SMART WASTE SEGREGATOR

Mini Project Report submitted by

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In partial fulfillment of the requirements for the

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Certified that the mini project work entitled

"Smart Waste Segregator"

is a bonafide work carried out by

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Bachelor of Engineering Degree in Artificial Intelligence and Machine Learning Engineering

prescribed by Visvesvaraya Technological University, Belgaum

during the year 2022-2023.

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Kavana Pai

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Abstract

The amount of waste has been increasing due to the increase in human population and urbanization. In cities, the overflowed bin creates an unhygienic environment. Thus degrades the environment, to overcome this situation “Smart Waste Segregator” is developed to reduce to work for the ragpickers the wastes are segregated by the human beings which leads to health problems to the workers. The proposed system separates the waste into three categories namely wet and dry waste. This developed system is not only cost efficient also makes the waste management productive one. Each of the wastes are detected by the respective sensors and gets segregated inside the bins.

TABLE OF CONTENTS

CHAPTER 1
INTRODUCTION

The abundant increase in population led to the improper waste disposal. Managing the garbage consumes more time and requires a lot of man power. In recent years the waste disposal is becoming a huge cause. The most of common method of waste disposal is unplanned and it is dumped at the landfill sites this method causes ill effects to all living beings. This method can generate liquid leachate and other fungus which pollute the surface and underground water also accelerates harmful dieases which leads to the degradation of a aesthetic value of environment. In India recycling of solid waste is done by the rag pickers who play an important role in this process while doing the ragpickers get affected with many health problems such as skin infections ,respiratory problems the dependent of ragpickers can be reduced if the automatic waste segregation takes place in the dustbin. The wastes is segregated into basic main streams such as dry and wet these waste has a large potential of recycled and reused . even through there are multiple industrial waste segregators present , it is always better to segregate the waste at source itself. The advantage of doing this type of segregation is, there is no need of rag pickers to segregate the waste. In addition to it the segregated waste can be directly sent to the recycling plant, instead of sending the waste to segregation plant and then to recycling plant. Currently there is no such system for the automatic segregation of waste into dry, wet and metallic waste, the main purpose of this project is compact, low cost and user friendly waste segregation system for urban cities to streamline the waste management process.

1.1 OVERVIEW

Waste Management and segregation is a much-needed process in metro cities and urban areas due to spreading of diseases. It is estimated that India produces 42.0 million tons of municipal solid waste annually at present. 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. When waste is thrown in the pipe, IR sensor will sense the waste. Waste is divided into three categories namely Wet, Dry and Metallic. Another sensor will sense the garbage category. As per the algorithm used, if the waste is metallic then the mechanism will bring the metal collecting bin below the pipe and with the help of servo motor the waste will fall into the metal bin. Similarly, the process will repeat if wet waste is sensed. If the sensor doesn't activate both the sensor category then the waste will be considered to be a dry waste.

1.2 PROBLEM STATEMENT

Waste is any substantial that is undesirable or unusable. It is any substance which is discarded after primary use, or is worthless, flawed and of no use. The rapid growth and accumulation of waste in our society is a major problem, especially when monitoring and management tools are not properly maintained. In a smart city that continuously reduces pollution, hygiene is essential and cleaning begins with the setting up of waste treatment facilities in strategic locations. Real-time monitoring and management of strategically placed containers and final destination dumping is essential. As we know that, house to house garbage collection is critical issue for the respective garbage management authority so, to overcome this kind of problem, we came up with the new and refreshing idea. Therefore, this study presents an innovative system that helps keep cities clean by applying a system to monitor and control the level of garbage cans.

1.3 STUDY AREA

Waste segregation is the sorting and separation of waste types to facilitate recycling and correct onward disposal.Waste segregation should be based on The type of waste and most appropriate treatment and disposal. Sorting your waste makes it easier to understand how to reduce your general waste output, identify items that can be reused and set aside items that should be recycled. Beyond that, however, there's also a moral imperative to be responsible for how you handle your trade waste.

1.4 OBJECTIVE

Our Project mainly deals with the most current topic i.e. Waste Segregation An efficient way of management needs to be provided for better place to live in. This project concentrate with the minimization of manual labour method utilization for exclusion of waste into an automated manner. This style which is automation of manual work not only saves the manual segregators of the numerous health issues, but also it is prove to bean economical to the nation. This proposed system when installed in apartments or small colonies, it proves to be beneficial in segregating the waste at the site of disposal itself. This is the objective of our project.

1.5 MOTIVATION

Though the world is in a stage of making things better, there is still problem that is to be dealt with Garbages . Pictures of overflowing dustbins with garbages and the garbage being spilled out from the bins can be seen all around. As large number of insects and mosquitoes breed on it ,this leads to various diseases. Currently the waste gathering is conventional which acquire a lot of labors and is time overwhelming process. So there is the requirement of segregation of waste ate the source level i.e segregation of household waste.

