Dustbin.

The population of cities is expanding day by day. The amount of waste produced increases in direct proportion to this situation. This case makes the development of sustainable solutions for city life a requirement, already.

This Smart Dustbin sense the person or object using Ultrasonic Sensor which send the message to Servo Motor using Arduino UNO.

When the person Comes closer to Smart Dustbin then the Dustbin Cap will automatically open for your waste and after some time it will automatically Close. By introducing smart **waste management system**, we will take a step closer towards becoming smart cities.

With the Smart Ultrasonic Sensor, it is aimed to create a more live able, smart, and clean city. Thanks to this goal, the contribution is made to the globally applied waste separation systems, the environment, and recycling.

LITERATURE SURVEY :

A State of the Art review on Internet of Things by P. Suresh, Vijay. Daniel, R.H. Aswathy, Dr. V. Parthasarathy. This paper gave the idea of IoT subject and addition details about IoT. The proper smart environment and various applications. **[1]Internet of Things**: Challenges and state-of-the art solutions in Internet-scale Sensor Information Management and Mobile analytics Arkady Zaslavsky. This paper gave us the details about mobile analysis and sensor information management that will help in data segregation of various dustbins**.[2]**Top-k Query based dynamic scheduling for IoT enabled small city waste collection by Theodoros Anagnostopoulos, Arkady Zaslavsky, Alexey Medvedev, Sergei Khoruzhnicov. This paper it gave us the concept of dynamic scheduling required for the cleaning of dustbin and the Top-k query led us to priority based cleaning of dustbins**.[3]**City Garbage collection indicator using RF(Zigbee) and GSM technology. This paper gave the details for the module required for the transmission of the data to the receiver side and also the main channel follow of the project. Initially we used GSM technology for our project but later on decided to us Wi-Fi module for the ease of data transmission**.[4]**IoT-Based Smart Garbage System for efficient food waste management by Insung Hong, Sunghoi Park, Beomseok Lee, Jaekeun Lee, Daebeom Jeong, Sehyun Park. This paper gave the overview working of the IoT based smart garbage bin and the food management. The main aim of this project is to reduce human resources and efforts along with the enhancement of a smart city vision.

COMPONENTS REQUIRED :

Hardware Requirements :

1. Arduino UNO
2. Ultrasonic distance sensor HC-SR04
3. Sg-90 micro servo motor
4. Dustbin
5. 16x2 LCD
6. Moisture Sensor

Hardware :

1. Arduino UNO

Arduino Uno is an open-source microcontroller board based on the processor ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller. Just plug it into a computer with a USB cable or power it with an adapter to get started. You can experiment with your Arduino without worrying too much about it. In the event of a worst case scenario, you could buy a new one as the Uno is very economical

2. Ultrasonic Distance Sensor HC-SR04

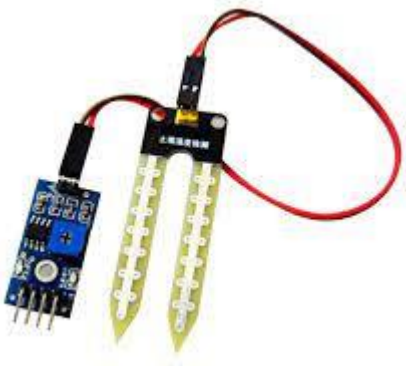
HC-SR04 is an ultrasonic distance sensor used for measuring the distance at which an object is located. The principle used by this sensor is called SONAR. It is perfect for small robotics projects such as obstacle avoiding robot, distance measuring device etc. It has two parts, one emits the ultrasound sonar to measure the distance to an object. The other part is the receiver which listens for the echo. As soon as the ultrasound hits the object it bounces back and is detected by the receiver. The time taken for the wave to come back decides the distance of the object being measured.

3. SG90 Micro Motor Server

The micro servo 9G is a light, good quality and very fast servo motor. This servo is designed to work with most radio control systems. It is perfect for small robotics projects. The SG90 mini servo with accessories is perfect for remote-controlled helicopters, planes, cars, boats and trucks.

