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AUTOMATED WASTE SEGREGATOR USING ARDUINO

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ABSTRACT—*Industrialization, modernization, rapid advancements and increase in population have led to large generation of waste. Segregation makes it possible to reuse and recycle the waste effectively. This paper proposes implementation of an automated waste segregator at household level using Arduino microcontroller, to control the entire process with ease and simplicity. The sensing unit consists of an IR (Infrared) sensor, a moisture sensor and a metal sensor used to detect and identify various types of waste respectively. The main architecture of the segregator comprises of three prominent stages consisting of an IR sensor, a metal sensor, a moisture sensor and the segregation bins. The IR sensor detects the arrival of waste. Identification and separation of waste is done by sensors. The microcontroller controls all the activity of sensors. Results have presented segregation of waste into metal, wet and dry waste.*

Keywords—*Arduino Uno, Gear motor,HC-05 Bluetooth module, IR Sensors, Moisture Sensor, Power supply, PMMC DC Motor with motor driver.*

I. INTRODUCTION

As we move towards a more digitalized future, it is directly proportional to increase in urbanization and industrialization. This is the main cause of generation of large amount of waste. As per the report published by World Bank, approximately 1.3 billion tones of municipal waste is generated every year and it is expected to rise to approximately 2.2 billion tons per year by 2025. Due to this waste lies littered in the surrounding, dumped on open lands and this becomes major problem for various types of disease causing bacteria and viruses which is why waste management is of vital importance. Segregation makes it possible to reuse and recycle the waste effectively. So the waste management becomes an important concern for the health and well-being of the society. Presently, the waste segregation is done manually by installing different bins for collecting different type of waste such as wet, dry and metal etc. But this method has lot of discrepancy; one is being the Unawareness of most people towards waste management. Due to lack of proper segregation methods, a large amount of untreated waste is dumped as landfills. So our idea is to make a garbage segregator which can identify the type of waste and put them in different bins accordingly and automatically. Implementing our project at household level will reduce the expenditure on waste disposal, manual effort

Required for waste segregation and the waste could be easily being recycled, reused and reduced.

II. OBJECTIVES

A trend of significant increase in municipal solid waste generation has been recorded worldwide. This has been found due to over population growth rate, industrialization, urbanization and economic growth which have ultimately resulted in increased solid waste generation. Final destination of solid waste in India is disposal. Most urban solid waste in Indian cities and towns is land filled and dumped. Our Project deals with the most blistering topic i.e. waste segregation. An efficacious management needs to be materialized for better planet to live in. Hence, with our cost effective project proposal, we try to bring in the change. It deals with the minimization of blue-collar method utilization for exclusion of waste into an automated panache. An automation of this style not only saves the manual segregators of the numerous health issues, but also proves to be economical to the nation. Besides, this system utilizes low cost components for the successful segregation of most types of waste. When installed in apartments or small colonies, it proves to be beneficial in sorting the waste at the site of disposal itself. This is the objective of our project.

III. SYSTEM DESIGN

The main goal of the project is to design and develop a sorting system that sorts and waste automatically into two categories namely dry waste, wet waste. Fig 1 shows the block diagram of automated waste segregator. It consists of certain blocks which are explained as follows:

A: Controller Unit: Arduino Uno is a microcontroller board based on the ATmega328 (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, 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.

B: Sensor Unit

This unit includes two types of sensors, they are: IR sensor, Moisture sensor.

- IR Sensor

An IR proximity sensor works by applying voltage to a pair of IR light emitting diodes (LED's) which in turn, emit infrared light. This light travels through the air and once it comes in contact with an object, it is reflected back towards the detector. The waste is dumped into the AWS and comes in proximity of IR proximity sensor module which marks the entry of the waste. When the IR sensing unit becomes active, it sends a corresponding signal to controller which in turn activates the other sensors.