1.6 ORGANIZATION OF THE CHAPTERS

The project report has been organized under nine chapters, which are as follows:

Chapter I: Introduces to the main idea of the project. It gives a brief knowledge about the aim and methodology of the same.

Chapter II: It includes literature survey of related works.

Chapter III: Discusses the system requirements that are needed for the project. These include functional requirements, non-functional requirements, user requirements and hardware requirements.

Chapter IV: Includes the system design details which includes flowchart,

sequence diagram.

Chapter V: Includes the implementation details of the project, application is explained in detail. It also deals with software approach.

Chapter VI: Deals with system testing concepts and the various test cases for the project.

Chapter VII: Includes the screenshots of the working model and code snippets.

Chapter VIII: Discuss the results of the project.

Chapter IX : outlines conclusions and future work that can be done

CHAPTER 2
LITERATURE SURVEY

2.1 Existing survey

Around 80% of waste collections happen at the wrong time. Late waste collections lead to overflowing bins, unsanitary environments, citizen complaints, illegal dumping, and increased cleaning and collection costs. Early waste collections mean unnecessary carbon emissions, more traffic congestion, and higher running costs.

Most of the times, the garbage bins are overflowing with excess waste and are scattered out in the street. These scattered wastes get either decayed or burnt in that place or overflows all over which leads to serious health issues to humans. The wastes which are dumped are segregated by Humans which leads to health problems to them. To overcome this problem a well organised waste segregation and monitoring system has been designed. It is an IoT based Waste Segregation and Monitoring system which is an innovative way to keep the cities clean and healthy. Since the population of our world is increasing rapidly, the environment should be clean and hygienic in order to lead a better life. This is a model for Waste Segregation for Smart cities

The old way of doing waste management is highly inefficient. And in today's ever-technological world, an innovative and data-driven approach is the only way forward. Traditionally, municipalities and waste management companies would operate on a fixed collection route and schedule. This means that waste collection trucks would drive the same collection route and empty every single waste container – even if the waste container did not need emptying. This means high labor and fuel costs – which residents ultimately foot the bill for. This is also an unsustainable way of working - the more vehicles on the road carrying out unnecessary collections means more carbon emissions are released into our planet's atmosphere.

2.1 PROPOSED SYSTEM

In order to segregate waste appropriately, it is important to correctly identify the type waste that is generated. For the purposes of waste segregation at source, waste is identified and classified into the different categories. Moisture sensor is used to classify the waste into dry and wet waste categories.

Waste segregation is critical because of the fact that certain types of wastes can be hazardous and can contaminate the environment if not managed correctly. (Some of these types of waste may also have the potential to cause disease or get into water supplies or contaminate the land with different types of leachates.)

When waste is unsegregated, it may get contaminated with different types of waste being stored together. Such waste cannot be treated or managed and most of the time end up being dumped into local dump yards or landfills. With waste segregation, management of different types of wastes becomes possible. This directly results in reduced amounts of waste being dumped at dump yards or landfills.

Waste Segregation is always step one for all types of waste management solutions that may be implemented either on individual level or community level.

CHAPTER 3
SYSTEM ANALYSIS AND REQUIREMENTS

3.1 SYSTEM ANALYSIS

3.1.1 Relevance of Platform

The Arduino IDE is an open-source software, which is used to write and upload code to the Arduino boards. The IDE application is suitable for different operating systems such as Windows, Mac OS X, and Linux. It supports the programming languages C and C++. Here, IDE stands for Integrated Development Environment.

The program or code written in the Arduino IDE is often called as sketching. We need to connect the Genuino and Arduino board with the IDE to upload the sketch written in the Arduino IDE software. Arduino is super easy to learn. Any beginner can learn Arduino with little or no knowledge of programming. It uses a simplified version of C/C++ language which is easily adaptable. It is an ideal board for beginners. Arduino is a plug and play electronic board with a simple and minimalistic hardware interface.

3.1.2 Relevance of Programming Language

Arduino is super easy to learn. Any beginner can learn Arduino with little or no knowledge of programming. It uses a simplified version of C/C++ language which is easily adaptable. It is an ideal board for beginners. Arduino is a plug and play electronic board with a simple and minimalistic hardware interface**.**

Programming languages get utilized to instruct a computer to perform certain tasks. Every programming language follows a set of rules and defines a vocabulary, just like a natural language. However, processors can't directly understand them, and a human-readable program needs to get converted into binary values that a computer can understand. C++ is an immensely popular and versatile language that usually requires a compiler which performs the translation.