4. MOISTURE SENSOR

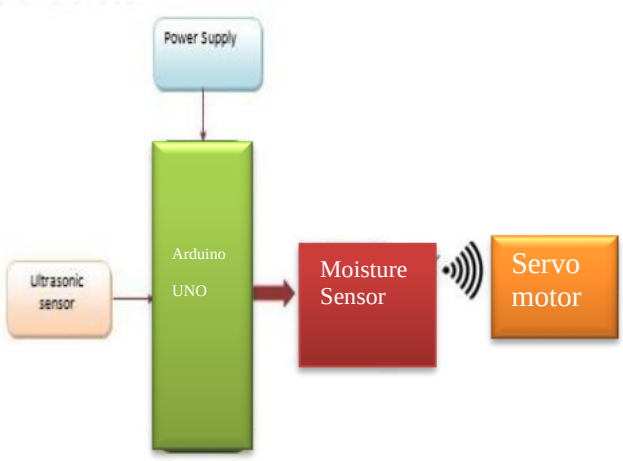
Moisture sensors measure the volumetric content of water in given substance.[1] Since the direct gravimetric measurement of free soil moisture requires removing, drying, and weighing of a sample, soil moisture sensors measure the volumetric water content indirectly by using some other property of the soil, such as electrical resistance, dielectric constant, or interaction with neutrons , as a proxy for the moisture content. Soil moisture sensors typically refer to sensors that estimate volumetric water content.



PROPOSED SYSTEM :

The system is supposed to have two halves i.e. one is WET side and other one is DRY side which will accumulate all the wet and dry wastes respectively. The type of waste will be detected by moisture sensor when any waste is kept over the dustbin. This system segregates the wastes and keep them in different stakes of the Dustbin Bucket. We will be able to monitor the % of wastebin is filled using Ultrasonic distance sensors which will help to measure the distance of garbage from the valve. Additionally , We will also use an IR sensor to sense if there is any waste kept on the Garbage or not. **Wet** and **dry** wastes needs to be separated as dry wastes can be recycled and can be used for reuse while wet wastes are generally the kitchen wastes which are directly composed in the environment otherwise it may reach our food also. Waste lying littered in the surrounding, dumped on open lands, becomes a major problem for various types of disease-causing bacteria and viruses hence, segregation, transport, handling and disposal of waste must be managed properly to minimize the risks of the public and environment. When mixed dry and wet waste breaks down in lowland, it creates nasty greenhouse gases. Segregation makes it attainable to utilize and recycle the waste effectively. This waste segregator system can easily segregate waste. The message of filled dustbin is sent to SmartPhone using Bylnk App which helps to track the dustbin filled / contained at any point of time.

BLOCK DIAGRAM :

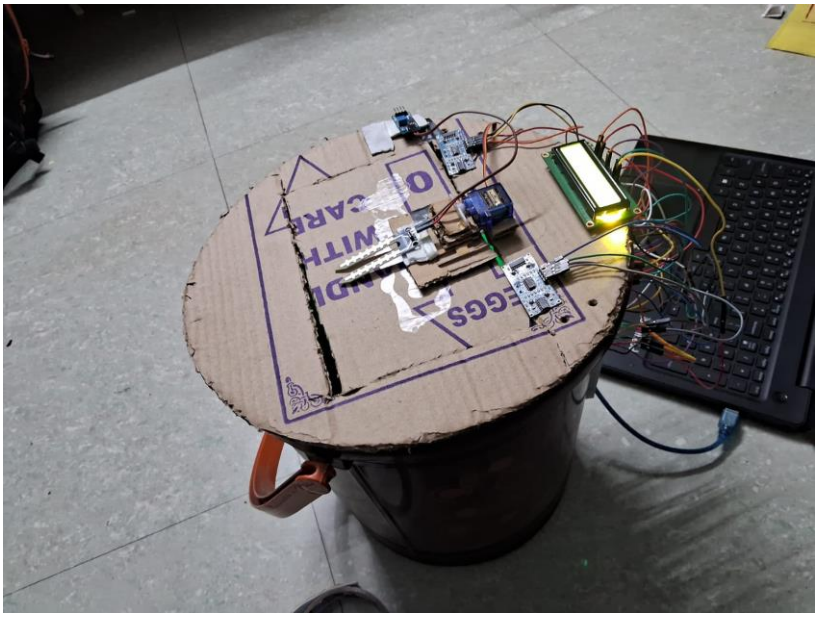


WORKING PRINCIPLE :

- It is important to dispose of the trash properly. It is a responsibility with which everyone should comply. In the era of Covid-19, people are trying to innovate everyday life things and make things as contactless as possible. Smart dustbin is one of those innovative ideas.
- The smart dustbin uses three Ultrasonic sensor HC-SR04 to detect objects is used as fill Sensors which indicates the % of dustbin part is filled.
- It then sends the signals to Arduino Uno. The Arduino understands the signal and sends a signal to the Servomotor which flaps on top of the dustbin.
- The flap is recovered within 5sec delay which progresses when the waste is within a specific range i.e. 7cm to 15cm of distance.