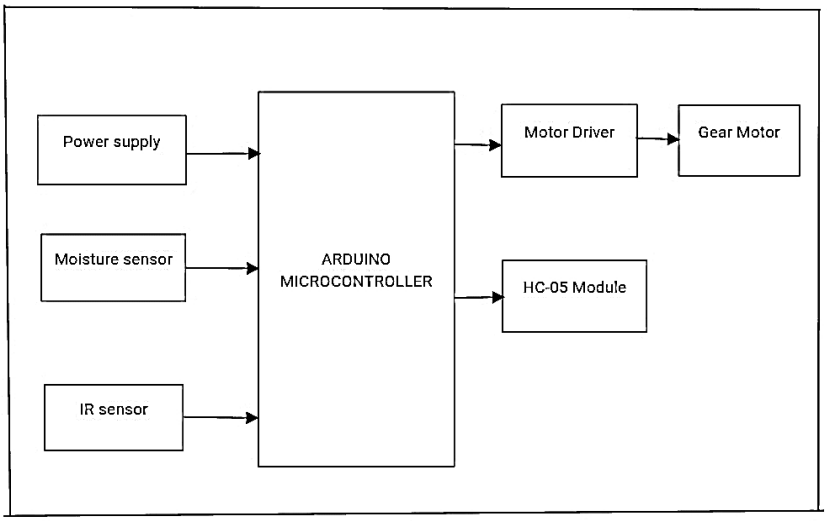

Fig 1: Block diagram of automated waste segregator

- Moisture Sensor

The Soil Moisture Sensor is used for measuring the moisture in soil and similar materials. The two large exposed pads are used as probes for the sensor, acting as a variable resistor. It measures the volumetric moisture/water content indirectly by using some properties of the object 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 electric conductivity, temperature, or soil type.

C: Power Supply Unit

In this project, circuits, sensors &motors are used, which require +12V & +5V (DC) supply. To fulfil this requirement we have used following circuit of power supply which provides regulated +12V & +5V (DC). Transformer (15V/1A) is used to down convert the AC up to 15V. For conversion of AC into DC, Bridge type rectifier is used made up of 4 diodes (1N4007) which is tied to secondary of the transformer [5]. Capacitors of value 1000 □f & 1□f are used as filters. 7812 IC is used as 12V regulator. It converts 15V into regulated +12V DC. IC 7805 is used as 5V regulator. It converts 12V into regulated +5V.

D: Motor Driver

Whenever a robotics hobbyist talk about making a robot, the first thing comes to his mind is making the robot move on the ground. And there are always two options in front of the Designer whether to use a DC motor or a stepper motor. When it comes to speed, weight, size, cost... DC motors are always preferred over stepper motors. There are many thing which you can do with your DC motor when interfaced with a microcontroller.

E: Gear Motor

A small motor (ac induction, permanent magnet dc, or brushless dc) designed specifically with an integral (not separable) gear reducer (gear head). The end shield on the drive end of the motor is designed to provide a dual function.

F: HC-05 Module

HC-05 Bluetooth Module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Its communication is via serial communication which makes an easy way to interface with controller or PC. HC-05 Bluetooth module provides switching mode between master and slave mode which means it able to use neither receiving nor transmitting data.

IV. DESIGN REQUIREMENTS

4.1 Hardware Requirements:

4.1.1 Arduino Uno

Fig 2: Arduino Uno R3 front panel

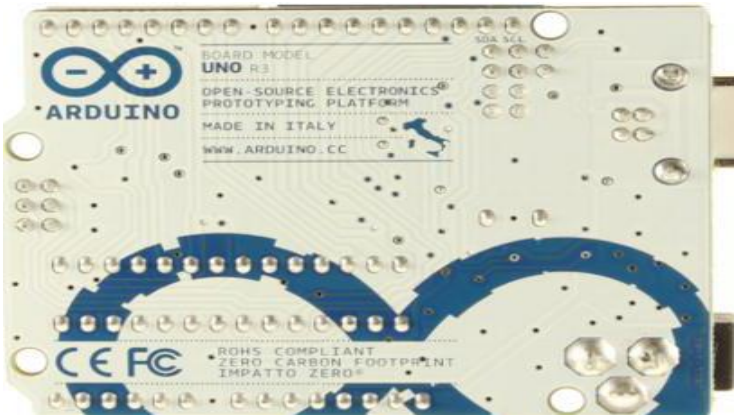

Fig 3: Arduino uno R3 back panel

The Arduino Uno is a microcontroller board based on the ATmega328 (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, 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. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

"Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform; for a comparison with previous versions, see the index of Arduino boards.

4.1.2 IR Sensor

This device emits and/or detects infrared radiation to sense a particular phase in the environment. Generally, thermal radiation is emitted by all the objects in the infrared spectrum. The infrared sensor detects this type of radiation which is not visible to human eye. An **infrared detector** is a detector that reacts to infrared (IR) radiation. The two main types of detectors are thermal and
Photonic (photo detectors).

Fig 4: IR Sensor

The thermal effects of the incident IR radiation can be followed through many temperature dependent phenomena. Thermocouples and thermopiles use the thermoelectric effect. Go lay cells follow thermal expansion.

4.1.3 Moisture Sensor

Soil moisture sensors measure the water content in soil. A soil moisture probe is made up of multiple soil moisture sensors. One common type of soil moisture sensors in commercial use is a frequency domain sensor such as a capacitance sensor.

