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Smart Dustbin Monitoring System using Arduino UNO

Dr. Sudha L K, Mohammed Tahir, Ruchitha E, Varshini R, Syed Saif Ali
Department of Electronics and Instrumentation Engineering,
Bangalore Institute of Technology
Bangalore, India

***Abstract*:- Continuous urbanization and industrialization has led to increase in volume and type of waste generated. It is estimated that in 2006 the total amount of municipal solid waste generated globally reached 2.02 billion tons, representing a 7% annual increase since 2003 (Global Waste Management Market Report 2007). This poses a problem for local and national government to ensure sustainable and effective waste management. Technology always helps mankind in making life easier. In public places proper disposal of waste is not being followed which causes overflow of waste and dustbins that has become a threat to the environment. Segregation, Management, Transport and disposal of waste place an important role to minimize the risk to the public and environment. The economic value of waste is best realized when it is segregated, i.e. Dry and Wet. We have developed smart dustbin where the waste are automatically segregated by various smart sensors and the wastage level of the dustbin is monitored. In this Project we have implemented a smart dustbin in which segregation is achieved using respective automated sensors and the wastage level both dry waste and wet waste of the dustbins are monitored and recorded simultaneously. It ultimately helps to keep cleanliness in the society and hence the expansion of diseases caused by waste material is reduced.**

Keywords— Automatic segregation, Solid waste management, Smart sensors, Wet-Dry segregation, Arduino UNO

I. INTRODUCTION

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 by means which have an adverse effect on the environment [1]. Waste Management includes arranging, financing, development and operation of facilities for the gathering, transportation, reusing and last disposal of the waste. 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. [2]The rate of increasing population in our country has increasing rapidly. Dustbin is a container which collects garbage or stores items which is recyclable or non-recyclable, decompose and non-decompose. [3]They are usually used in Homes, offices, industries etc., but when the bins are full the collection and disposal is a major issue. The surrounding of a dustbin is also conducive for increasing the pollution level. Air pollution due to a dustbin can produce bacteria and virus which can produce life with harmful diseases for humans and animals. The smart dustbin is a carefully designed solution that solves the social issue of waste disposal, the smart dustbin identifies the kind of material being thrown inside it and segregates it into dry and wet waste [4]. As the world is in a stage of scaling up still there is one major problem, waste is the foul smell around us and we have to deal with it most often that is Garbage.

Most of the time we see garbage bin is overfull still some people keep on adding garbage over it which makes the surrounding look untidy [5]. This unclean surrounding leads to cause number of diseases as large number of mosquitoes and insects procreate on it. Managing waste appropriately has always been an issue not only in India but also in some other parts of the globe. Therefore, such a system must be developed which can reduce this problem at minimum level. With this growing generation our prime need begins with cleanliness and cleanliness begin with our surroundings. [6]So, we have to say no to the old traditional method of collecting and segregating waste manually which is not an efficient method, it also consumes a lot of time and workload increases.

In India total 60 million tonnes of waste are generated per year. 10 million tonnes garbage is generated only in metropolitan cities of India which is a big amount of waste and it is a serious concern for the authorities to manage it efficiently without much workload [7]. The ideology of "waste management hierarchy" has been accepted by most nations as the step for developing municipal solid waste (MSW) control policy. Thus, we have propounded a constructive Automated waste Segregator and Monitoring System which helps to monitor the level of waste in the bin. Once the bin is 90% full it will display the message and overflow of that dustbin can be prevented [8]. If the waste items are segregated properly at their initial level, a major portion of the waste management cycle is covered. The utilization of automation in segregation of waste items can significantly enhance its efficiency and at the same time reduce the health hazards related with manual segregation.

Therefore, we have designed a smart dustbin using Arduino UNO [9], ultrasonic sensor which will automatically separate the dry and wet waste placed on it with the help of servo motor and the level of dustbin is also monitored and displayed on the LCD display. It is an Arduino based project that will bring a new and smart way of cleanliness.

II. OBJECTIVES OF THE STUDY

- To design a "SMART DUSTBIN" which is Arduino based and can automatically segregate wet and dry waste and also detect the garbage level thus updating the status of the bin.
- To build a clean environment and to empower the "SWACHH BHARATH" mission with the use of "Smart Dustbins".