WORKING METHODOLOGY :

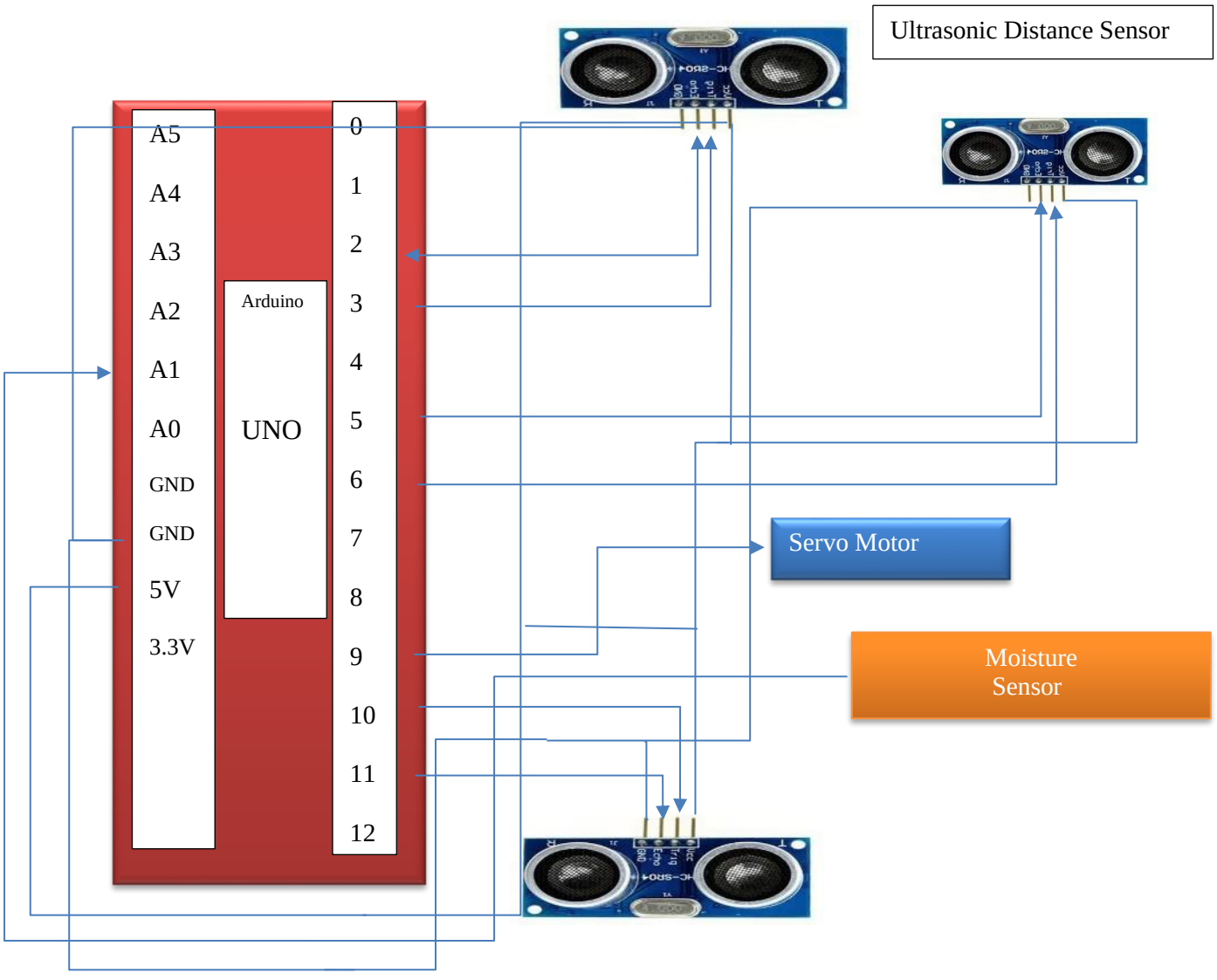
- It is important to dispose of the trash properly. It is a responsibility with which everyone should comply. In the era of Covid-19, people are trying to innovate everyday life things and make things as contactless as possible. Smart dustbin is one of those innovative ideas.
- Here We have used Arduino IDE as a Software for compiling and uploading the documents.
- The smart dustbin uses an Ultrasonic sensor HC-SR04 to detect objects on the top.
- It then sends the signals to Arduino Uno. The Arduino understands the signal and sends a signal to the Servomotor which opens the flap on top of the dustbin.
- The flap is recovered within 5sec delay which progresses when the waste is within a specific range i.e. 7cm to 15cm of distance.