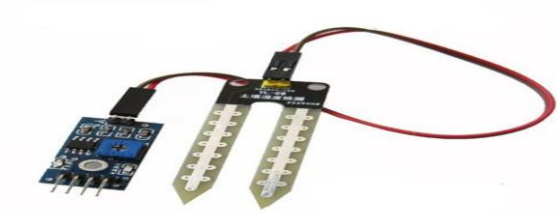

Fig 5: Moisture sensor

Measuring soil moisture is important in agriculture to help farmers manage their irrigation systems more efficiently. Not only are farmers able to generally use less water to grow a crop, they are able to increase yields and the quality of the crop by better management of soil moisture during critical plant growth stages. Besides agriculture, there are many other disciplines using soil moisture sensors. Golf courses are now using sensors to increase the efficiencies of their irrigation systems to prevent over watering and leaching of fertilizers and other chemicals offsite.

4.1.4 Motor Driver

By using two motors we can move our robot in any direction. This steering mechanism of robot is called as Differential driver.

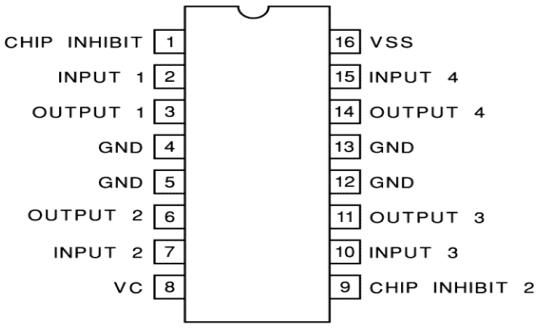

Fig 6: Pin description of dual L293D H-Bridge motor

L293D is a dual H-Bridge motor driver, so with one IC we can interface two DC motors which can be controlled in both clockwise and counter clockwise direction and if you have motor with fix direction of motion. You can make use of all the four I/Os to connect up to four DC motors. L293D has output current of 600mA and peak output current of 1.2A per channel.

Moreover for protection of circuit from back EMF output diodes are included within the IC. The output supply (VCC2) has a wide range from 4.5V to 36V, which has made L293D a best choice for DC motor driver.

4.1.5 Gear Motor

A small motor (ac induction, permanent magnet dc, or brushless dc) designed specifically with an integral (not separable) gear reducer (gear head). The end shield on the drive end of the motor is designed to provide a dual function. The side facing the motor provides the armature/rotor bearing support and a sealing provision through which the integral rotor or armature shaft pinion passes. The other side of the end shield provides

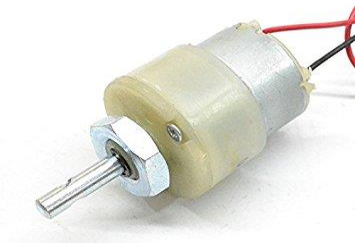

Fig 7: Gear motor

Multiple bearing supports for the gearing itself, and a sealing and fastening provision for the gear housing. This construction provides many benefits for a user and eliminates the guesswork of sizing a motor and gear reducer on your own.

4.1.6 HC-05 Module

HC-05 Bluetooth Module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Its communication is via serial communication which makes an easy way to interface with controller or PC. HC-05 Bluetooth module provides switching mode between master and slave mode which means it able to use neither receiving nor transmitting data.

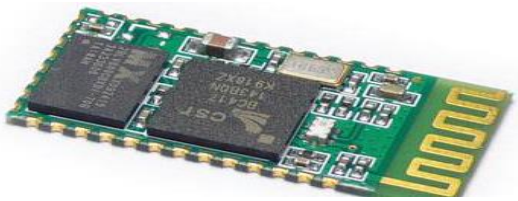

Fig 8: HC-05 Module

Serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Blue core 04-External single chip Bluetooth system with CMOS technology and with AFH (Adaptive Frequency Hopping Feature). It has the footprint as small as 12.7mmx27mm. Hope it will simplify your overall design/development cycle.

4.2 Software Requirements:

4.2.1 Arduino IDE:

Arduino is an open-source computer hardware and software company. The Arduino Community refers to the project and user community that designs and utilizes microcontroller-based development boards. These development boards are known as Arduino Modules, which are open-source prototyping platforms. The simplified microcontroller board comes in a variety of development board packages.

The most common programming approach is to use the Arduino IDE, which utilizes the embedded C programming language. This gives you access to an enormous Arduino Library that is constantly growing thanks to open-source community.

4.2.2 Android Bluetooth SPP Pro

Bluetooth Serial Port Profile which comfortable to developer application to communication with microcontroller or android device via Bluetooth. Bluetooth SPP pro library include all important methods for serial port profile on Bluetooth communication. It has built-in Bluetooth device list.

Features:

- It's very easy to use.
- Solve the lack of data like as "abcdefg" which divided to "abc" and "defg" when receive these data.
- Auto adds LF (0x0A) and CR (0x0D) when send data to connection device.
- Auto connection supported.

