A
Project Report
on

DESIGN AND DEVELOPMENT OF AUTOMATIC SORTING OF RAILWAY PLATFORM DUSTBIN-WASTE FOR EFFICIENT RECYCLABILITY

submitted to

Sant Gadge Baba Amravati University,
Amravati (M.S.) 444 602

in partial fulfillment of the requirement

for the degree of

BACHELOR OF ENGINEERING
in
MECHANICAL ENGINEERING

by

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Certificate

This is to certify that the project report entitled **"Design and Development of Automatic Sorting of Railway Platform Dustbin Waste for Efficient Recyclability"** is hereby approved as a creditable study carried out and presented by

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Abstract

In recent decades, Urbanization has increased tremendously. At the same phase there is an increase in waste production. Keeping in focus the crucial issue of Waste management and recycling, a smart dustbin is built on a microcontroller based platform Arduino Uno board which is interfaced with embedded systems, which enables us to segregate wet and dry waste automatically and collect both types of waste in individual containers. In this project, a system has been proposed which reduces the collection of wet waste and dry waste altogether in households as well as in public which is non -recyclable. The dry waste that will be collected separately can be recycled efficiently and lessen the chances of air and soil pollution. We used four different filtering units for respecting metal, plastic, wet and dry waste.

KEYWORDS: Waste segregation, Smart Dustbin, Embedded System.

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INTRODUCTION

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INTRODUCTION

1.1 Overview

In recent times, garbage disposal has become a huge cause for concern in the world. A voluminous amount of waste that is generated is disposed of by means which have an adverse effect on the environment. The common method of disposal of the waste is by unplanned and uncontrolled open dumping at the landfill sites. This method is injurious to human health, plant and animal life.

This harmful method of waste disposal can generate liquid leachate which contaminates surface and ground waters, can harbor disease vectors which spread harmful diseases and can degrade aesthetic value of the natural environment and it is an unavailing use of land resources. In India, rag pickers play an important role in the recycling of urban solid waste. Rag pickers and conservancy staff have higher morbidity due to infections of skin, respiratory, gastrointestinal tract and multisystem allergic disorders, in addition to a high prevalence of bites of rodents, dogs and other vermin.

Dependency on the rag-pickers can be diminished if segregation takes place at the source of municipal waste generation. The economic value of the waste generated is not realized unless it is recycled completely. Several advancements in technology has also allowed the refuse to be processed into useful entities such as Waste to Energy, where the waste can be used to generate synthetic gas (syngas) made up of carbon monoxide and hydrogen. The gas is then burnt to produce electricity and steam, Waste to Fuel, where the waste can be utilized to generate biofuels. When the waste is segregated into basic streams such as wet, dry and metallic, the waste has a higher potential of recovery, and consequently, recycled and reused. The wet waste fraction is often converted either into compost or methane-gas or both. Compost can replace demand for chemical fertilizers, and biogas can be used as a source of energy. The metallic waste could be reused or recycled. Even though there are large scale industrial waste segregators present, it is always much better to segregate the waste at the source itself. The benefits of doing so are that a higher quality of the material is retained for recycling which means that more value could be recovered from the

waste. The occupational hazard for waste workers is reduced. Also, the segregated Waste could be directly sent to the recycling and processing plant instead of sending it to the segregation plant then to the recycling plant.

We recommended that a least cost, most appropriate technological option for safe management should be developed. The purpose of this project is the realization of a compact, low cost and user friendly segregation system for urban households to streamline the waste management process.

1.2 Problem Statement

The main sources of waste are industrial and domestic waste. This project mainly concentrates on domestic waste whose value is unrecognized since people don't spend time on segregating waste into their basic streams. The wet waste generated can be used to generate biogas, metallic and dry waste can be sent for recycling, if metallic waste is left untreated then it becomes a threat to animal and plant lives. If waste is separated at household level then they can be directly sent for recycling instead of sending them to industries first for segregation which becomes a huge task and the waste does not get segregated accurately. The methods adopted for waste segregation in industries is hazardous to human health since it makes use of x-rays and infrared rays.

The environmental risks associated with poor waste management are well known and understood. Fly tipped wastes can poison and injure children and animals as well as create an eyesore. Careless disposal of liquid wastes such as solvents can leach into the ground water and contaminate drinking water supplies. Poorly planned and managed landfills will create a significant neighborhood nuisance, and where landfill gas and leachate are not properly treated there will be a serious threat to the safety of residents. Incinerators operated without adequate pollution abatement equipment will release highly toxic dioxins. Even recycling and composting facilities can be a source of litter and unpleasant odor if not properly regulated. The main aim of the project is to segregate waste at source level to wet, dry and metallic such that waste is not wasted but their value is understood and can be converted to a source of energy, in a cost-effective way.

1.3 Objective

The main sources of waste are industrial and domestic waste. This project mainly concentrates on domestic waste whose value is unrecognized since people do not spend time segregating waste into their basic streams. The wet waste generated can be used to generate biogas, and metallic and dry waste can be sent for recycling, if metallic waste is left untreated then it becomes a threat to animal and plant lives. If waste is separated at the household level then it can be directly sent for recycling instead of sending them to industries first for segregation which becomes a huge task and the waste does not get segregated accurately. The methods adopted for waste segregation in industries are hazardous to human health since it makes use of X-rays and infrared rays. The environmental risks associated with poor waste management are well-known and understood. The main aim of the project is to segregate waste at the source level to wet, dry and metallic such that waste is not wasted but there value is understood and can be converted to a source of energy, cost-effectively.

CHAPTER 2

LITERATURE REVIEW

CHAPTER 2

LITERATURE REVIEW

This section is dedicated to the work done on the sorting of waste and the results obtained to outline the objectives of this project. It cites the work done by the various authors contributing to the literature for this subject.

2.1 Research Papers

1) Mohit Sharma.et al **[1]** Waste management (WM) challenges in the IR are specific to two different situations traction and non-traction. While waste is generated across various IR operations, this preliminary analysis considers moving trains and railway stations, which are seen as low hanging fruits for effective implementation of waste management practices. Inconsistent or more often, non-existent data make it difficult to estimate how much waste is generated and the quantum of investment and other types of resources to be allocated to manage waste. It has also been noted that a strong institutional arrangement is needed to give the necessary importance to waste management within the Indian Railways. Food catering units are the main centers of solid waste generation at railway platforms. A large amount of recyclables, which are used for packaging food and beverages, also get generated as a result. Packaging waste includes paper, cardboard, glass bottles, metal cans and large amounts of various plastics.
2) A. Sharanya.et al **[2]** Presently, there is no automated system for segregation of wet, metallic and dry wastes where it further segregates dry into plastic and paper at domestic level. This paper shows the working of an automatic waste segregator using Arduino UNO and different sensors for detecting each type of waste i.e. wet, metal, paper and plastic. There are two circular discs where one being stationary and the other one rotatory. The sensors are placed on poles that are fixed on the stationary disc. The waste is kept on a slot cut on the rotating disc which moves to each sensor to detect the type of waste thus, opening the slot if detected correctly which ultimately falls into the respective bin kept below each sensor on the stationary disc. The purpose of this project

is the realization of a compact, low cost and user-friendly segregation system for urban households to streamline the waste management process.