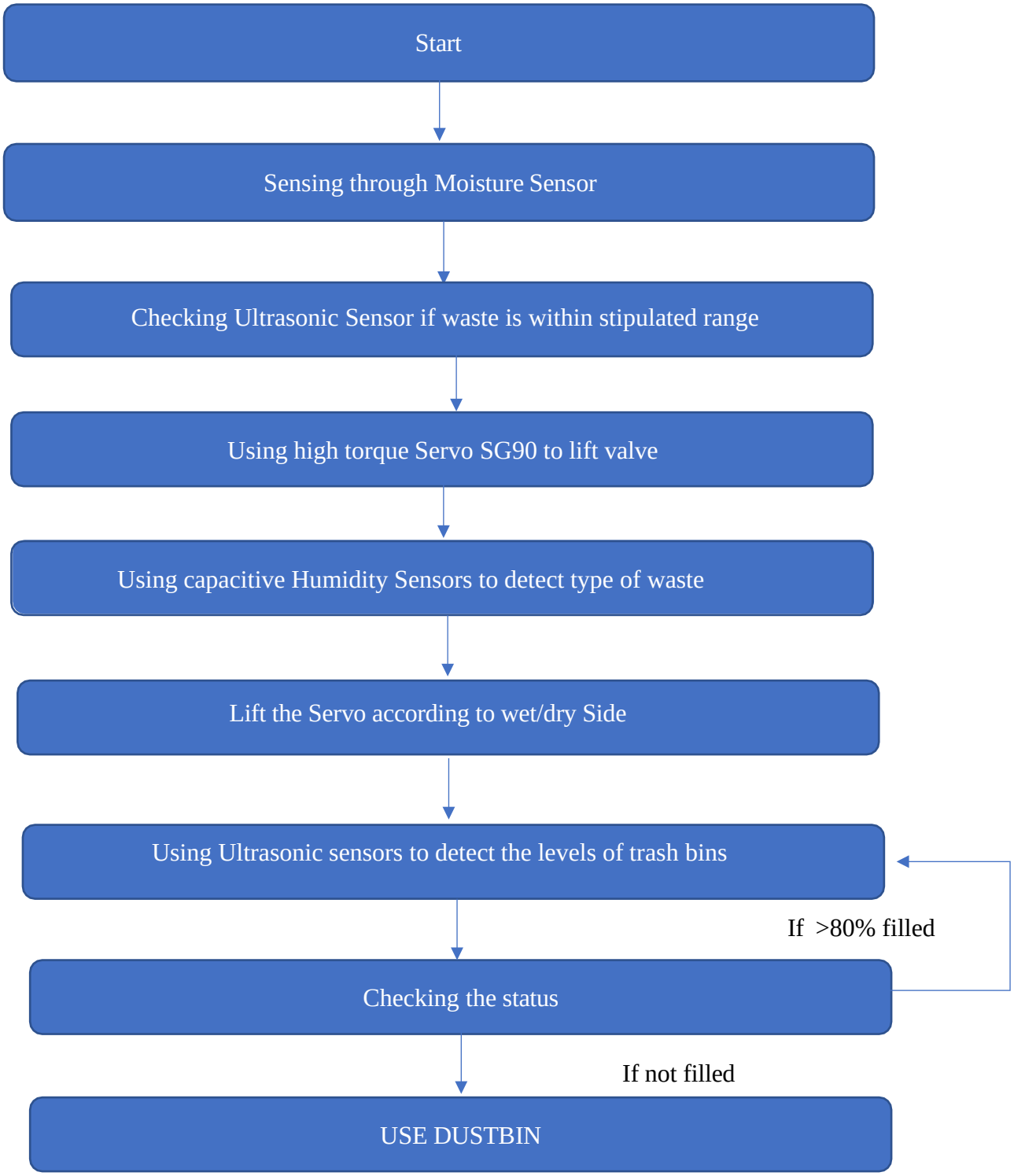
- Here we have program it to open the race for only 5 seconds after 5 seconds the flap automatically closes.