3.2 REQUIREMENT ANALYSIS

3.2.1 Scope and Boundary

Requirements are during early stages of a system development as a specification of what should be implemented or as a constraint of some kind of on the system. They may be a user level facility description, a detailed specification of expected system behaviour, a general system property, a specific constraint on the system, and information on how to carry out some computation or a constraint on the development of the system. The end product of the requirement analysis phase is a requirement specification. The requirement specification is a reconstruction of the result of this analysis phase. Its purpose is to communicate this result to others. System requirements are more detailed descriptions of the user requirements. They may serve as the basis for a contract to the implementation of the system and should therefore be a complete and consistent specification of the whole system. In principle, the system requirements should state what the system should do and not how it should be implemented. However, at the level of detail required to specify the system completely, it is virtually impossible to exclude all design information.

3.3 FUNCTIONAL REQUIREMENTS

3.3.1 Software Requirements:

- Software: Arduino IDE

3.3.2 Hardware Requirements

- Operating system: windows 7 and above.
- RAM: 4GB and above.
- Processor: Intel® Core(TM)2 duo CPU T6500.
- Processor speed: 2.67 GHz.
- CPU: 64-bit operating system.

- Sensors : Moisture sensor, Touch Sensor
- Actuator : Servo Motor (200 W)
- Micro-controller : Arduino board

3.4 NON-FUNCTIONAL REQUIREMENTS:

In systems engineering and requirements engineering, a non-functional requirement (NFR) is a requirement that specifies criteria that can be used to judge the operation of a system, rather than specific behaviours. Non-functional requirements are conditions under which the system must be able to function and the quality the system must have. It defines how a system is supposed to be.

- Performance
  - With ideal condition of sensors and input, response should be fast and error free.
  - Model performance shall not decrease with time or by usage.
- Flexibility:
  - It will be easy to learn and use.
  - Is able to sense and give the output as quickly as possible.
- User-friendly:
  - The Segregator's multiple features should be self explanatory.
- Response Time:
  - The segregator should sense ang segregate as quickly as possible.
  - The code should be complied and uploaded fast to the Arduino board.
- Understandability:
  - All users can learn to operate the model because of its simplicity.

CHAPTER 4
APPORACH

4.1 Arduino IDE

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino hardware to upload programs and communicate with them.

Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension .ino. The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information. The bottom righthand corner of the window displays the configured board and serial port. The toolbar buttons allow you to verify and upload programs, create. open, and save sketches, and open the serial monitor.

4.2 Arduino board

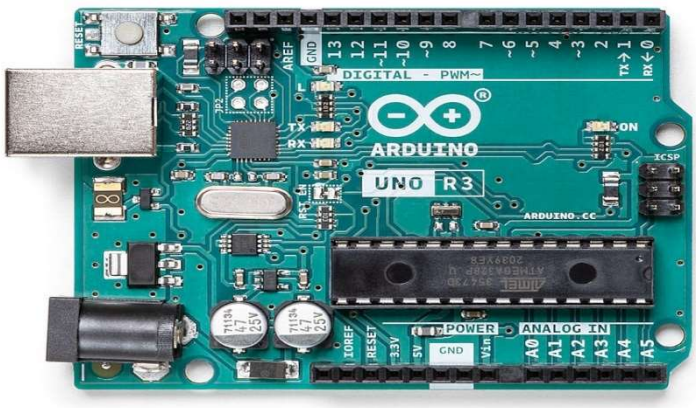


Fig 4.2 Arduino Uno

Arduino Uno is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller;

simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

4.3 Moisture sensor

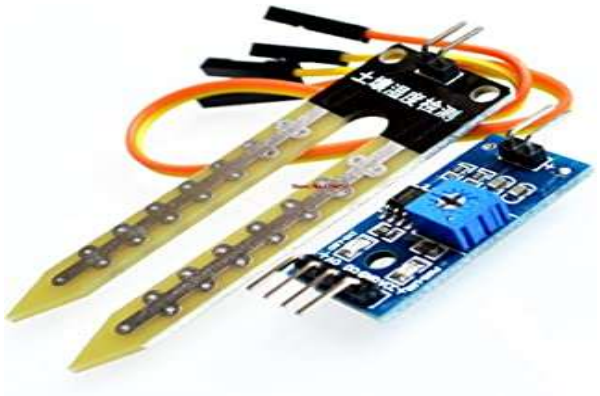


Fig 4.3 Moisture Sensor

Soil moisture sensors measure the volumetric water content in soil. 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.

The relation between the measured property and soil moisture must be calibrated and may vary depending on environmental factors such as soil type, temperature, or electric conductivity. Reflected microwave radiation is affected by the soil moisture and is used for remote sensing in hydrology and agriculture. Portable probe instruments can be used by farmers or gardeners.

4.4 Touch Sensor

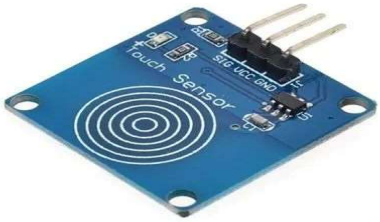


Fig 4.4 touch sensor

Touch sensors are also known as Tactile sensors. These are simple to design, low cost and are produced in large scale. With the advance in technology, these sensors are rapidly replacing the mechanical switches. Based on their functions there are two types of touch sensors- Capacitive sensor and Resistive sensor. Capacitive sensors work by measuring capacitance and are seen in portable devices. These are durable, robust and attractive with low cost. Resistive sensors don't depend on any electrical properties for operation. These sensors work by measuring the pressure applied to their surface.