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III. REVIEW OF THE RELATED WORK

Table 1: List of the papers reviewed

SL NO.	AUTHOR & YEAR	TITLE	CONTRIBUTIONS
1.	Md Abdullah Al Rakib, Md. Sohel Rana, Md. Moklesur Rahman, (2021)	Dry and Wet Waste Segregation and Management System.	This work contributes a Spontaneous Waste Segregator (SWS) which is a modest, simple to utilize answer for an isolation framework at family units.
2.	Varsha Pathak, Shubhi Atri, Sneha Shahu. (2021)	Automated Dry and Wet Waste Segregator and Monitoring System.	This project contributes at primary level in our society for segregating waste initially it will make the process easy and less time consuming.
3.	Viral Rambhia, Aman Valera, Rahul Punjabi. (2019)	Automatic Segregation & Efficient Solid Waste Management using IoT Solutions for Smart Cities.	Real-time status of each smart bin is sent to the cloud. A mobile application assists the trash collector using optimal dynamic routes. Municipal corporations monitor the entire waste collection process using the proposed system. Also, a way to automatically segregate wet and dry waste using moisture detection.

IV. PROPOSED PRODUCT DESIGN

In this project we will be segregating two types of waste that is wet and dry waste before collecting it into the garbage bin. When waste is dumped, the waste gets segregated into two separate bins using a Moisture Sensor Unit.

When the dry waste bin is full 90% it will give notification on the LCD screen stating the dustbin is full or If the Wet waste bin is full 90% it will give notification on the LCD screen stating the dustbin is full. A moisture sensor will sense the moisture content of the waste then it will send the details to the Processing unit and it will inform the servo motor about the type of waste. We will pre-feed the information in the servo motor. For example: if we have set the direction for the wet waste as left and for dry waste as right then the waste will be thrown in the dustbin accordingly.

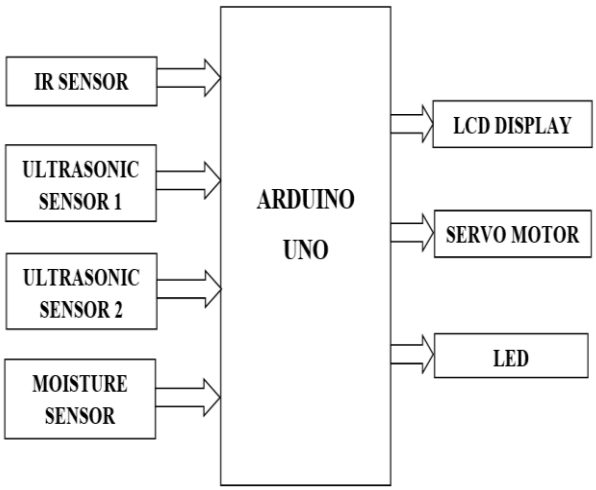

Fig.1 Proposed Block Diagram of Smart Dustbin

Fig.1 Proposed block diagram of Smart Dustbin shows the sensors and other components connected to the Arduino UNO. This block diagrams shows the input that we are taking through the sensors and passing to Arduino UNO. The outputs that will be controlled via the Arduino UNO, Servo Motor and the outputs are displayed using LED and LCD display.

V. METHODOLOGY

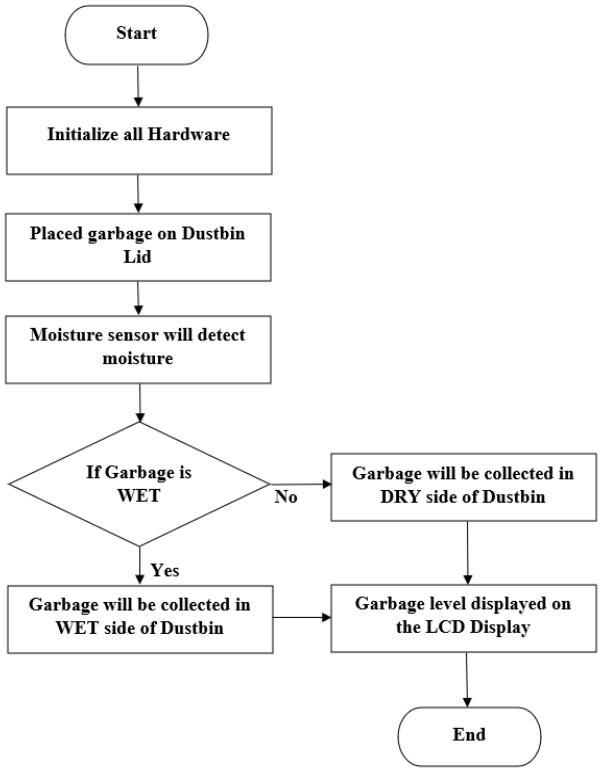

Fig.2 Flow Chart of the proposed Smart Dustbin

Step 1: Interfaces the Arduino UNO processor with various sensors and other components.