- We would segregate the waste as wet and non-wet waste using Moisture sensor

CIRCUIT DIAGRAM :



FLOWCHART :


Start
Sensing through Moisture Sensor
Checking Ultrasonic Sensor if waste is within stipulated range
Using high torque Servo SG90 to lift valve
Using capacitive Humidity Sensors to detect type of waste
Lift the Servo according to wet/dry Side
Using Ultrasonic sensors to detect the levels of trash bins
If >80% filled
Checking the status
If not filled
USE DUSTBIN

}

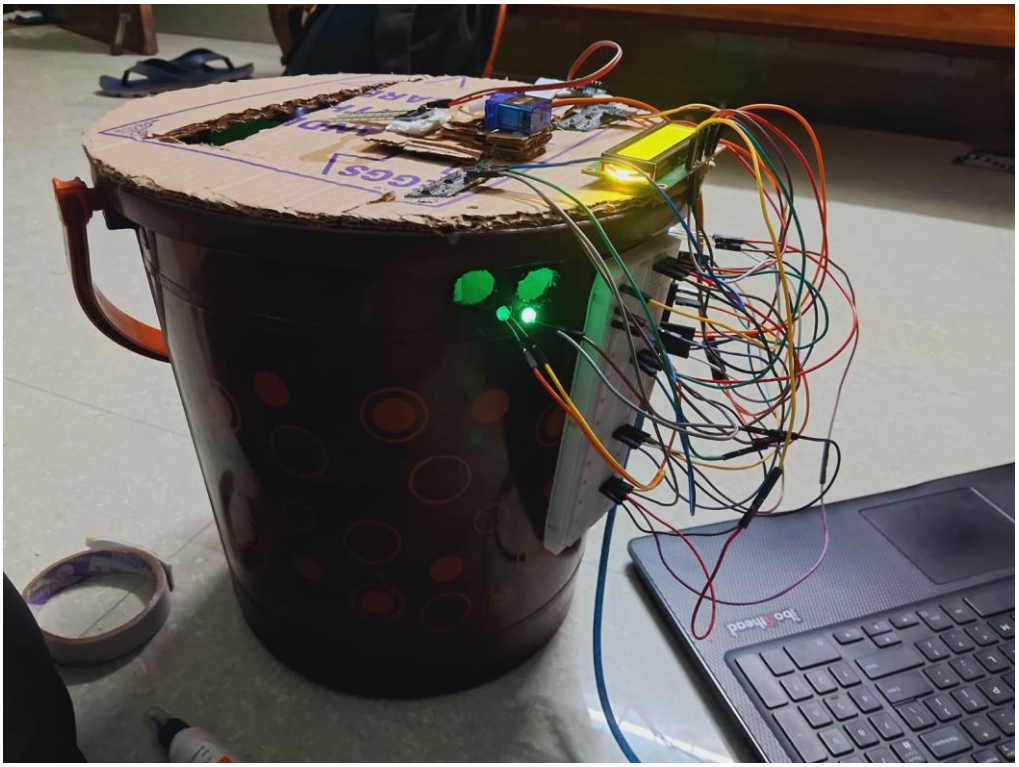
Project Code :

```
const int trigPin = 6;
const int echoPin = 5;
const int trigPin1 = 3;
const int echoPin1 = 2;
const int trigPin2 = 10;
const int echoPin2 = 11;
const int sensor_pin = A1;
long duration;
int distanceCm;
long duration1;
int distanceCm1;
long duration2;
int distanceCm2;
#include <Servo.h>
Servo Servo1;
int servoPin = 9;
void setup() {
  Serial.begin(9600);
  pinMode(trigPin, OUTPUT);
  pinMode(echoPin, INPUT);
  pinMode(trigPin1, OUTPUT);
  pinMode(echoPin1, INPUT);

  pinMode(trigPin2, OUTPUT);
  pinMode(echoPin2, INPUT);

    Servo1.attach(servoPin);
}
void loop() {
  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);
  duration = pulseIn(echoPin, HIGH);
  distanceCm = duration * 0.034 / 2;
  int a=distanceCm;
digitalWrite(trigPin1, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPin1, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin1, LOW);
  duration1 = pulseIn(echoPin1, HIGH);
  distanceCm1 = duration1 * 0.034 / 2;
  int b=distanceCm
  digitalWrite(trigPin2, LOW);
delayMicroseconds(2);
  digitalWrite(trigPin2, HIGH);
  delayMicroseconds(10);
```

```
  digitalWrite(trigPin2, LOW);
  duration2 = pulseIn(echoPin2, HIGH);
  distanceCm2 = duration2 * 0.034 / 2;
  int d=distanceCm2;
  int sensor;
  sensor = analogRead(sensor_pin);
  int c=sensor;
  Serial.println(sensor);

    Serial.println((distanceCm*100)/27);
   Serial.println((distanceCm1*100)/26);
    Serial.println(distanceCm2);

  delay(1000);
//''''''''''''''''''''''''''''''''''''''''
if(d>8&&d<17){

  if(a<5&&b<5)
  {
   Servo1.write(130);
   delay(500);
  }
   else if(a>5&&b<5&&c<800)
   {
     Servo1.write(120);
   delay(5000);
   Servo1.write(130);
   delay(500);
  }
  else if(a>5&&b>5&&c>800)
   {
     Servo1.write(60);
   delay(5000);
   Servo1.write(130);
    delay(500);
  }
   else if(a>5&&b>5&&c<800)
    {
      Servo1.write(180);
    delay(5000);
    Servo1.write(130);
    delay(500);
  }
  }
else {
Servo1.write(130);
}
}
```