3) N. S. Gupta.et al **[3]** It is a discrete state control system to prevent over dumping of waste in bins and to separate wastes automatically through conveyor belts. The filling level of each bin arranged at different positions, is detected using the IR sensor. Each bin will have separate sub conveyor belts and all these sub conveyor belts are connected to the main conveyor belt. The wastes from all sub conveyor belts will get collected in the main conveyor belt. The wastes from the main conveyor belt are given into dry, wet and metallic wastes. Internet of Things used in this project is useful for counting the number of different types of wastes. Hence the quantity of each type of wastes is also noticed.
4) M. Jayson.et al **[4]** SmartBin works on a simple yet efficient methodology. It may be customised for domestic or public use. The domestic variant will be smaller in size. The external surface may be made of durable plastic. The electronics and sub-bins for the different types of waste are made into two separate layers. The sub-bins are removable for cleaning purposes. The design uses a dual motor and tray mechanism. The waste is disposed of into a common waste tray, the only part visible to the user. It is detected by the IR sensor. This activates the moisture sensor which is fitted on the tray. There is a pre-set threshold value for classification as dry or wet waste. If the moisture sensor reading is above that value, it is classified as wet waste else it is classified as dry waste. The pre-set value may be suitably chosen to provide accurate segregation.
5) N. N. Ahamad.et al **[5]** In this paper, a fully automated waste separation system to discriminate residual and recyclable household waste is proposed. The system is designed to focus on household waste, since household waste ranks the highest volume of waste among others. It is designed to separate household waste into recyclable and residual waste according to the materials' state, which is dry and wet, by employing a moisture sensor to the waste separation system. In order to differentiate between wet waste and dry waste, a

moisture sensor is used as the main component in this system. The moisture sensor is used to measure the dielectric permittivity of the waste by using the principle of capacitance. The sensor creates a voltage proportional to the dielectric permittivity. In this specific project, the dielectric permittivity is a function of the water content. Wet waste will have more water content compared to dry waste. Hence, the dielectric constant of wet waste will be more compared to dry waste. A current is passed across the electrodes through the waste material, and the resistance to the current in the material determines the water content. If the water content of waste is high, the resistance will be low, and thus more current will pass through. On the other hand, the resistance will be at high level when the water content of waste is low.

6) S. Lopes.al et **[6]** The prototype works around the principle of waste detection with the use of an ultrasonic sensor that measures the distance to an object by using sound waves, thereby sensing the arrival of waste. Later, the metallic sensor detects metallic debris. When a metallic object is in the proximity of the coil, there is a change in the inductance of the coil. This change in inductance is used to detect the presence of metal. Once the metallic waste is isolated, the capacitive sensor separates the remaining waste as wet and dry waste. A capacitive sensor is a conductor that detects anything that is conductive or has a dielectric constant different from air. A threshold level is set, which helps us differentiate between wet and dry waste. Thus the garbage is segregated and put into the respective bins with the wipers. The waste in the containers can now be collected separately and sent for further processing. The proposed system also senses the garbage level of the dustbin and sends an alert in case if it is full. Thus the idea presented in this paper is to resolve the issue of waste segregation by automating the entire process. Also, by reducing the cost, it could be adapted at a household level. Furthermore, our honorable Prime Minister Mr. Narendra Modi's noble idea of "Swach Bharat Abhiyaan" can be achieved at a smaller level through this research work.

2.2 Overview of papers

Above research papers can be presented in brief in a tabular form as follows:

Paper No.	Waste Generation Location	Waste Constituent Material	Sorting Method
1	Railway Station	Plastic, Cardboard, Metal Cans, Paper	Not Specified
2	Household	Dry, Metal	Rotating bin
3	Not Specified	Metal, Dry, Wet	Conveyor Belt
4	Household	Dry, Wet	Tilting tray mechanism
5	Household	Dry, Wet	Conveyor belt
6	Household	Dry, Wet, Metal	Lead Screw based

Figure 2.1 Overview of Papers

CHAPTER 3

MUNICIPAL DUMP YARD SURVEY FOR WASTE MANAGEMENT

CHAPTER 3

MUNICIPAL DUMP YARD SURVEY FOR WASTE MANAGEMENT

3.1 Introduction

The survey conducted for this thesis aimed to assess the current state of a municipal dump yard and its impact on waste management practices. The study focused on gathering detailed information regarding the composition of waste, segregation practices, environmental risks, and potential opportunities for improvement. By understanding the existing challenges and identifying areas for intervention, the thesis aims to propose effective waste management strategies for the dump yard.

3.2 Methodology

Site Selection: A suitable municipal dump yard was selected based on factors such as location, size, and accessibility. Consideration was given to a dump yard that represents the typical waste management scenario in the region.

Data Collection: Data was collected through a combination of qualitative and quantitative methods, including observations, interviews, and surveys. The following aspects were covered in the survey:

a. Waste Composition: A systematic sampling method was used to determine the composition of waste in terms of wet waste, dry waste, metallic waste, and other categories. The collected samples were analyzed to quantify the percentages of different waste types.

b. Segregation Practices: The survey investigated the existing waste segregation practices at the dump yard. It included observing the segregation process, interviewing dump yard workers, and assessing the infrastructure and equipment available for waste segregation.

c. Environmental Risks: The environmental risks associated with poor waste management were evaluated. This included assessing the presence of fly-tipped waste,

contamination of groundwater, emission of hazardous gases, and any other potential risks to the local ecosystem.

d. Stakeholder Interviews: Key stakeholders involved in waste management, such as municipal authorities, waste collectors, recycling agencies, and local residents, were interviewed to gather their perspectives on the current waste management system and identify areas for improvement.

e. Best Practices and Innovative Solutions: The survey also focused on identifying successful waste management practices implemented in other regions. This involved studying case studies, reviewing literature, and exploring innovative technologies that could be adapted to improve waste management at the dump yard.

Data Analysis: The collected data was analyzed using appropriate statistical methods and qualitative analysis techniques. The waste composition data was used to understand the predominant types of waste and identify potential opportunities for recycling and energy generation. The information gathered from stakeholder interviews and best practices research was used to develop recommendations for waste management improvements.

Recommendations and Conclusion: Based on the analysis of the survey findings, the thesis will propose recommendations and strategies for effective waste management at the municipal dump yard. The recommendations will focus on waste segregation techniques, infrastructure development, stakeholder collaboration, and the adoption of innovative technologies to minimize environmental risks and maximize resource utilization.

