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Smart Waste Segregation System with Deep Learning Algorithm for Plastic Bottle Detection

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Abstract - With the continuous growth in urbanization and industrialization, there is a rapid increase in the quantity of waste being produced every day. A huge amount of waste, that is generated and disposed by means which have an adverse effect on the environment. The common method of disposal of waste is by unplanned and uncontrolled open dumping at the landfill sites. We are dumping the waste generated every day in landfills all over. These causes – injurious to human health, plant and animal lives, etc... If we adopt a proper segregation procedure for the generated waste, it is possible to utilize and separate the waste effectively. This system helps the smart world by giving an advanced method for segregation of waste. Lately there have been a lot of difficulties to dispose the waste in right manner. So the Smart Waste Segregator system gives a new light to this growing hazardous affair.The proposed segregator system segregates the waste into three types, metallic, wet and dry, and in addition, separating dry waste further into paper and plastic. Here, Arduino Uno board is used as the main controller and various sensors are used to detect each type of waste, which is segregated and thrown into the respective bins. The system detect the human presence to open and close the bin lid using sensor and also provide a temporary closing of bin lid at the critical level filling. Smart Waste Segregation system also monitor the waste level and gives alert information to the authorities about the condition at the critical level by using IoT.

***Keywords*—Internet of things(IOT) ,Smart waste segregation(SWS)**

I.INTRODUCTION

Around the world, million tons of waste are generated each day. The major part of it is generated in metropolitan cities. Only a few amount of it is recycled. The unplanned and uncontrolled dumping at landfills is hazardous to environment and it turn affects plant, animal and human life. Because of that, the lack of proper segregation methods, the waste management is becoming a major problem these days. In this paper, we have proposed a Smart Waste Segregator system for the proper disposal of waste. This system can used anywhere like house, offices, educational institutions, hospitals, etc. In this paper, we have implemented a Smart Waste Segregator (SWS) system for segregating the waste automatically. It will be beneficial, if we segregate that at the source level itself, so we can recycle and reuse the waste effectively. This can reduce the work done by the municipality. Here, we are segregating the waste into metallic, wet and dry waste and further separating dry waste into paper and plastic by using the sensors. This type of SWS system can help the Government to recycle the waste in a much simple and faster way.

II.LITERATURE REVIEW

“Automated waste segregator" Introduced by AmruthaChandramohan, JoyalMendonca, Nikhil Ravi Shankar, Nikhil U Baheti. Rapid rise in volume and types of solid and hazardous waste due to continuous economic growth, urbanization and industrialization, is becoming a burgeoning problem for national and local governments to ensure effective and sustainable management of waste. This paper proposes an Automated Waste Segregator (AWS) which is a cheap, easy to use solution for a segregation system for the household use, so that it can be sent directly for processing. It is designed to sort the refuse into metallic waste, wet waste and dry waste.Waste is pushed through a flap into the proposed system. An IR proximity sensor in the proposed system detect this and starts the entire system. The waste is then falls on the metal detection system. This system used to detect metallic waste. After this, the object falls on the capacitive sensing module. This module distinguishes between wet waste and dry waste. After the identification of the waste, a circular base which holds the containers for dry, wet and metallic waste is rotated. The collapsible flap is lowered once the container corresponding to the type of the waste is positioned under it. The waste falls on the container and the flap is raised. The waste in the containers can now be collected separately and then sent for further processing.This system has its own limitations. It can segregate only one type of waste at a time with an assigned priority for the metal, wet and dry waste.

“Intelligent Sensors Based Waste Disposal System For Smart Cities” Introduced by Ms. Chinmai Shetty Mr. Dhananjaya B Ms. Deepa Ms. Rashmi N. In this system, the various bins in the city are equipped with intelligent sensors (Ultrasonic sensors). These sensors are employed to sense the waste level in the bins and to check if any wastes are outside the waste boxes.. The dustbins can be deployed based on actual use and not on assumptions. The real-time information is received by the driver and the webpage (using GSM and GPRS). The details on the webpage can be accessed by authenticated users. The collection of garbage can be easily monitored through the webpage. It reduces the excessive usage of petrol by providing the shortest and fastest path (by using Google Map API) to the drivers through the android application and by collecting the garbage only after the threshold level is reached The intelligent collection bin employs two sensors such as weight sensor and InfraRed (IR) sensors to indicate the weight and levels of waste in the bins respectively. The IR sensors help in getting information regarding the levels of waste in the bins. The weight sensor activates and sends information to the concerned once the waste in the bin reaches the threshold level. This information is passed on to the microcontroller Arduino UNO and further to the transmitter module (Wi-Fi module).