4.5 Servo Motor

Fig 4.5 Servo Motor

A servomotor (or servo motor) is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration.[1] It consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors. Servomotors are not a specific class of motor, although the term *servomotor* is often used to refer to a motor suitable for use in a closed-loop control system. Servomotors are used in applications such as robotics, CNC machinery, and automated manufacturing.

CHAPTER 5

SYSTEM DESIGN

5.1 HIGH LEVEL DESIGN ARCHITECHTURE

Code is injected to the arduino uno board. All components are mounted on aurdino uno board connected using the jumper wires. The code runs continuously until the connection got disconnected.

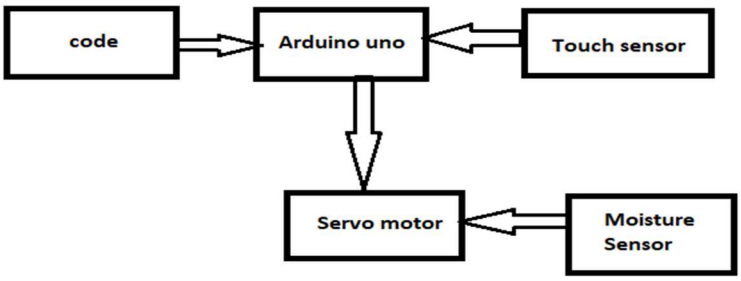


Figure 5.1: High Level Design Architecture

5.2 LOW LEVEL DESIGN ARCHITECHTURE

5.2.1 Circiut Diagram

A circuit diagram is a graphical representation of an electrical circuit. A circuit diagram, also called an electrical diagram, elementary diagram, or electronic schematic, is a simplified graphical representation of an electrical circuit. Circuit diagrams are used for the design, construction and maintenance of electrical and electronic equipment. A circuit diagram is a simplified representation of the components of an electrical circuit using either the images of the distinct parts or standard symbols. It shows the relative positions of all the elements and their connections to one another.