V. RESULTS

The automated waste segregator exactly fits at the source itself. The authorities in each city such as BBMP in Bangalore will collect the segregated wastes in separate containers and disposes the waste accordingly. Dry waste is recycled and reused. Wet waste is turned into compost and can be used to generate biogas. Connect the Arduino board to PC by using cable. Open the Arduino IDE software, take a new file and type a program then verify/compile the code. After code compilation, go to **Tools** select **Port: "Arduino/Genuino Uno"** in that select **"Arduino Genuino Uno".** After that again go to **tools** select **"Port: "COM4 (Arduino/Genuino Uno)".** In the next step we are going to upload the program to our Arduino board. Once code is uploaded we get done uploading command.

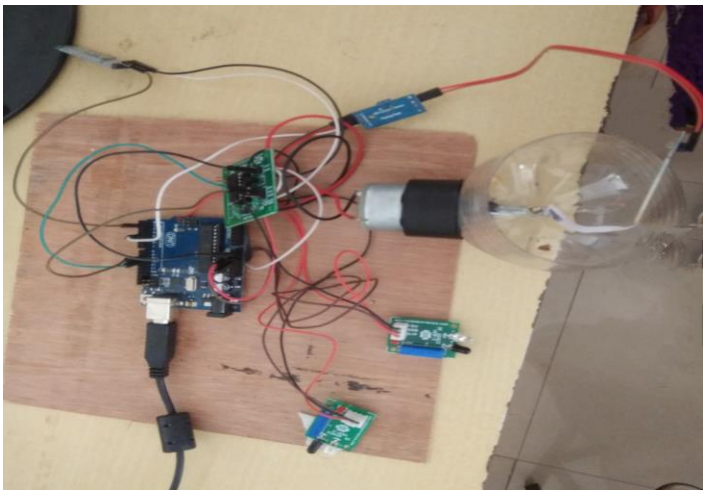

Fig 9: Model of automated waste segregator

When we get done uploading command then its confirmed code is uploaded to Arduino Uno board. Then initially put some dry or wet waste to garbage bin, after that press reset button of Arduino board if the waste collected is wet then motor rotate to right direction and put wet dust into wet garbage bin.
If collected waste is dry, then motor rotate to left direction and put the waste into dry garbage bin.

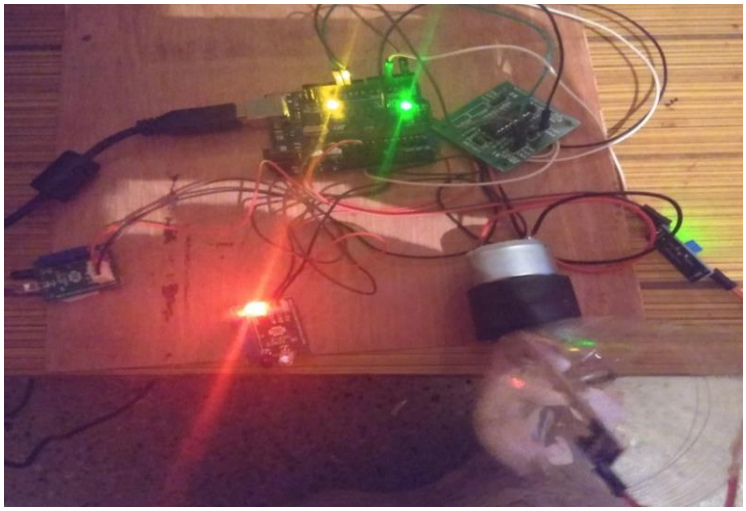

Fig 10: Waste Segregation

If the garbage bin is filled or not that should be also check easily in PC even also in android mobile phone with the help of Bluetooth SPP pro app for that reason HC-05 module is connected to Arduino Uno board.

VI. CONCLUSION

Automatic Waste Segregator has been successfully implemented for the segregation of waste into metallic, dry and wet waste at a domestic level. The system can segregate only one type of waste at a time with an assigned priority for metal, wet, dry and glass waste. The experiment has been conducted for wet, dry, glass and metallic wastes. It is found that the change of capacitive count value is greater for wet waste and very less for dry waste. Other objects like glass and wood have intermediate relative dielectric constant and thus are detected as dry waste. Experimental result shows that the waste has been successfully segregated into glass, metallic, wet and dry using the Automatic Waste Segregator.

VII. FUTURESCOPE

Every project is always has scope for improvement, perhaps the most pressing issue of separation of waste is when their dispose simultaneously. The waste segregator can be improvised to include the separation of paper and plastic, safe segregation of biomedical waste generated at home, compact and aesthetic Mechanical design.

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