“Arduino Based Automated Domestic Waste Segregator” introduced byT.M.B.Shankar Balu, R.S.Raghav, K.Aravinth, M.Vamshi, M.E.Harikumar, Rolant Gini J. In this paper, an automated waste segregator is proposed that segregates the waste into wet and dry waste at the household level using capacitive proximity sensor and inductive proximity sensor, which also detects the bin filling status The proposed waste segregator separates the waste into dry and wet waste using inductive, capacitive and IR proximity sensors.This segregating bin can be used in households Inputs are obtained from the corresponding capacitive proximity sensor, inductive proximity sensor, and IR proximity sensors. These inputs are processed by using Arduino UNO and the servomotors are used to move and segregate the waste. LCD is used to display which type of waste placed on the segregating bin and whether the bins are full

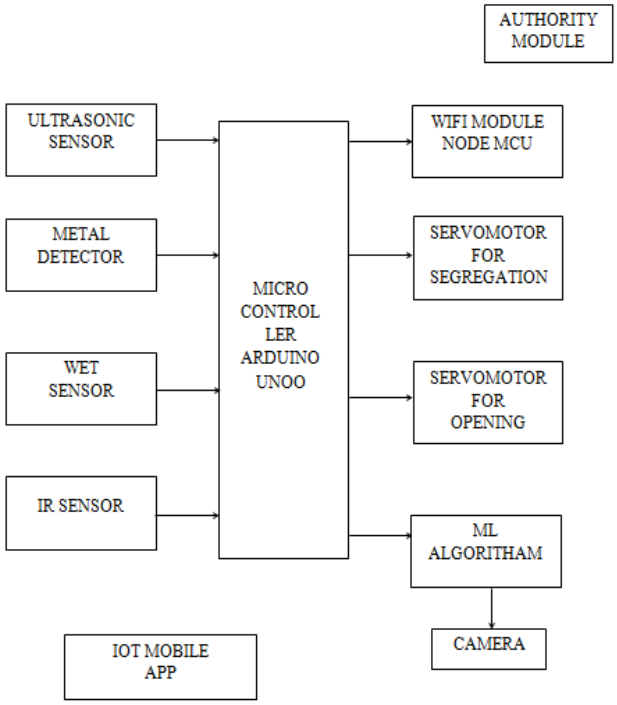
"DevelopmentofAutomaticWasteSegregatorwithMonitoringSystem"IntroducedbyNurishaHaniaKamarudin,IliShairahAbdulHalim,SitiLailatulMohdHassan,Noor EzanAbdullah. A satisfactory combination of a few sensor which are inductive proximity sensor, light dependent resistor and liquid sensor to do main task to sort recyclable materials into different bins automatically. NPN type of inductive proximity

sensor with a detecting distance of 4 mm is a useful device to detect metal objects. . Liquid sensor was used to recognize wet waste. By using light dependent resistor and laser module, plastic and paper material can be identified. If the light passes the object, then it is decided as plastic otherwise it can be categorized as paper. Besides that, this project is equipped with notification system to alert the janitor to ease the process of waste collection by receiving SMS. It can be done using Icomsat 1.1 SIM900 GSM module and Arduino UNO.

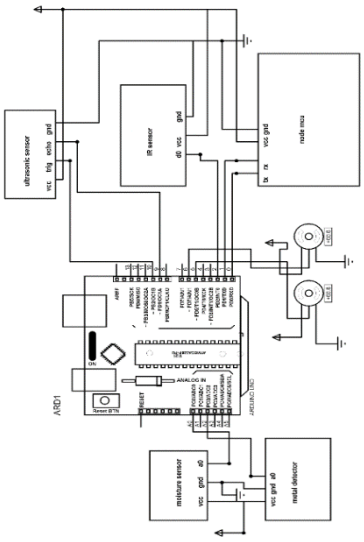
"Automated Waste Segregation System and its approach towards generation of Ethanol" Introduced by AbhishekMadankar,,MinalPatil,,Dr.PrabhakarKhandait. The goal of the scheme in this paper is, the method by which the system works starts with detection of the filled combined garbage inside the container by an IR sensor or Proximity sensor. After the garbage is detected the slider activates and pushes the combined garbage onto the conveyer belt. The conveyer belt works and rotates with the help of the 12V DC motors. As the combined garbage passes onto the conveyer belt the metallic components in the garbage get separated with the help of an Electromagnet and are collected inside a separate container the dry garbage is separated with the help of a blower. , and is collected inside a separate container. Now the rest of the garbage further passes on the conveyer belt and get the wet and Ethanol based garbage which get stored inside a separate container, which can further go for processing and can lead towards the production and generation of Ethanol.