Figure 3.1 Municipal dump yard

Figure 3.2 Municipal dump yard

3.3 Conclusion

The municipal dump yard survey conducted for this thesis provides a comprehensive analysis of the current state of waste management practices. It examines waste composition, segregation practices, environmental risks, and stakeholder perspectives to identify opportunities for improvement. The survey findings will serve as a foundation for proposing effective waste management strategies, aiming to enhance resource recovery, reduce environmental impacts, and promote sustainable waste management practices in the dump yard and similar settings.

CHAPTER 4

MECHANICAL SYSTEM

Chapter 4

MECHANICAL SYSTEM

4.1 Design Iteration

After considering four major design iterations namely, Conveyor based system, Lead-screw based system and rotating bin system and rotating arm-based system; rotating arm based system was proposed for our project. We selected this design iteration by estimating all the important parameters like aesthetics, ergonomics, economics, manufacturability & accuracy of the system. These iterations are discussed with the help of table.

Parameters	Conveyor System	Lead Screw System	Rotating Bin System	Rotating Arm System
Aesthetics	Bad	Good	Very Good	Very Good
Ergonomics	Need large space	Medium sized	Compact	Compact
Economics	Very costly	Costly	Economical	Economical
Manufacturability	Hard	Medium	Easy	Easy
Accuracy	Good	Poor	Very Good	Very Good
Limitations	Separate mechanism to segregate each type of waste	Large power required	Bin rotation is not efficient	Input waste size restricted

Figure 4.1 Design Iteration

4.2 Design Overview

4.2.1 Rotating Bin System

In rotating bin system, the waste bins rotate when the waste is detected. The system is activated with the help of the Infrared sensor which triggers all the other sensors sequentially to detect the waste type. After detection of the waste, microcontroller actuates the DC motor so that the waste bins rotate and the bin with detected waste type comes under the detection bin and the servo motor starts flapping.

The waste is dropped in the appropriate bin and the initial position of the waste bins is restored.

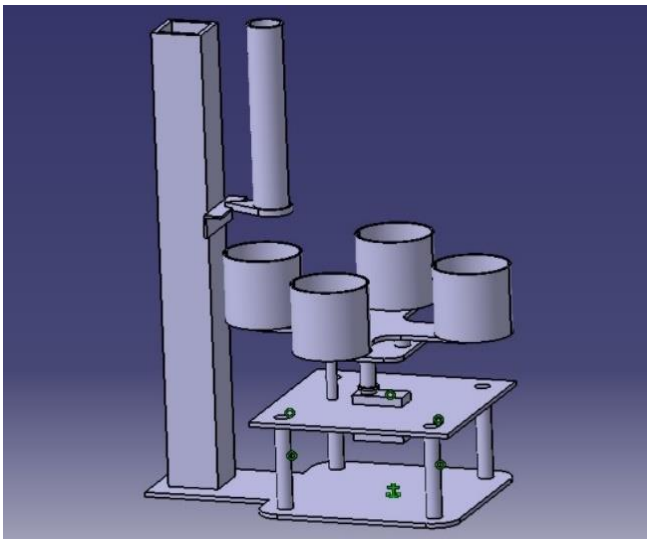

Fig. 4.1 Design of rotating bin system

4.2.2 Rotating Arm System

In Rotating Arm System, the waste bins do not rotate. In this system the DC motor is placed in between waste bins. A tapered plate is attached to the dc motor. The system is activated with the help of Infrared sensor which triggers all the other sensors sequentially to detect the waste type. When the waste is detected the DC motor rotates and the tapered plate rotates towards the bin in which waste has to be dropped.

Fig 4.2 Rotating arm system

4.3 Mechanical Process Flow

The distribution of waste according to its type is depicted as follow

4.3.1 Rotating Bin System

4.3.1.1 Distribution of Metallic Waste

- Bins are in its initial position and proximity sensor has detected metallic waste.
- LM393 DC Motor starts rotating and metallic waste bin comes under detection bin according to delay provided in clockwise.
- Servo motor is actuated to dump the waste in the bin.
- After dumping of metallic waste, the initial position is restored.

4.3.1.2 Distribution of Wet Waste

- Bins are in its initial position and moisture sensor has detected wet waste.
- LM393 DC motor rotates and wet waste bin comes under detection bin according to delay provided in clockwise direction.
- Servo motor is actuated to dump the waste in bin below.
- Initial position was restored by DC motors.

4.3.1.3 Distribution of Plastic Bottle

- Bins are in its initial position and LDR and LED setup has detected plastic bottle waste.
- LM393 DC motor rotates and plastic bottle bin comes under detection bin according to delay provided in anti-clockwise direction.
- Servo motor is actuated to dump the waste in bin below.
- Initial position is restored by DC motor.

4.3.1.4 Distribution of Dry Waste

- Bins are in initial position and only IR sensor detected the waste.
- LM393 DC motor will not rotate.
- Servo motor is actuated to dump the waste in bin below.
- Initial position is restored by DC motor.

4.3.2 Rotating Arm System

4.3.1.1 Distribution of Metallic Waste

- Bin is in its initial position and proximity sensor has detected metallic waste.

- LM393 DC Motor starts rotating and tapered plate rotates in anticlockwise direction according to the delay is provided and faces towards the metal waste bin.
- Servo motor is actuated to dump the waste in the bin.
- After dumping of metallic waste, the initial position of tapered plate is restored.

4.3.1.2 Distribution of Wet Waste

- Bin is in its initial position and moisture sensor has detected wet waste.
- LM393 DC motor rotates and tapered plate rotates in anticlockwise direction according to the delay is provided and faces towards the wet waste bin.
- Servo motor is actuated to dump the waste in bin below.
- After dumping of metallic waste, the initial position of tapered plate is restored.

4.3.1.3 Distribution of Plastic Bottle

- Bin is in its initial position and LDR and LED setup has detected plastic bottle waste.
- LM393 DC motor rotates and tapered plate rotates in clockwise direction according to the delay is provided and faces towards the plastic bottle waste bin.
- Servo motor is actuated to dump the waste in bin below.
- Initial position is restored by DC motor.

4.3.1.4 Distribution of Dry Waste

- Bin is in initial position and only IR sensor detected the waste.
- LM393 DC motor will not rotate.
- Servo motor is actuated to dump the dry waste in bin below.
- Initial position is restored by DC motor.

CHAPTER 5

SYSTEM REQUIREMENT

Chapter 5

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5.1 Hardware Requirement

- **Arduino Uno**

The Arduino UNO is a standard board of Arduino. Here UNO means 'one' in Italian. It was named as UNO to label the first release of Arduino Software. It was also the first USB board released by Arduino. It is considered as a powerful board used in various projects. Arduino.cc developed the Arduino UNO board. Arduino UNO is based on an ATmega328P microcontroller. It is easy to use compared to other boards, such as the Arduino Mega board, etc. The board consists of digital and analog Input/Output pins (I/O), shields, and other circuits. The Arduino UNO includes 6 analog pin inputs, 14 digital pins, a USB connector, a power jack, and an ICSP (In-Circuit Serial Programming) header. It is programmed based on IDE, which stands for Integrated Development Environment. It can run on both online and offline platforms. The IDE is common to all available boards of Arduino.