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Step 2: The Waste coming on the lid is sensed by the IR sensor.

Step 3: Analyzes the garbage whether it is dry or wet.

Step 4: The garbage is sensed with the help of moisture sensor to check that moisture is less or more and then moisture input is given to the micro controller for further analysis.

Step 5: If the moisture is less, then micro controller will get to know that the garbage is dry, and it will rotate the servo motor 90 degrees and the garbage will fall into dry bin.

Step 6: If the moisture is more, then micro controller will get to know that the garbage is wet, and it will rotate the servo motor 180 degrees and the garbage will fall into wet bin.

Step 7: When the dustbin is almost full, the message states that "Dustbin is full" and is displayed on the LCD Display.

VI. HARDWARE COMPONENTS

The hardware components required are Arduino UNO, Ultrasonic Sensor, IR Sensor, Moisture Sensor, Servo Motor.

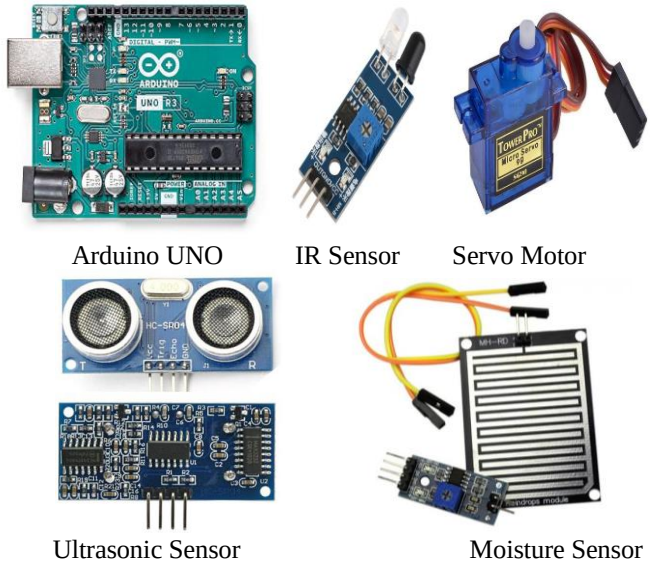

Fig. 3 Hardware components

Fig. 3 shows the various sensors and actuators used in this system.

A: Arduino UNO: Arduino UNO is a microcontroller board based on the Microchip ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header and a reset button. Arduino is programmable with the Arduino IDE (Integrated Development Environment), via a type B USB Cable powered by the USB cable or by an external 9-volt battery, though it accepts voltages between 7 and 20 volts. It contains everything needed to support the microcontroller, simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

B: IR Sensor: The IR sensor is a multipurpose infrared sensor which can be used for obstacle sensing, color detection, fire detection, line sensing etc. and also as an encoder sensor. The sensor provides a digital output. The sensor outputs a logic one (+5V) at the digital output when an object is placed in front of the sensor and a logic zero(0V), when there is no object in front of the sensor. An onboard LED is used to indicate the presence of an object. This digital output can be directly connected to an Arduino, Raspberry Pi, AVR, PIC, 8051 or any other microcontroller to read the sensor output. IR sensors are highly susceptible to ambient light and the IR sensor on this sensor is suitably covered to reduce effect of ambient light on the sensor. The sensor has a maximum range of around 40-50 cm indoors and around 15-20 cm outdoors.

C: Ultrasonic Sensor: The HC-SR04 ultrasonic sensor uses SONAR to determine the distance of an object just like the bats do. It offers excellent non-contact range detection with high accuracy and stable readings in an easy-to-use package from 2 cm to 400 cm or 1" to 13 feet.

D: Raindrop Sensor: Raindrop Sensor is a tool used for sensing rain. It consists of two modules, a **rain board** that detects the rain and a **control module**, which compares the analog value, and converts it to a digital value. The raindrop sensors can be used in the automobile sector to control the windshield wipers automatically, in the agriculture sector to sense rain and it is also used in home automation systems.

E: Servo Motor: Servo motors SG90 (or servos) are self-contained electric devices that rotate or push parts of a machine with great precision. Servos are found in many places: from toys to home electronics to cars and airplanes.