III.PROPOSED SYSTEM

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.processing plant instead of sending it to the segregation plant then to the recycling plant.This paper proposes an Smart Waste Sagregator which is a cheap, easy to use solution for a segregation system, so that it can be sent directly for processing. It is designed to sort the waste into metallic waste, wet waste and dry waste. Machine Learning based logarithms are included in hardware design to detect plastic bottles. Also the project aims to include IoT communication system to alert the waste collecting authorities on filling of the waste bin. The proposed system is consisted by the ultrasonic sensor to measure the waste level, and an Arduino which Control the system operations. It can be also generate warning message to the municipality via IOT when the garbage bin is full or almost full, so the garbage can be collected immediately. The major aim of this project is to reduce human resources and efforts along with the enhancement of a smart city vision and it is expected to contribute to improving the efficiency of the solid waste disposal management. Fig shows the block diagram of proposed system



IV.WORKING METHODOLOGY



connection to the arduino is depicted in the circuit diagram. Arduino is the main component that control all the other components.A number of sensors are used in this project. Each components have different application. Ultrasonic Sensors- Waste level monitoring and IoT based alert to authorities on filling maximum level .Using IoT send warning message to higher officials if waste not collected till critical level.By Servomotor Mechanism Temporary closing of waste bin lid on critical level filling is possibleWaste segregation unit separats metal waste, wet waste, miscellaneous. IR Sensor used for Waste bin lid closure and open detecting human presence . Deep Learning based algorithm used for Plastic Bottle detection.

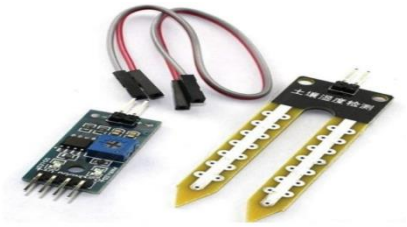
V.SENSORS AND MODULES

A).ARDUINO UNO

The Arduino Uno is an open- source micro controller based on the Microchip ATmega328P microcontroller.It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramics resonator (CSTCE16M0V53-R0), a USB connections, a power - jack, an ICSP header and a reset button. It consists 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 start. You can tinker with your Uno without worrying too much about doing something wrong, worst case you can replace the chip for a few dollars and start over again.

B).MOISTURE SENSOR

It is an electronic device that measures and reports the moisture and air temperature of the surrounding environment where they are deployed. Here we use a moisture sensor to detect the wet wastes. Its operating voltage is 3.3 to 5V. The sensor have dual output mode is possible and analog output is accurate. Lm393 comparator chip is included in the sensor. Also the sensor consist the power indicator and digital switching output indicator.



C).METAL DETECTOR

Themetaldetectorisamodulethatespeciallydesignedtodetectthemetal.Themoduleoperatesbyincludingcurrentsinmetalobjectsandrespondingwhenitoccurs.CAniceon-boardbuzzersignalswhenitdetectssomethingandon-boardpotentiometerallowsadjustmentofsensitivity.Operatingvoltageofthemoduleis3 to 5V

D).NODE MCU

Node MCU is a low-cost and open source IoT platform. It connect an objects and let date transfer using Wi-Fi. It included firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which was based on the ESP-12 module. later support for the ESP32 32-bit MCU was added.The name "NodeMCU" combines "Node" and "MCU" (micro-controller unit) the term "NodeMCU". It contains all crucial elements of modern computer, the system also have Wi-Fi capabilities, so we can control it wirelessly and make it work on remote installation easily. The board sending instruction to the microcontroller on the board.

E).SERVOMOTOR

A Servomotor is a rotary or linear actuator that allows for precise control of angular position or linear position, velocity and acceleration. It contains a suitable motor coupled to a sensor for position feedback. It requires a relatively sophisticated controller, often a module designed specifically for use with servomotors.

F).ULTRASONIC SENSOR

Ultrasonic sensors working by sending out a sound wave at a frequency above the range of human hearing. The transducer of the sensor act as a microphone to receive and send the ultrasonic sound. Our ultrasonic sensors, likes many others, use a single transducer to send a pulse and to receive the echo. The sensor determines the distance to a target by measuring time lapse between the sending and receiving of the ultrasonic pulse.