The Arduino board is shown below:

The components of the Arduino UNO board are shown below:

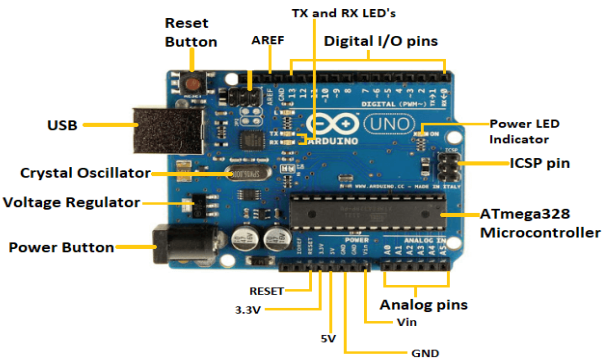


Figure.5.1 Arduino

- ATmega328 Microcontroller- It is a single-chip Microcontroller of the ATmel family. The processor code inside it is 8-bit. It combines Memory (SRAM, EEPROM, and Flash), Analog to Digital Converter, SPI serial ports, I/O lines, registers, timers, external and internal interrupts, and an oscillator.
- ICSP pin - The In-Circuit Serial Programming pin allows the user to program using the firmware of the Arduino board.
- Power LED Indicator- The ON status of the LED shows the power is activated. When the power is OFF, the LED will not light up.
- Digital I/O pins- The digital pins have the value HIGH or LOW. The pins numbered from D0 to D13 are digital pins.
- TX and RX LEDs- The successful flow of data is represented by the lighting of these leds.
- AREF- The Analog Reference (AREF) pin is used to feed a reference voltage to the Arduino UNO board from the external power supply.
- Reset button- It is used to add a Reset button to the connection.
- USB- It allows the board to connect to the computer. It is essential for the programming of the Arduino UNO board.
- Crystal Oscillator- The Crystal oscillator has a frequency of 16MHz, which makes the Arduino UNO a powerful board.
- Voltage Regulator- The voltage regulator converts the input voltage to 5V.
- GND- Ground pins. The ground pin acts as a pin with zero voltage.
- Vin- It is the input voltage.
- Analog Pins- The pins numbered from A0 to A5 are analog pins. The function of Analog pins is to read the analog sensor used in the connection. It can also act as GPIO (General Purpose Input Output) pins.

- **Inductive Proximity Sensor**

Inductive sensor is an essential component used in machines. These sensors are robust devices and are mainly designed depending on the requirements of the proximity sensor. These sensors detect conductive otherwise metallic parts where contact is difficult. These sensors are used in hygiene based and outdoor applications.

Figure 5.2 Inductive Proximity Sensor

The designing of these sensors can be done based on the particular application. For instance, multi-voltage and high-temperature sensors. These sensors give suitable signals for limits & positions which works like a pulse pick-up used for checking counting tasks as well as rotational speed. When these sensors are used in a non-contact form, then it can be last for a long time because they are not focused on any mechanical wear & tear. And also, these sensors are opposed to severe environmental situations like dust, vibration, & moisture to make them the perfect choice to use within numerous industries.

The working principle of an inductive sensor mainly depends on the electromagnetic induction principle for detecting or measuring objects. Inductive sensor mainly includes an induction loop which is enough for detecting electromagnetic. The working of these sensors can be done by generating an oscillating electromagnetic field which is formed by a magnetic object when it is in motion. The moving object activates the current flow within the induction loop likewise with Faraday's law of induction. So that changes will have occurred within the electromagnetic field. So it can be detected with the circuit of sensors. A suitable signal can be an output when a magnetic metal is noticed.

- **LM393 Motor IC**

The IC LM393 has two internally inbuilt operational amplifiers which are internally compensated with frequency. These ICs are specially designed for performing their different tasks using a single power supply. It can also execute its functions properly with a split power supply. The supply of the current drain does not rely on the amount of the power supply. One of the most important features of this IC is, it includes ground in its common-mode input voltage. The applications of this IC mainly include various fields in real life, and also industrial, ADC (analog to digital

converters), electrical systems powered by the battery, time-delay generators limit comparators, etc.

Figure 5.3 LM393 Motor IC

- **IR Sensor**

IR Sensors or Infrared Sensor are light based sensors that are used in various applications like Proximity and Object Detection. IR Sensors are used as proximity sensors in almost all mobile phones.

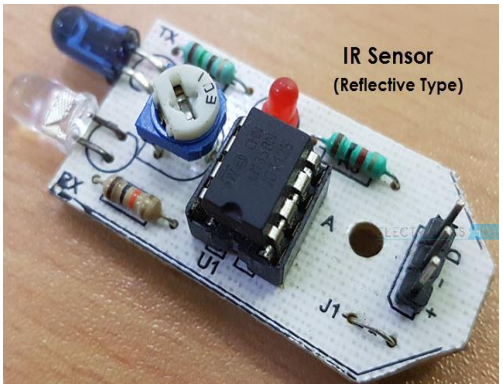


Figure 5.4 IR Sensor

There are two types of Infrared or IR Sensors: Transmissive Type and Reflective Type. In a Transmissive Type IR Sensor, the IR Transmitter (usually an IR LED) and the IR Detector (usually a Photodiode) are positioned facing each other so that when an object passes between them, the sensor detects the object.

The other type of IR Sensor is a Reflective Type IR Sensor. In this, the transmitter and the detector are positioned adjacent to each other facing the object. When an object comes in front of the sensor, the infrared light from the IR Transmitter is reflected from the object and is detected by the IR Receiver and thus the sensor detects the object.

- **Moisture Sensor**

When the concentration of water droplets on the sensing pad's surface increase, it increases its conductivity and drops its resistance in return. Hence, a low amount of voltage from the sensing pad is given to the Inverting input of the IC. Then the LM393 IC compares this voltage with the threshold voltage. In this condition, this input voltage is less than the threshold voltage, so the sensor output goes LOW (0). Similarly, the output goes HIGH (1) if the input voltage is greater than the threshold value as a result of low concentration of water droplets onto the sensing pad.

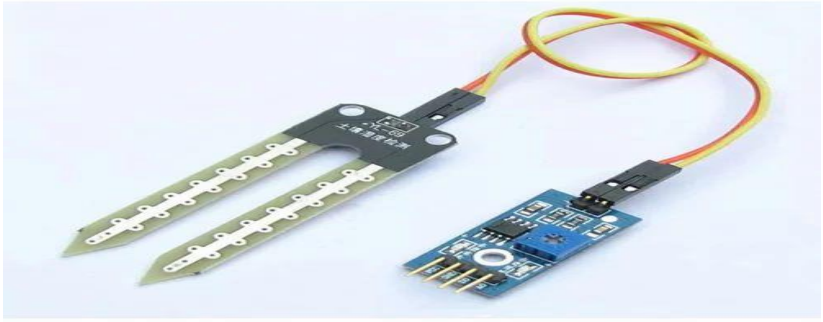


Figure 5.5 Moisture Sensor

- **Light Dependent Resistor**

This resistor works on the principle of photo conductivity. When the light falls on its surface, then the material conductivity reduces and the electrons in the valence band of the device are excited to their conduction band. These photons in the incident light must have energy greater than the band gap of the semiconductor material. If this requirement is fulfilled, the electrons jump from the valence band to the conduction band. These devices depend on the intensity of light; as and when light falls on the LDR, its resistance decreases, and vice versa.