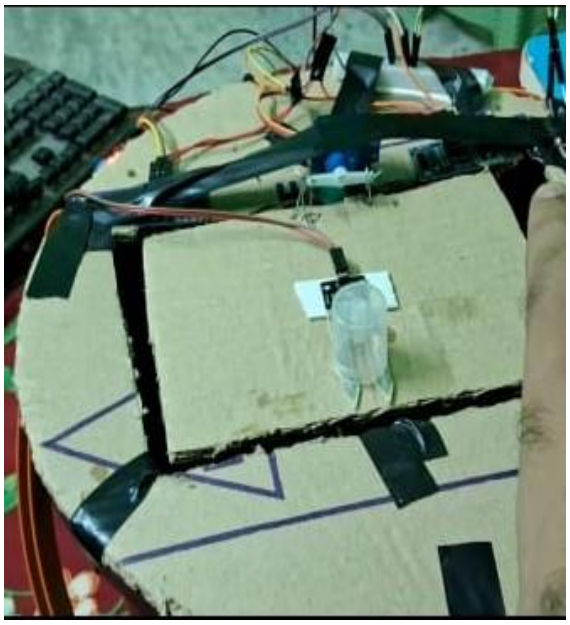
PROJECT WORKFLOW

1. Literature survey on various Garbage Collection technologies
2. Studied on how can we implement different sensors and their uses in this particular field
3. Understanding basic requirements of the projects
4. Unleash the model requirements and trying to understand the components cost and budget of the model
5. Circuit completion
6. Implementation of idea inside dustbin