VII. SOFTWARE REQUIREMENTS

The Arduino Integrated Development Environment - or Arduino Software (IDE) tool - 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 and Genuine hardware to upload programs and communicate with them. It is an open-source software that is used for writing and compiling code into the Arduino module.

- It can easily run on different types of operating systems like Mac-OS, Windows and Linux and runs on JAVA Platform that comes with inbuilt functions and commands that helps in editing, compiling and debugging the code in the environment.
- A range of Arduino types like Arduino UNO, Arduino Mega, Arduino Nano and so on can be programmed using the Arduino IDE.
- It supports both C and C++ languages.
- Code compilation is very easy.

The Fig. 4 shows the flowchart of the software to develop the system using Arduino IDE.

VIII. EXPERIMENTAL ANALYSIS

Fig 5 shows the arrangement of hardware model. The moisture sensor is placed at the center of the lid. The LCD display which is used to display the type of waste separated and the level of dustbin, the Arduino UNO, IR sensor all are placed on a small piece of board attached on the top of dustbin. Servo motor involved in the project which is used to rotate the lid is attached to the lid which is supported by a thin rod. The ultrasonic sensors are placed below the board in both dry and wet compartments to detect the distance. All the

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power-supply is provided via 5V wall adapters through USB type B

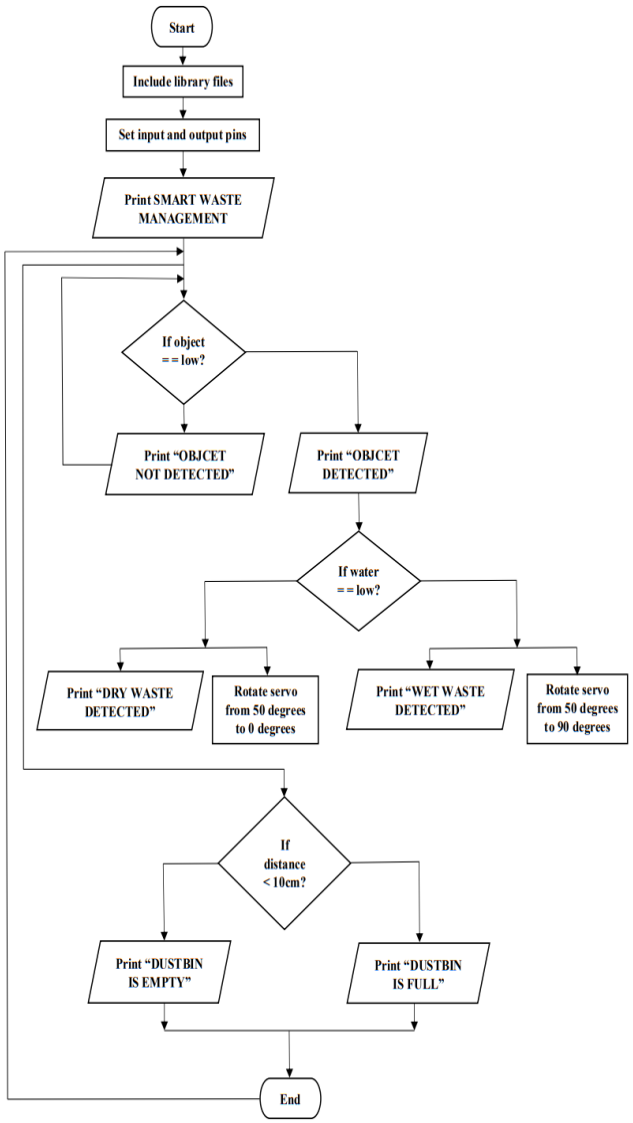

Fig. 4 Flow Chart diagram of the Software System

- As the power supply module is switched ON the Arduino UNO is turned ON and starts working according to the code executed and uploaded through Arduino IDE.
- The waste is placed on the sensor placed on the lid, this waste is detected by the IR sensor placed in front of the moisture sensor.
- The moisture sensor then senses the moisture content of the waste and if any moisture is present, then the servo motor rotates to an angle causing the lid to rotate towards the wet side and hence the waste is dropped on the wet compartment of the dustbin.
- Similarly, if there is no moisture content present, then the servo motor rotates to an angle causing the lid to rotate towards the dry side and hence the waste is dropped on the dry compartment of the dustbin.
- Simultaneously the type of waste detected is displayed on the LCD display.
- Once the dustbin is almost full, the LED turns on and the notification stating the dustbin is full appears on the LCD display preventing the overflow.