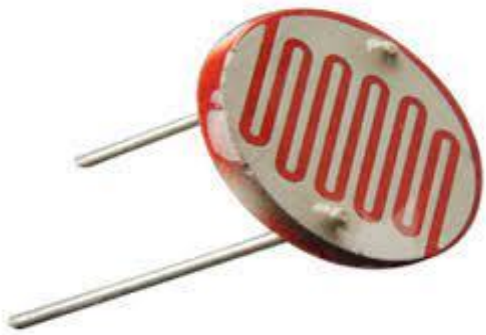


Figure 5.6 Light Dependent Resistor

- **MG996R SERVO MOTOR**

The MG996R is a metal gear servo motor with a maximum stall torque of 11 kg/cm. Like other RC servos the motor rotates from 0 to 180 degree based on the duty cycle of the PWM wave supplied to its signal pin.

Figure 5.7 MG996R servo motor

MG996R Servo Motor Features

- Operating Voltage is +5V typically
- Current: 2.5A (6V)
- Stall Torque: 9.4 kg/cm (at 4.8V)
- Maximum Stall Torque: 11 kg/cm (6V)
- Operating speed is 0.17 s/60°
- Gear Type: Metal
- Rotation : 0°-180°
- Weight of motor : 55gm
- Package includes gear horns and screws

5.2 SOFTWARE REQUIRED

- **Arduino UNO**

An official software introduced by Arduino.cc, that is mainly used for writing, compiling and uploading the code in almost all Arduino modules/boards. Arduino IDE is open-source software and is easily available to download & install.

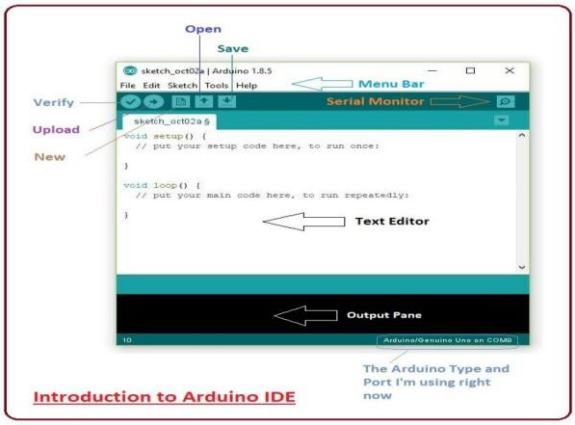


Figure 5.8 Arduino Software

Arduino IDE is an open-source software, designed by Arduino.cc and mainly used for writing, compiling & uploading code to almost all Arduino Modules. It is an official Arduino software, making code compilation too easy that even a common person with no prior technical knowledge can get their feet wet with the learning process. It is available for all operating systems i.e. MAC, Windows, Linux and runs on the Java Platform that comes with inbuilt functions and commands that play a vital role in debugging, editing and compiling the code. A range of Arduino modules available including Arduino Uno, Arduino Mega, Arduino Leonardo, Arduino Micro and many more. Each of them contains a microcontroller on the board that is actually programmed and accepts the information in the form of code. The main code, also known as a sketch, created on the IDE platform will ultimately generate a Hex File which is then transferred and uploaded in the controller on the board. The IDE environment mainly contains two basic parts: Editor and Compiler where the former is used for writing the required code and later is used for compiling and uploading the code into the given Arduino Module. This environment supports both C and C++ languages.

File	
New	This is used to open new text editor window to write your code
Open	Used for opening the existing written code
Open Recent	The option reserved for opening recently closed program
Sketchbook	It stores the list of codes you have written for your project
Examples	Default examples already stored in the IDE software
Close	Used for closing the main screen window of recent tab. If two tabs are open, it will ask you again as you aim to close the second tab
Save	It is used for saving the recent program
Save as	It will allow you to save the recent program in your desired folder
Page setup	Page setup is used for modifying the page with portrait and landscape options. Some default page options are already given from which you can select the page you intend to work on
Print	It is used for printing purpose and will send the command to the printer
Preferences	It is page with number of preferences you aim to setup for your text editor page
Quit	It will quit the whole software all at once

Figure5.9 Arduino IDE

- As you go to the preference section and check the compilation section, the Output Pane will show the code compilation as you click the upload button.

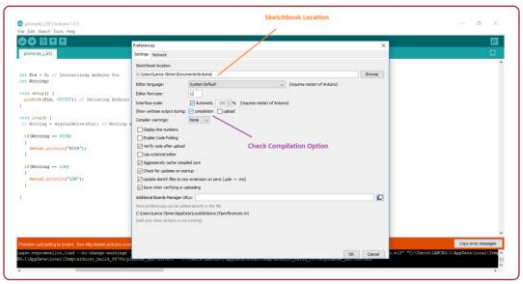


Figure5.10 Arduino Preferences

- And at the end of the compilation, it will show you the hex file it has generated for the recent sketch that will send to the Arduino Board for the specific task you aim to achieve.

Figure5.11 Hex File Generation

- Edit – Used for copying and pasting the code with further modification for font
- Sketch – For compiling and programming
- Tools – Mainly used for testing projects. The Programmer section in this panel is used for burning a bootloader to the new microcontroller.
- Help – In case you are feeling skeptical about software, complete help is available from getting started to troubleshooting.

The Six Buttons appearing under the Menu tab are connected with the running program as follows.

Figure5.12 Menu Tab

- The checkmark appearing in the circular button is used to verify the code. Click this once you have written your code.
- The arrow key will upload and transfer the required code to the Arduino board.
- The dotted paper is used for creating a new file.
- The upward arrow is reserved for opening an existing Arduino project.
- The downward arrow is used to save the current running code.
- The button appearing on the top right corner is a **Serial Monitor** – A separate pop-up window that acts as an independent terminal and plays a vital role in sending and receiving the Serial Data. You can also go to the Tools panel and select Serial Monitor, or pressing Ctrl+Shift+M all at once will open it instantly. The Serial Monitor will help to debug the written Sketches where you can get a hold of how your program is operating. Your Arduino Module should be connected to your computer by USB cable in order to activate the Serial Monitor.

- You need to select the baud rate of the Arduino Board you are using right now. For my Arduino Uno Baud Rate is 9600, as you write the following code and click the Serial Monitor, the output will show as the image below.