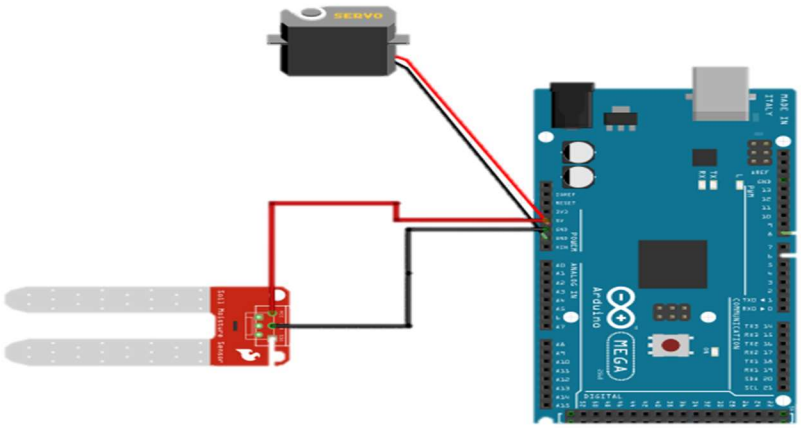


Figure 5.2.1 : Circuit Diagram of moisture sensor and servo motor

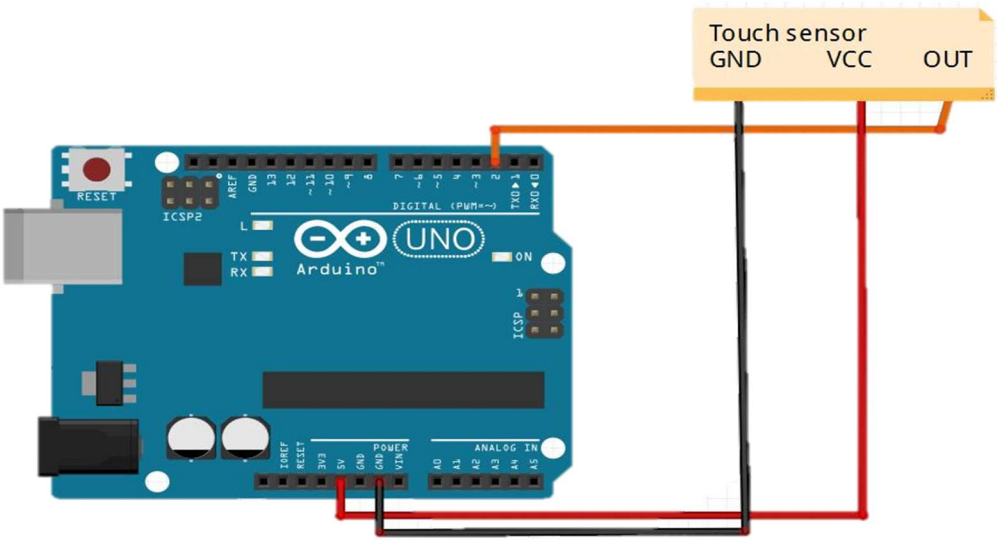


Figure 5.2.2 : Circuit Diagram of touch sensor

5.2.2 Construction

- I have used 2 acrylic sheets as body of my segregator
- Servo motor is used as an actuator which will rotate depending on the type of waste (dry or wet)
- I have used very low cost stationary Scale /Ruler as the shaft of my servo motor. This connects the upper base and servo Motor. I have used Glue gun to stick it.
    - Note: you can also use feviquick as your glue but its risky so use it carefully.
- 4.Moisture sensor is fixed on to upper part of segregator such that when is waste is put it directly lands on sensor. There is also a touch sensor besides it to detect dry waste. This Completes the construction of this project.

CHAPTER 6
SYSTEM IMPLEMENTATION

6.1 Implementation

- Step 1: As shown in the above image gather 2 Acrylic sheets. You can get these sheets anywhere in local shops or order it online through amazon.
- Step 2: Make the holes in the acrylic sheets as shown in the image so that you can fix the batter holder to it.
- Step 3: Then on the upper side of the battery holder stick the servo motor pointing straight ahead as shown in the image. You can fix the servo motor by double sided tape or glue gun.
- Step 4: Then take a plastic stationary scale(That you used to use in schools for drawing lines) and make a hole in it at its bottom which will be little less than the diameter of the motor shaft.(You can make the holes by using a hot soldering iron or any other thin steel rod.)
- Step 5: Stick the other acrylic sheet on the top of the scale as shown in the image using glue gun. Make sure it's fixed tight and doesn't move.
- Step 6: Place the moisture sensor and touch sensor on the top of the acrylic plate.

6.2 MODULES

Waste segregation is extremely crucial due to the fact that if all waste materials such as polythene bags, old furniture, and e-waste get mixed up in the landfills, could lead to contamination of the land and water through leaking harmful substances in the atmosphere. Moreover, non-segregation also affects climate change which may lead to drought conditions. Thus, it is essential to separate waste before disposing into the landfill. Waste segregation is also not only important but also beneficial for human beings. The recyclable parts of the waste can be recycled into useful resources after the segregation process. It has a large meaning for the current society which is facing the problem of resource shortage.

If we segregate waste at the source itself, it solves more than half of our task and the main problem that we face in managing solid waste would lessen considerably. Only we need to behave responsibly to accomplish the goal of waste separation. To increase the activity of recycling, a basic requirement is to concentrate on waste segregation that helps to recognize the degradable and non-biodegradable parts of the waste. Since the degradable waste is organic, its disposal does not cause any harm. The non-biodegradable waste is the inorganic part that is good for recycling. The biggest danger is when the inorganic waste finds its way back to the earth and raises the pollution measurement besides causing other damages to the environment. The inorganic waste reaches the market that deals in scrap materials where further segregation breaks it into its elements like paper, plastic, metal, etc. These materials ultimately pass through the market chain and reach the manufacturers who use it as raw material.

Dry waste :

Dry waste consists of waste that does not decay. It is also known as waste which cannot be biodegradable. Dry waste consists of paper, glass, thermocol, Styrofoam, rubber, metal, cloth, empty bottles, stationeries, etc. and can be recycled into new products further. Before segregating, sharp materials like glass and other metals shall be kept in a separate bag/container**.** Dry waste is the kind of waste which is not biodegradable. Hence wet waste can be converted and recycled into new products and reused further.

Wet waste :

Wet waste is all the kitchen waste that we produce. Eg: vegetable peels, used tea bags, fruits, leftovers, coconut shells, flowers, leaves, meat or nonveg, expired food items, bread, biscuits, etc. This is organic waste which can be recycled and converted into compost. Most of the wet waste comes from the kitchen itself. Restaurants, buildings and factories need efficient wet waste management systems.

CHAPTER 7

SYSTEM TESTING

7.1 Testing

Testing phase is performed after coding and connection to detect all the errors and provide quality assurance and ensure reliability of the model. Testing is vital to the success of the system. Testing is a process used to identify the correctness, completeness and quality of the developed software. Testing is the process of questioning a product in order to evaluate it, where the questions are things the tester tries to do with the product and the product answers with its behaviour in reaction to probing of the tester.

Unit Testing is a level of software testing where individual units/ components of a software and equipment are tested. The purpose is to validate that each unit of the software performs as designed. Unit testing increases confidence in changing/ maintaining system. Codes are more reusable. The cost of fixing a defect detected during unit testing is lesser in comparison to that of defects detected at higher levels.