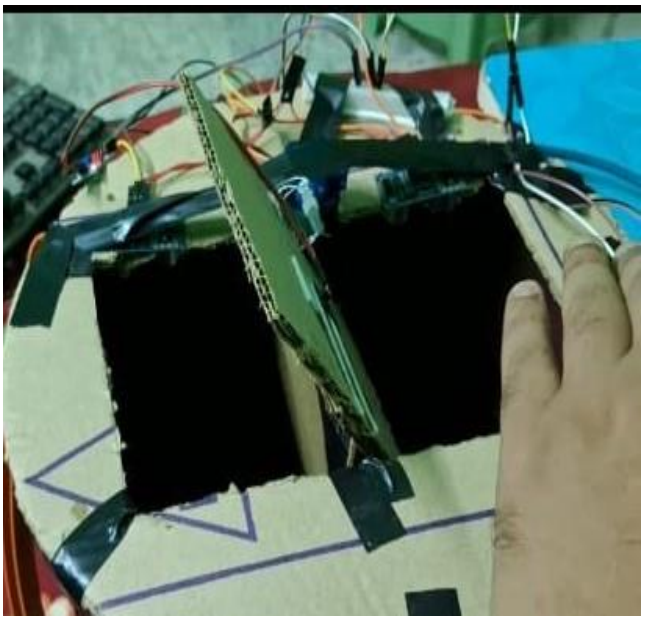


RESULTS AND DISCUSSION

CASE 1: When both wet and dry Wastebins are EMPTY

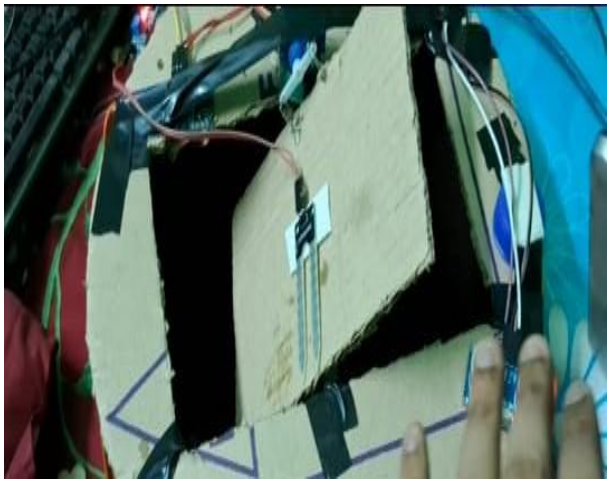


Dry Waste



Opening Right Valve for Garbage Disposal

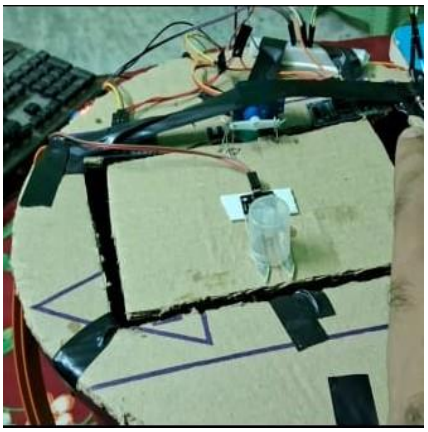
Wet Waste



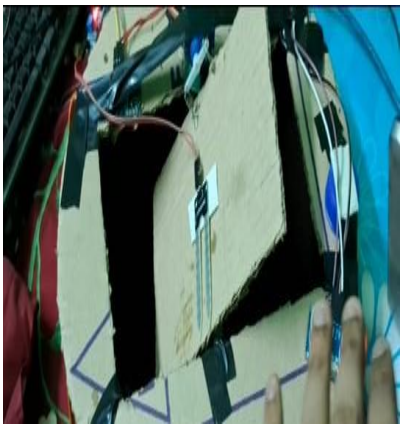
Opening Left Valve for Garbage Disposal

Case 2 : When either of two halves is filled (Say dry side is filled)

Wet Waste



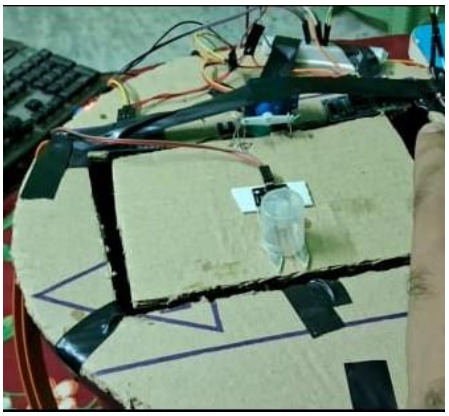
Dry
Waste



Use Wet Side Bin as
Dry Side is filled

Case 3 : When both wet side and dry side are filled

When the wet waste is given ,
the dustbin will not open as it is full



When the dry waste is given ,
the dustbin will not open as it is full

FUTURE PLAN :

Initially , We will try to focus on the basic structure of the model. Our next step is to modify the models in different ways by adding different key features which will make the implementation of smart waste management system in more faster way. We will add the feature of monitoring the levels of waste through a automation which can be controlled or displayed in personal phones. When implemented in real time environment , it would help to fetch information about the people that which nearby dustbin is empty available , also it would help city Garbage collector to collect the garbage when its necessary.