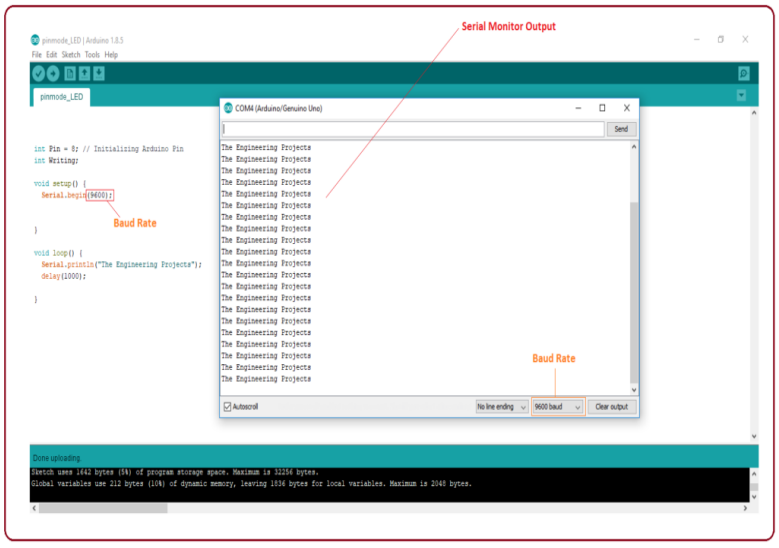


Figure5.13 Serial Monitor

- **Proteus**

It is a software suite containing schematic, simulation as well as PCB designing. ISIS is the software used to draw schematics and simulate the circuits in real time. The simulation allows human access during run time, thus providing real time simulation. Areas is used for PCB designing. It has the feature of viewing output in 3D view of the designed PCB along with components. The designer can also develop 2D drawings for the product.

➢ Features

ISIS has a wide range of components in its library. It has sources, signal generators, measurement and analysis tools like oscilloscope, voltmeter, ammeter etc., probes for real-time monitoring of the parameters of the circuit, switches, displays, loads like motors and lamps, discrete components like resistors, capacitors, inductors, transformers, digital and analog Integrated circuits, semiconductor switches, relays, microcontrollers, processors, sensors etc.

ARES offers PCB designing up to 14 inner layers, with surface mount and through hole packages. It is embedded with the footprints of different categories of components like ICs, transistors, headers, connectors and other discrete components. It offers Auto routing and manual routing options to the PCB Designer. The schematic drawn in ISIS can be directly transferred to ARES.

➢ Application

This new technology for trash management is not only used for trash management but also for the management of Waste oils, Textile products, and Other recyclable materials. This product can also be used in places where human involvement in checking the levels of the fill-up of containers is not possible E.g., Dams, Waste filled tanks like UGD.

➢ Advantages

1. This system keeps our surroundings free, clean, and green from the odor of trash, supports good environmental conditions, and keeps towns more beautiful.
2. It also helps to reduce the requirement of manpower to manage the waste collection process.

3. The automatic waste segregation process also helps to reduce the health issues and work stress of workers who manually segregate the wastes.
4. It also plays a major role in the reduction of environmental pollution

- **Disadvantage**

It is an automatic system where there is no human requirement which results in unemployment.

CHAPTER 6

RESEARCH METHODOLOGY

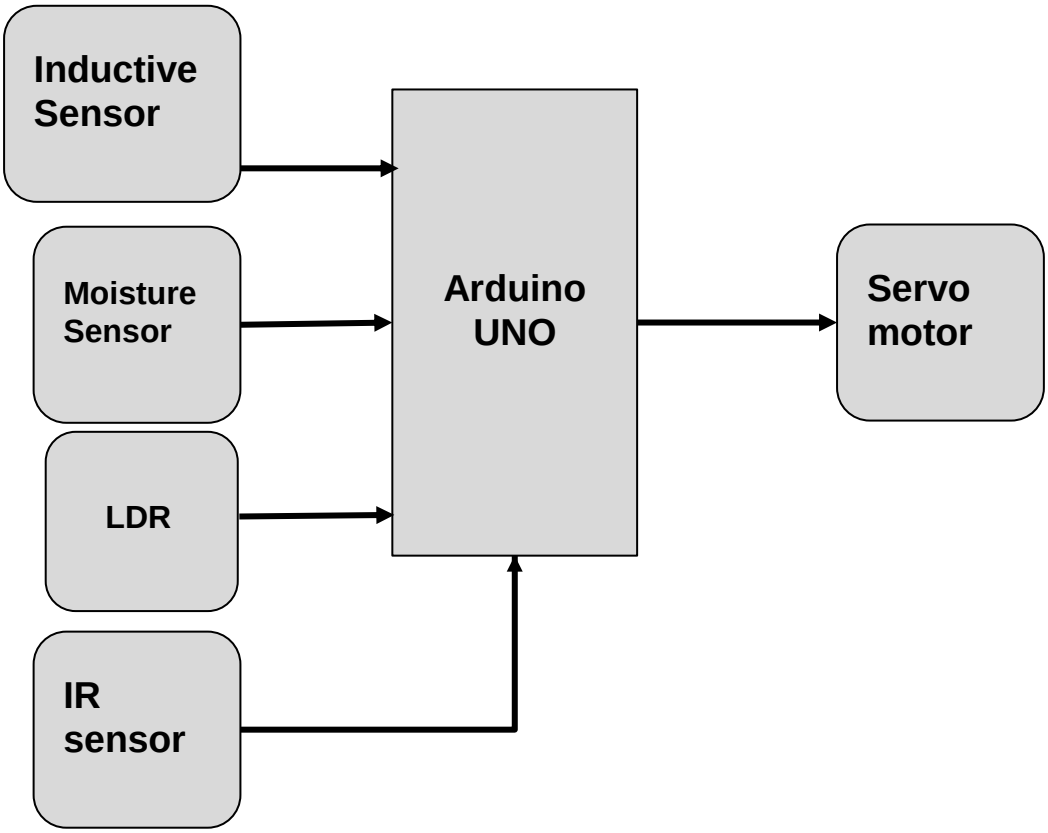
Chapter 6

RESEARCH METHODOLOGY

6.1 Proposed Solution

Segregation is the initiative to complete waste management. Studies show that most of the population in urban and rural areas do not segregate waste being a reason that they notice it inconvenient. Management or assortment of waste is secondary. In this proposed System we separate the waste of 4 types by using 4 different filtering units. 3 different types of sensors which are inductive sensor, wet sensor, and dry sensor is used in the proposed system.