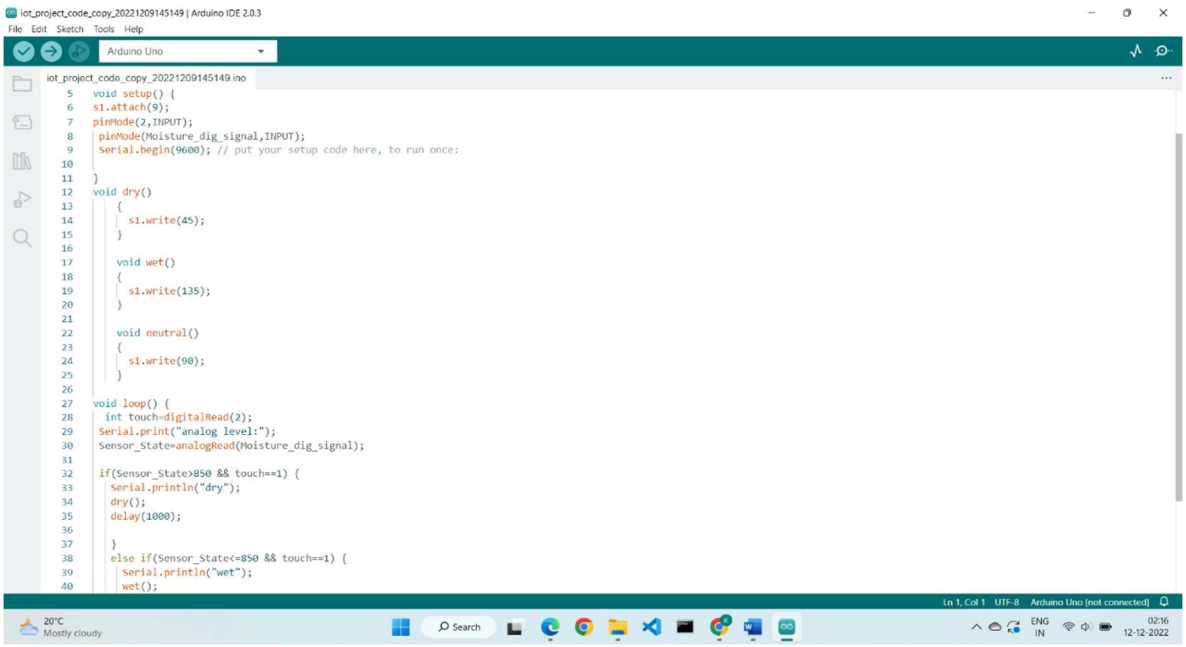
Integration Testing is a level of software testing where individual units are combined and tested as a group. The purpose of this level of testing is to expose faults in the interaction between integrated units. Test drivers and test stubs are used to assist in Integration Testing. Testing performed to expose defects in the interfaces and in the interactions between integrated components or systems. Testing the integration of systems and packages; testing interfaces to external organizations.