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Implementation of Smart Waste Management System

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Report for Project Part-II (EC882)

Group no. 14

B. Tech in Electronics and Communication Engineering

B. P. Poddar Institute of Management & Technology under

Maulana Abul Kalam Azad University of Technology

Under the supervision of

Ms. Banhi Das

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Academic Year: 2022 - 2023

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Department of Electronics & Communication Engineering B.P.Poddar Institute of Management & Technology

Studying related documents and research papers Components accumulation Recognizing the connections

8th Semester:-JOB 23rd-19th

Jan-Feb 20th-18th Feb-Mar 19th -2nd

Mar-Apr 3rd – 9th

Apr 9th - 30th Apr 1st-15th

May 16th- 30thMay

Testing the model

Using software simulation Understanding the algorithm & Program logic building Implementing the full circuit using the circuit simulation Mid-term report preparation Code implementation and Recognizing the connections Testingthe actual model Final Report Writing and Presentation

INTRODUCTION :The Embedded devices that are connected to Internet and sometimes these devices can be controlled from the internet is commonly called as Internet of Things. In our system, the Smart dustbins are connected to the internet to get the real time information of the smart dustbins. In the recent years, there was a rapid growth in population which leads to more waste disposal. So a proper waste management system is necessary to avoid spreading many diseases by managing the smart bins by monitoring the status of it and accordingly taking the decision. There are multiple dustbins that are located in the city or the Campus (Educational Institutions, Companies, Hospitals etc.). These dustbins are interfaced with micro controller based system with Ultrasonic Sensors and Wi-Fi modules. Where the Ultrasonic sensor detects the level of the waste in dustbin and sends the signals to micro controller the same signal are encoded and send through Wi-Fi Modular (ESP8266) and it is received by the end user. The data will be sent to the user through E-Mail i.e, a mail will be sent as notification that the dustbin is full so that the municipality van can come and empty the dustbin. In this Corona pandemic everything must be contactless, So we try to make a Contactless Dustbin called Smart Dustbin.

The population of cities is expanding day by day. The amount of waste produced increases in direct proportion to this situation. This case makes the development of sustainable solutions for city life a requirement, already.

COMPONENTS REQUIRED :Hardware Requirements :Arduino UNO

Ultrasonic distance sensor HC-SR04

Sg-90 micro servo motor

Dustbin

```
else if(a>5&&b>5&&c8&&d5&&b5&&b>5&&c>800)
{
Servo1.write(130);
delay(500);
}
else if(a>5&&b>5&&c<800>write(180);
delay(5000);
Servo1.write(130);
delay(500);
}
}
else {
Servo1.write(130);
}
}
```

PROJECT WORKFLOW

Literature survey on various Garbage Collection technologies

Studied on how can we implement different sensors and their uses in this particular fieldUnderstanding basic requirements of the projects

Unleash the model requirements and trying to understand the components cost and budget of the model

Circuit completion

Implementation of idea inside dustbin

RESULTS AND DISCUSSION

CASE 1: When both wet and dry Wastebins are EMPTY

290112117890351834211789O

Dry Waste Opening Right Valve for Garbage Disposal

3510390293200031396629320O0

Wet Waste Opening Left Valve for Garbage Disposal

Case 2 : When either of two halves is filled (Say dry side is filled)

296583763390004845436466040289587470730O

Wet Waste Dry Use Wet Side Bin as Waste Dry Side is filled

Case 3 : When both wet side and dry side are filled

71142114406200

3724717861400

When the wet waste is given , When the dry waste is given ,

the dustbin will not open as it is full the dustbin will not open as it is full

FUTURE PLAN :Initially , We will try to focus on the basic structure of the model. Our next step is to modify the models in different ways by adding different key features which will make the implementation of smart waste management system in more faster way. We will add the feature of monitoring the levels of waste through a automation which can be controlled or displayed in personal phones. When implemented in real time environment , it would help to fetch information about the people that which nearby dustbin is empty available , also it would help city Garbage collector to collect the garbage when its necessary.

MATCHED SOURCES:

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