IX. RESULTS AND DISCUSSIONS

As a result, the servo motor is at 90 degrees in the initial position, further it rotates 180 degrees when it is wet waste and rotates 0 degree when it is dry waste. Database gives the information to the application regarding weather the bin is full or empty and which bin is full or empty. All in all, the proposed system is working as planed in real time situation.

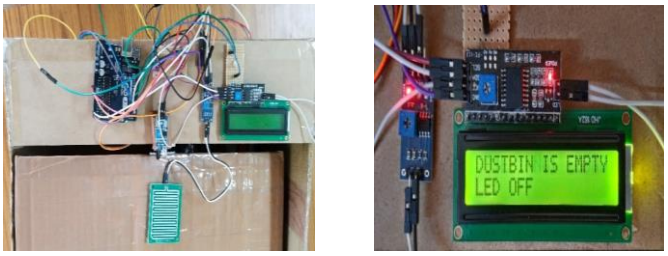

Fig. 5 LCD display of dustbin is empty

CASE 1: Dustbin is Empty

Fig. 5 shows the obtained LCD display reading of the initial stage when the dustbin is empty.

Fig. 6 LCD display of dry waste found

CASE 2: When placed waste is dry

Fig 7.1.2 shows the tilting of lid towards the dry side and obtained LCD display reading when dry waste is placed on top of the dustbin lid. This action of lid results in the dropping of waste in the dry compartment.

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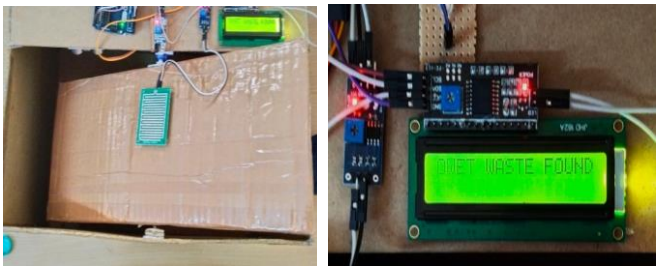

Fig. 7 LCD display of wet waste found

CASE 3: When placed waste is wet.
Fig 7.1.3 shows the tilting of lid towards the wet side and obtained LCD display reading when wet waste is placed on top of the dustbin lid. This action of lid results in the dropping of waste in the wet compartment.

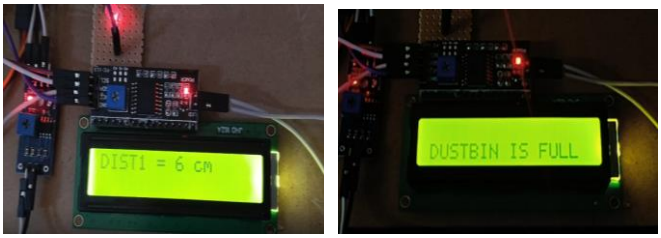

Fig. 8 LCD display of dustbin full

CASE 4: When the dustbin is full**.**

Fig 7.1.4 shows the red LED which is turned ON when the dustbin is full and also the simultaneous LCD display reading obtained during this action**.**

X. FUTURE SCOPE

This Project can be taken to product level. It can be made durable, by making it compact and cost effective. Instead of using two separate dustbins for wet and dry waste, we can use this single dustbin. Wet waste can be decomposed and used for making biogas.

CONCLUSION

As a conclusion to this project the proposed system would be able to monitor the solid waste collection process and management of the overall collection process. This project is very effective in managing waste in any big city rather than segregating the garbage using old segregation methods that is manually. With help of this project the dustbin overflow problems will be resolved which makes the surrounding neat, clean and hygienic. The proposed system is the most efficient way to collect and segregate the garbage. Solid waste collection in recent years is somewhat stagnant way. We have proposed a more efficient waste management system in order to overcome this situation. The automatic segregation of wet and dry waste proves useful to identify economic value of waste and also manage the waste efficiently. Furthermore, the system can be made greener and cleaner by utilizing renewable and clean sources of energy. Many advancements can be done, which include detecting metallic, glass and plastic waste. Managing solid waste efficiently will be a huge leap towards greener and cleaner environment.

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AUTHOR'S PROFILE

Dr Sudha L K, Associate Professor working for the department of Electronics and Instrumentation Engineering, Bangalore Institute of Technology, Bangalore, India having 26 years of teaching experience. Specialization in Nanoelectronics, MEMS, Mechatronics, VLSI and its allied subjects. Published 10 international journals and published a book on " Aircraft Instrumentation and Systems"