CHAPTER 8

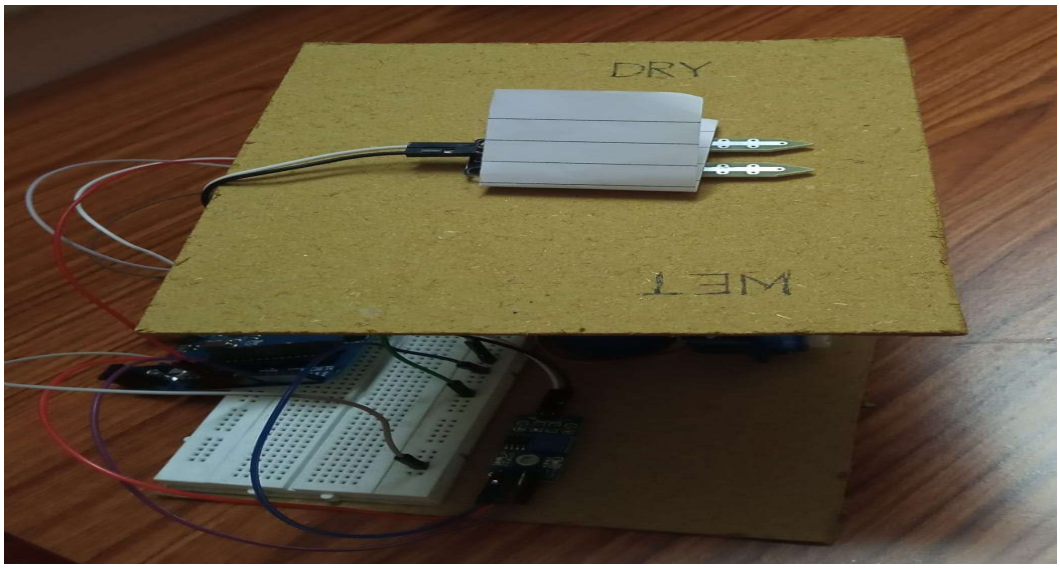
RESULTS AND DISCUSSSIONS

8.1 Working

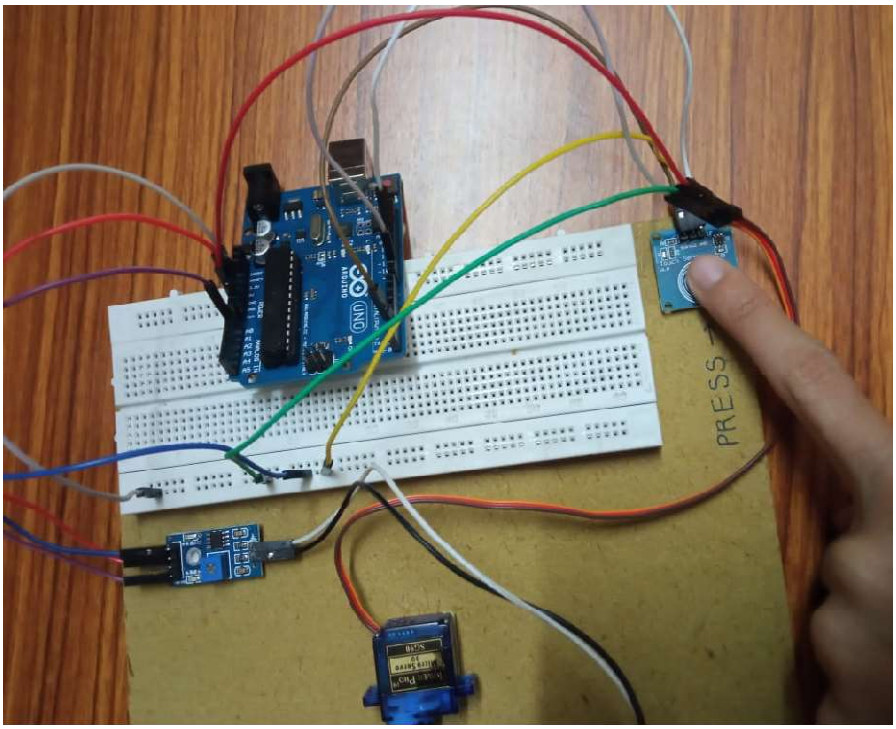
- Step 1: write the program to classify the waste as dry and we waste in Arduino IDE



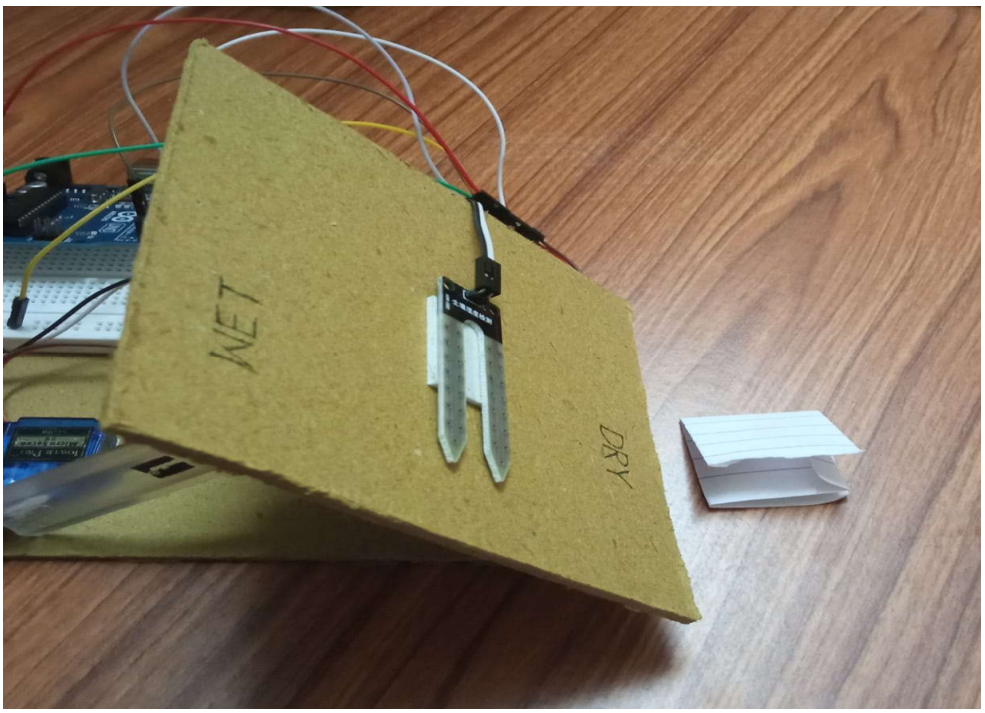
- Step 2: Waste is put and lands on moisture sensor.