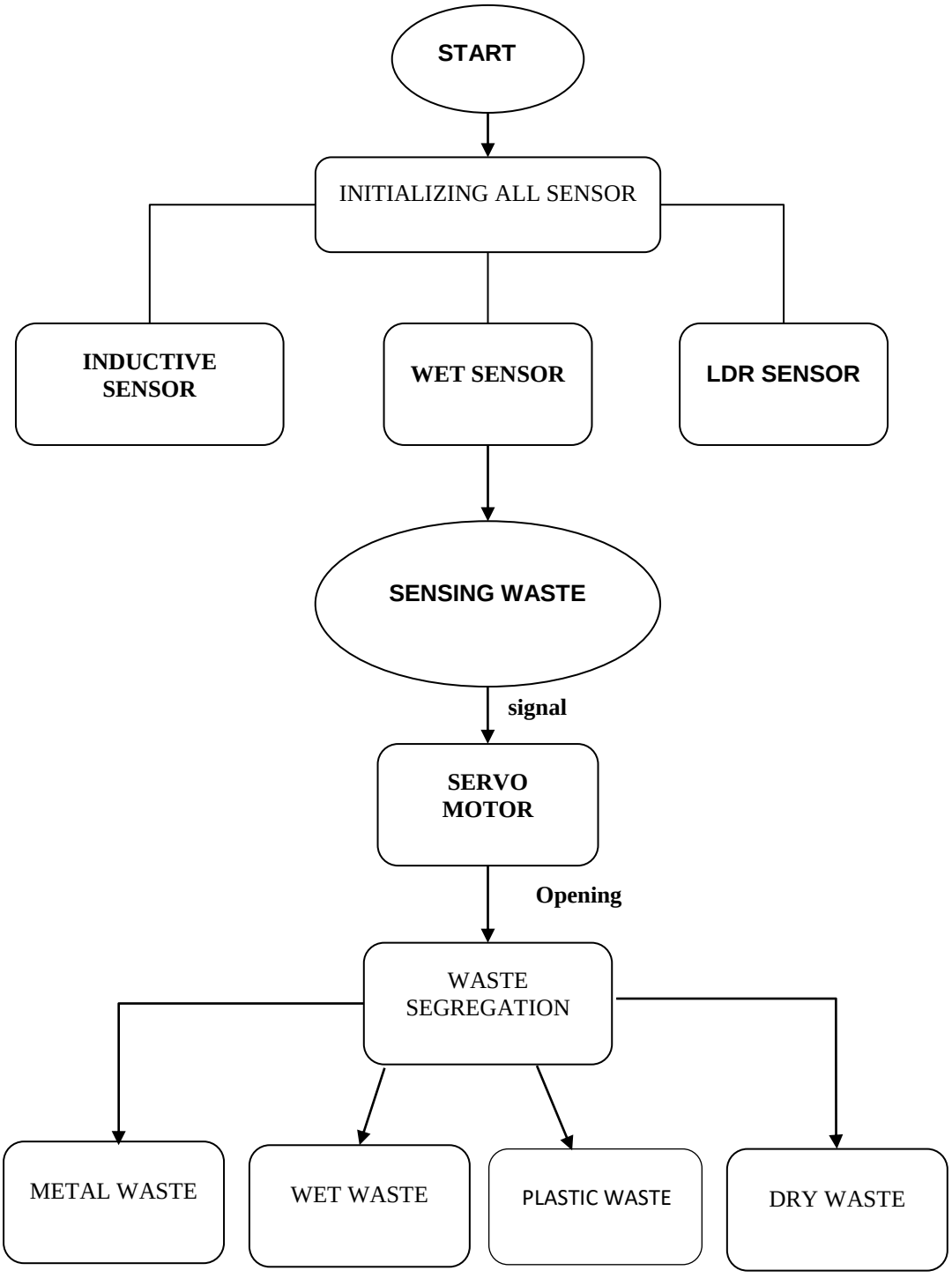
6.2 Block Diagram



6.3 Description

In this we used Arduino Uno as a microcontroller. Where we connect an inductive sensor and Soil moisture IC that is LM393 IC and IR sensor to the Arduino Uno as input device and as an output device we connect the servo motor for output to the microcontroller.

6.4 Flow Chart



6.5 Circuit Diagram

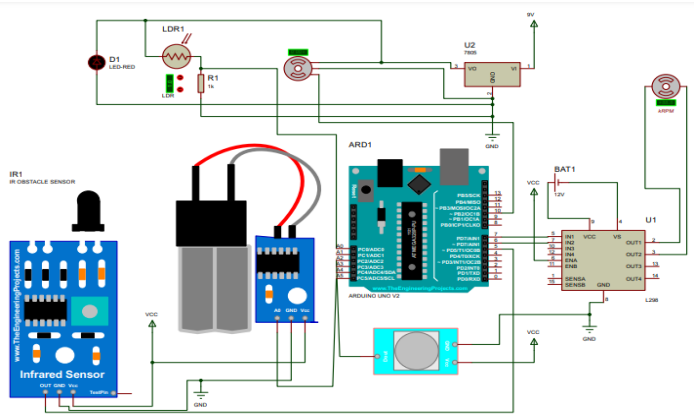


Fig 6.1 Circuit Diagram

6.6 Working

The project title is **"Design and development of automatic sorting of railway platform dustbin waste for efficient recycling"** and is implemented to monitor the sensor to segregate the waste according to three types i.e., metal, wet and dry waste. This proposed design consists of a standard bin with sensors and microcontrollers attached for sensing, processing, and data transmission from one end to the other. The sensing of garbage is done with the help of respective sensors. Hence, the metal sensor senses the metal items and the moisture sensor senses the wet waste or wastes with moisture content, and dry waste using an IR sensor. The Arduino uno is used as a microcontroller. The programming of the system is made using Arduino IDE software and circuit Simulation is carried out using proteus software. The system starts with the initialization of all sensor, the sensor senses the data, and the servo motor. after sensing the sensor, the respective garbage bin opens the Garbage Disposal Unit. The opening and closing of the bin is controlled with the help of servo motors. They receive the signals after sensing the garbage and the respective garbage bin opens for disposal.