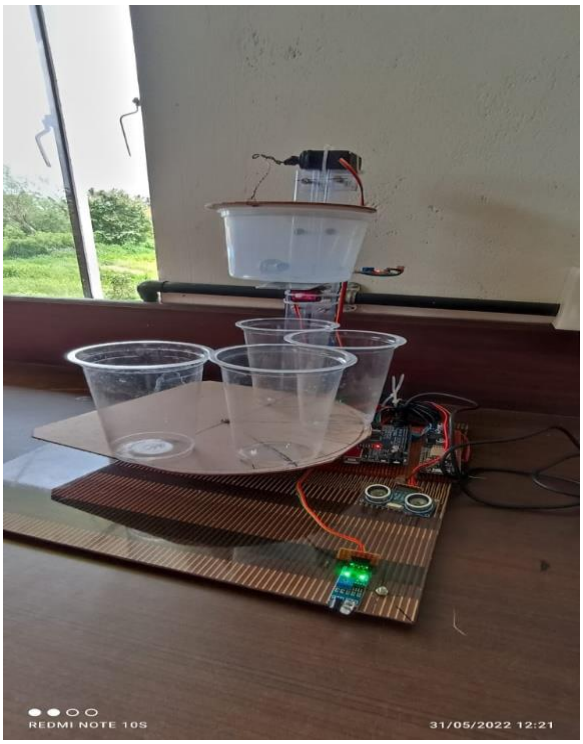
G).IR SENSOR

An infrared (IR) sensor is an electronic device which measures and detects infrared radiation in its surrounding environment. There, two types of infrared sensors: active and passive. Active infrared sensors both emit and detects infrared radiation. That have two parts: a light emitting diode (LED) and a receiver. When an object comes close to the sensor, the infrared light from the LED reflects off of the object and is detected by the receiver. Active IR sensors act as proximity sensors, and they are commonly used in obstacle detection systems.

mechanism.by using ultrasonic sensor the waste level in the upper waste bin can be determined .if the waste level is less than 5cm from the lid of waste bin a notification will be displayed “waste bin is full” and the information is given to higher authorities so they can collect the waste at the earliest.Here it is implemented by blynk application.

VI.RESULT ANALYSIS

There are one upper bin and one circular disc used here. the lower disc consist of four separate waste bins namely wet, metal ,normal & plastic bottle bin. The circular disc rotates by a fixed angle to drop the waste in to the corresponding bins and is controlled by a servo motor. The wet, metal, plastic and normal bins are fixed on the circular disc.. In the Upper bin the waste is thrown, to determine the type of waste. Inside the bin, IR sensor and metal detector are placed directly opposite to each other, moisture sensor is placed at the bottom of the upper circular bin.When the waste is thrown into the upper bin, then all the sensors sense the given waste. If the moisture sensor detects the given waste as wet, In this case, the lower circular disc does not rotate because the wet bin is right below the upper circular bin. If the waste is identified as metal waste by the metal detector, then the servomotor rotates to position the metal bin below the upper circular bin, and the metal waste is dropped into the metal bin.. After dropping the waste in the metal bin, the servo motor then rotates anticlockwise and goes back to its starting position..If the waste is detected as normal by IR sensor, then the servo motor rotates to position the paper bin below the, and the upper circular bin. Normal waste is dropped into the paper bin by the upper bin .by using deep learning plastic bottle detection, recognised the plastic bottle by camera and that waste goes to plastic bottle waste bin.. In this manner, the waste can be segregated at the household level automatically.An IR sensor is used to detect the human presence near the waste bin.if it detects the human presence the lid of the upper waste bin automatically opens.after putting the waste the bin automatically closes by using servomotor



VII.CONCLUSION

The project has been implemented using low-cost components and based on Arduino platform with an aim to develop a system which will be effective to to reduce human resources and efforts along with the enhancement of smart city vision. Furthermore, it is expected to contribute to improving the efficiency of the solid waste disposal management ..This system proposes an Automated Waste Segregator which is a cheap, easy to use solution for a segregation, so that it can be sent directly for processing. It is designed to sort the refuses into metallic waste, wet waste and dry waste. Machine Learning based alogarithams are included in hardware design to detect plastic bottles. Also the project aims to include IoT communication

system to alert the waste collecting authorities on filling of the waste bin. The proposed system is consisted by the ultrasonic sensor to measure the waste level, and an Arduino which Control the system operations. It can be also generate warning message to the municipality via IOT when the garbage bin is full or almost full, so the garbage can be collected immediately.

VIII.FUTURE SCOPE

For the future development of this system, we have three options here: the first one is -By adding waste disposal to each waste materials that makes a new advantage in this field. And the other one is -If the system is fabricated in large scale, which can be use for the industrial segregation purposes. Ultrasonic sensor can use for each corresponding waste bins and that detects the level of waste of the waste bin. Set a critical level for each waste bin. If the waste of one bin reach the critical level, then the sensor detects the level of waste of that bin and send that information like to the higher authorities like municipality and etc,.for example, if the wet waste bin is reached the critical level, the ultrasonic sensor detects that and sent that message like wet bin is full - to the authorities. Then the next is - we can add biodegradable waste bin to this system. So that we can easily manage that kind of waste disposal.

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