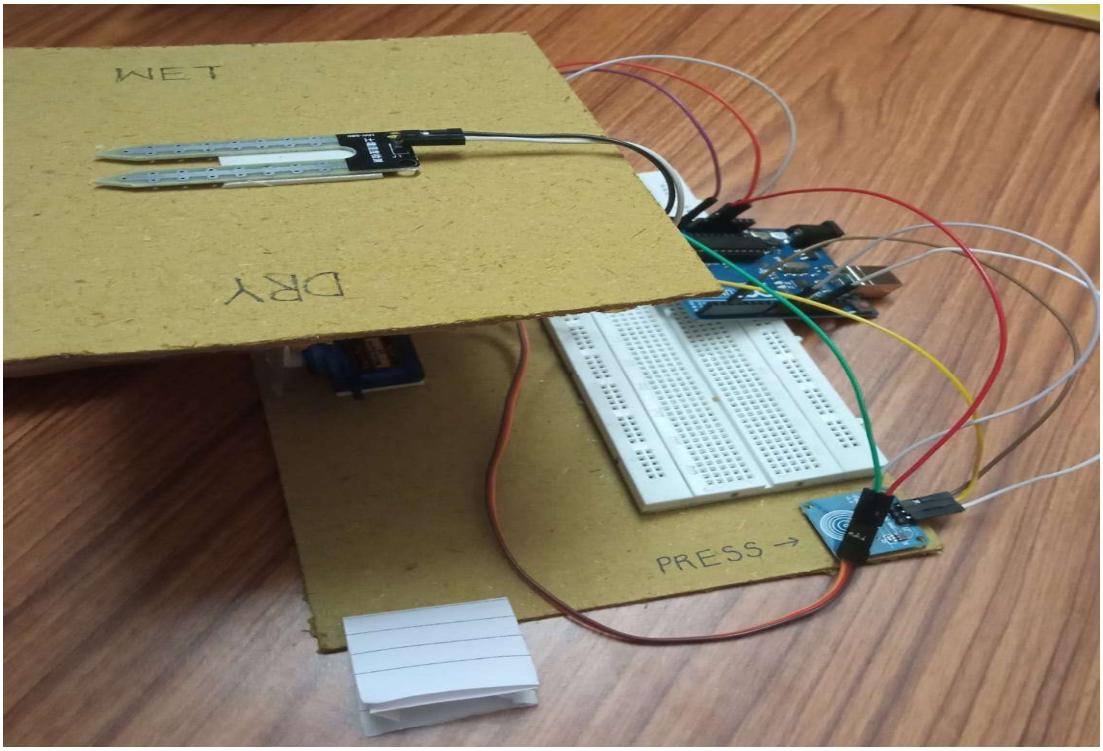
- Step 2: Using the touch sensor, activate the moisture senor to segregate the waste



- Step 3: Depending upon the Threshold set Moisture sensor classifies it as dry or wet.



- Step 4: As soon step 2 is done Servo Motor runs to either direction depending upon the type of waste and the waste goes in the appropriate compartment.



- Step 5: The whole process is autonomous and Continuous.

8.2 DISCUSSIONS

In the present world of digitizing everything in our surroundings has been equipped with modern technology and the internet to ease our work and gain more efficiency. But the systems existing today for waste management are the same as they were before in most of the countries. Currently, for the collection of waste in some countries, we have door to door collection systems that require a lot of efforts and money. A waste collector has to visit everybody's place, knocking the doors and has to wait until each resident brings the waste to them. Moreover, residents have to be available in order to get their waste collected at that particular time which brings in a major disadvantage of this system. Also in some countries, systems do exist in which waste is collected from the trash bins of each colony, but this system also brings a disadvantage that many a time dustbins are overfilled and waste isn't collected from it, as waste is collected on a particular day and not according to its status. This also makes dustbins, a place facilitating bacterial growth, feeding animals and a breeding place for insects. Also at times, it happens that dustbin collection is done in prior resulting in wastage of fuel and increasing costs of waste collection. So, at each step, a lot of fuel and money is invested unnecessarily for the process.

CHAPTER 9

CONCLUSION AND FUTURE WORK

9.1 CONCLUSION

With growing urbanisation and increasing population, effective waste disposal is a major concern. Manual waste segregation is very expensive, time consuming and inefficient. This paper presents a smart and cost effective solution for waste segregation. The proposed SmartBin is an efficient waste segregation system that requires no human intervention to separate dry and wet waste and paves the path for timely collection and disposal. The proposed system can be deployed a domestic scale in households or on a large scale in public places.

9.2 FUTURE WORK

The Automatic Waste Segregator has been implemented for the segregation of waste into dry waste and waste waste. Smart dustbin is an innovative step in the direction of bringing a change in the current garbage disposal system. Further the self-changing technology can be implemented so that the battery of the smart bin is low on power then using solar tracker the smartbin

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