6.7 Coding

```
#include <Servo.h>
#define LDR A0
#define IR 11
int SOIL = 4;
int in1 = 5;
int in2 = 6;
int Metal = A1;
Servo myservo;
int a, b, c, d;
void setup()
{
  myservo.attach(10);
  pinMode(LDR, INPUT);
  pinMode(IR, INPUT);
  pinMode(Metal, INPUT);
  pinMode(SOIL, INPUT);
  pinMode(in1, OUTPUT);
  pinMode(in2, OUTPUT);
  Serial.begin(9600);
  Serial.print("Starting.....");
  delay(500);
}
void loop()
{
  a = analogRead(LDR); // 0
  b = digitalRead(IR); // 1
  c = digitalRead(SOIL); // 1
  d = analogRead(Metal); //1
  int data = map(a, 0, 700, 0, 200);
  int i = map(d, 0, 500, 0, 2);
  digitalWrite(in1, LOW);
  digitalWrite(in2, LOW);
```

```
Serial.print("LDR:");
Serial.print(data);
Serial.print("\t");
delay(500);
Serial.print("IR :");
Serial.print(b);
Serial.print("\t");
delay(500);
Serial.print("SOIL :");
Serial.print(c);
Serial.print("\t");
delay(500);
Serial.print("Metal :");
Serial.println(i);
delay(500);
myservo.write(0);
delay(60);
if ( data < 90 &&  b == 0 && c == 0 && i == 0) // Wet
{
  Serial.println("WET");
  digitalWrite(in1, LOW);
  digitalWrite(in2, HIGH);
  delay(1200);//forward
  myservo.write(170);
  delay(60);
  digitalWrite(in1, LOW);
  digitalWrite(in2, LOW);
  delay(500);
  digitalWrite(in1, HIGH);
  digitalWrite(in2, LOW);
  delay(1200);////// return
}
  if (data < 10 && b == 0 && c == 1 && i == 0) // Metal Detected set d = 1
```

```
{
  Serial.println("Metal");
  digitalWrite(in1, LOW);
  digitalWrite(in2, HIGH);
  delay(2700);//forward
  myservo.write(170);
  delay(60);
  digitalWrite(in1, LOW);
  digitalWrite(in2, LOW);
  delay(1500);
  digitalWrite(in1, HIGH);
  digitalWrite(in2, LOW);
  delay(2700);////// return
}
if ( data < 60 && data > 20 &&  b == 0 && c == 1 && i == 0) // Garbage
{
  Serial.println("DRY :");
  myservo.write(170);
  delay(60);
}
if ( data > 160 &&  b == 1 && c == 1 && i == 0) // Garbage
{
  Serial.println("Garbage :");
  myservo.write(0);
}
if (data < 160 && data > 100 && b == 0 && c == 1 && i == 0) //Water Bottle
{
  Serial.println("Water Bottle ");
  digitalWrite(in1, HIGH);
  digitalWrite(in2, LOW);
  delay(1200);// forward
  myservo.write(170);
  delay(60);
```

```
    digitalWrite(in1, LOW);
    digitalWrite(in2, LOW);
    delay(1500);
    digitalWrite(in1, LOW);
    digitalWrite(in2, HIGH
    );
    delay(1200);/// return
  }
}
```

CHAPTER 7

RESULT AND DISCUSSION

Chapter 7

RESULT & DISCUSSION

In this section, we present the results of our project, which aimed to develop an automatic sorting dustbin system using an Arduino platform. Our main focus was on addressing the waste management challenges on railway platforms and reducing the negative impact of manual waste sorting on human health. We evaluated the performance of the system in terms of cost reduction, the time required for manual sorting, and the potential benefits to human health.

Cost Reduction: To assess the cost reduction achieved by our automatic sorting dustbin system, we compared it with traditional waste management practices, which typically involve manual sorting. We considered various factors, including the cost of labor, time spent on manual sorting, and potential losses due to improper waste disposal. Our analysis revealed that the implementation of our system significantly reduced the overall cost associated with waste management on railway platforms. During our survey it has been observed that in manual sorting nearly 2,00,000rs as labor cost and considering maintenance and other miscellaneous cost it will increase to nearly 3,00,000rs. If we install our system in place of four dustbins. The cost require to develop one system will be approximately 15000rs. So if we compare the manual sorting operation and our system implementation at Shegaon station there will be approximately cost saving of around 70000rs to 80000rs monthly. So after implementation of one system there will be cost saving of nearly 4500rs to 5500rs.

Time of Manual Sorting: We conducted experiments to measure the time required for manual sorting of waste before and after implementing our automatic sorting dustbin system. We compared the efficiency of the system by timing manual sorting activities performed by waste management personnel. The results showed a substantial reduction in the time required for waste sorting with the implementation of our system. This improvement in efficiency allows for the allocation of resources to other important tasks and contributes to a more streamlined waste management process.

Human Health: The impact of manual waste sorting on human health was a significant concern addressed by our project. We conducted surveys and interviews with waste management personnel working on railway platforms to understand the health issues they faced due to prolonged exposure to waste materials. We found that manual sorting often led to respiratory problems, skin infections, and other health-

related issues. By automating the waste sorting process, our system minimizes the direct contact of personnel with hazardous waste, thus reducing the potential health risks associated with manual sorting.

Detection Accuracy: We assessed the accuracy of our automatic sorting dustbin system by conducting extensive testing using various waste items commonly found on railway platforms. The system employed multiple sensors, including a light-dependent resistor (LDR), inductive proximity sensor, moisture sensor, and infrared sensor, to identify different types of waste such as metal, wet waste, water bottle waste, and general waste. The results demonstrated a high level of accuracy in distinguishing between different waste categories, ensuring efficient sorting and appropriate disposal.

Our project successfully developed an automatic sorting dustbin system for railway platform waste management. The implementation of this system yielded significant results in terms of cost reduction, decreased manual sorting time, and improves human health conditions. By reducing the reliance on manual labor and improving waste sorting efficiency, our system provides a sustainable solution to address waste management challenges on railway platforms, while also prioritizing the well-being of waste management personnel.

CHAPTER 8

BILL OF MATERIAL

Chapter 8

BILL OF MATERIAL

Sr.No	Component Name	Specification	Quantity	Cost (Rs)
1	IR Sensor	LM393	1	179
2	Raindrop sensor	LM393	1	300
3	Inductive proximity sensor	8mm NPN RM 18 DC6- 36V	1	490
4	Light dependent resistor LDR	0V-5V , adjustable trigger level from preset	1	230
5	PCB Board	-	1	200
6	Microcontroller	Arduino UNO	1	800
7	Servo motor	MG90S	1	280
8	DC Motor	10 RPM	1	250
9	Battery connector	-	1	30
10	Battery	12V	1	400
11	Plywood	60cm	2	50
12	Steel Rod	160cm	1	50
13	Adaptor	9V	1	350
14	Motor driver	L293D	1	200
15	Mosfet	7805	1	120
16	Jumper wire	(M-M,M-F,F-F)	-	200
17	L-Clamp	-	1	40
18	TOTAL			RS.4068/-

CHAPTER 9

CONCLUSION

Chapter 9

CONCLUSION

The Automatic waste management system may be a leap forward to create the manual assortment and segregation of waste automatically in nature. The developed system would pioneer work for solid waste management and segregation processes. This automation of waste conjointly reduces the human effort and consequently the price of the entire method. This technique will be enforced anywhere with ease and among affordable quantities of your time. The implementation prices for the automation are additionally reasonable. The general methodology for the detection and management of waste becomes economical and intelligent. We have shown the appliance and implementation of the above system.

CHAPTER 10

FUTURE SCOPE

Chapter 10

FUTURE SCOPE

The current prototype of the project is constrained to classify an individual entity at a time and is restricted to only four types of waste. To widen it's scope, the system needs to incorporate an Artificial Intelligence Neural Network (AI NN) based system which involves building an image classifier that refers the data from an image dataset. This system can be made to work in unison with a robotic arm which uses a prediction based model and thus segregate the waste. The system can also incorporate a blower system which removes the dust particles from the waste. Deployment of a weight-sensor based model with an IR sensor would potentially provide a better control the over the drop down mechanism. To make the system more suitable for segregation of Railway Platform Waste, we can also incorporate an IoT based IR sensor model which can send signals to the authorities to collect the waste if it reaches the pre-set threshold level.

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