DEVELOPMENT OF REVERSE VENDING MACHINE (RVM) FRAMEWORK FOR A WASTE MANAGEMENT MONITORING BY IOT


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ABSTRACT

Pollution increases day to day life to reduce that an efficient method is required to dispose of the waste material. These days with the increasingly large amount of waste generated and limited landfill space for waste disposal, recycling is one of the important approaches to manage waste effectively. Moreover, waste is not separated in a proper way in which they are deposited in many places, due to this all the materials are mixed and stored in the same place in which both the decaying and non-decaying products are stored in the same places. To overcome such a problem, in this project a standard recycle bin with a reward feature is proposed that obtain from a reverse vending machine carried by redeem card. Basically, the system is implemented in a standard recycle bin provided by local municipalities that equipped with a microcontroller and collection of sensors. Throughout the process, the sensors responsible for identifying user information, corresponding points automatically update in the IoT cloud. Through the IoT recycle bin has been monitoring. Once the process completed, the user can claim their allotted points by using an RFID point card. All the mentioned processes will be controlled by a microcontroller. The system has been implemented in a small-scale user evaluate and the framework shows its effectiveness for handling the whole process. The prototype is expected to aid in accelerating the motivation among India to recycle their waste and can be one of the frameworks to overcome the urban poverty issue by using the waste to wealth concept.

Keywords: Reverse vending machine, IOT, RFID

I. INTRODUCTION

1.1 Waste management

Garbage disposal is now a worldwide concern. Large amount of waste generated every day are disposed by means that cause adverse environmental effects. The common method of waste disposal is by unplanned and uncontrolled open dumping at the landfill sites and ocean. This method is noxious to human health, plant and animal life. This method of waste disposal can generate liquid leachate which contaminates surface and ground waters that can result to a spread of harmful diseases and the irreversible destruction of the natural environment.

1.2 Reverse vending machine

Reverse Vending Machine (RVM) is used for recycling of materials such as paper, bottles, cans, and bulbs. A reverse vending works like a vending machine but in reverse. This paper focuses specifically on reverse vending machine of plastic bottles. The purpose of reverse vending machine is purely to encourage recycling and provide an incentive for the user. The operation of RVM is very straightforward and simple.

Users simply place their empty plastic bottles into the machine; the machine collects those plastic bottles and prints out a receipt with a barcode or an amount stated which is redeemable for cash. In an effect to identify all the different types of beverage containers by their shape, weight, material and barcode, the real-time image processing system is used by most RVM. The incentive can be of any type such as cash, reward points on smart
cards, shopping coupons, bus/train tickets, mobile phone credit or donating to charity. Reverse vending machines utilize advance technology to identify, sort, collect and process the recycle materials. The technologies that are used are bar code scanners, camera imaging, sensor-based sorting of materials, touch screen technologies, etc. Reverse Vending Machines are widely use now-a-days; they are installed in hospitals, schools, universities, departmental stores, shopping malls and offices. They are widely used in countries like China, USA, Germany, Wales, Scotland, Ireland, Australia, Norway, Brazil, the Middle East and the UK. An algorithm was developed in VHDL and simulated using Xilinx FPGA Spartan 3 development board. Bottles were detected using a sensor and the RVM gave out outputs such as coins and snacks (candies, chocolates, or cold drinks). The aim of this project is to develop a prototype of the Reverse Vending Machine using FPGA.

This prototype enables the user to recycle plastic bottles and get cash rewards. An ultrasonic sensor is used to recognize different bottle sizes, according to which the cash reward is calculated. FPGA is used here as a faster mechanism compared to microcontrollers. This project will make RVM cheaper than most of the reverse vending machines. It uses a proximity sensor which is cheaper than a conventional video camera that uses image processing technology. In developing countries, cost of the RVM is one of the biggest factors that prevents its proliferation. As the main objective of this project is to recycle and thus help protect the environment; this RVM has to be as affordable and accessible as possible to have a positive impact on society.

II. SYSTEM OVERVIEW

A general over view of the proposed the main consumption of the work is done with the help of Arduino and fully operated automatically. Several types of sensors are used in this project to detect the type of material like inductive type proximity sensor, capacitive type proximity sensor, ultrasonic sensor. The crushing process is done with the help of DC Motor and the plate on each side gets pressed.

![RVM for waste management](image)

2.1 Mechanical Mechanism Development

For the mechanical development, major design idea and concept was gain from the previous version of the standard recycle bin. Physically, the design consisted of the relay, conveyor belt, metal plate. In the fig.1 the barricade is responsible to block and drop the thrown waste in the standard recycle bin to the bin as the slider move in the other direction. Since the standard recycle bin is originally designed to replace the bin lid, only minimum modification is needed to utilize the standard recycle bin in the existing recycling bin system. The bins can either from the same type of metal waste or from a different type during the operation. If the system operates under the same type of waste mode, only one bin will be activated during operation and the other bin will be closed and act as a reserve bin. The role will be servo motor to open the door. In a condition when the system is used for a different type of waste other than metal and plastic, initially both doors will be locked. When the user wants to throw garbage to the respective bin, s/he needs to show the redeem card the RFID reader that represents each bin. Once the reader the card the door has been opened. Place the wastage. Once reached, the selected bin ready to process the waste management accordingly. In this paper, the focus is on operating the BPU by considering two types of recycling bins which are metallic recycle bins and other wastages recycle bins. Fig 1 shows the model of this project.

2.2 Electrical and Electronic Development
A number of important issues need to be considered in designing the electronic parts for the standard recycle bin to ensure its automated process can work accordingly. Include RFID, ultra-sonic sensor, inductive sensor, IR sensor, power consumption, display, servo motor, and last but not least the DC gear motor and ease of the part Maintenance. The former comprises RFID, PIR sensor, microSD, real time clock and load cell, servo motor, buzzer, and DC motor. Fig 3 shows the block diagram. Through the block diagram the components are connected.

If everything is in order processing loop starts with the sensor senses any motion in front of the bin. When there is no activity or motion, the bin has been closed. If user has to be uses the bin first the RFID card has been placed in front of the RFID reader. After the card placed the details of the user will be displayed on the LCD. As the user insert the waste into the SRB, the inductive sensor senses the metal wastage and IR sensor senses the other wastage through this separate wastage, the SRB will be locked and s/he can claim the corresponding point that related to the waste by the RFID card. Once the user interaction process is completed, the SRB move the slider to the other side of the SRB to dump the waste from the SRB into the recycle bin. All the transactions will be recorded and saved to the IoT analytics and will be collected during the waste collection cycle by the local municipal. Fig 2 shows the list of the electrical components which is used in this project.
In this section, we analyzed the performance of the constructed framework which constitutes the mechanical part and the electronic part. The assessment is divided into three main parts which are visualization of the prototype flow, wastage detectivity analysis and IoT monitoring. Sample snapshot of the SRB prototype attached with the recycle bin is shown in Fig. 4(a) in which the prototype was constructed using PVC material. In the figure, sample of LCD screen during operation when waiting user input is also provided. Fig. 4 (b) shows the output board.

3.1 SRB Visualization flow of the prototype

The first assessment was performed to demonstrate the SRB ability for completing the sequence of task starting from receiving command from the user until the point redemption stage. Fig. 4 shows the results. It shows the process where initially after user is detected in front of the SRB, the RFID reader is switch on. The user carries a card placed on the RFID reader(fig.4(a)). The user is then directed to the place the type of waste that s/he intended to dump (Fig. 4(b)), for this case the user selects the metal type waste in which the location is in the right side of the user fig(4(d)). As soon as the door has been opened start dumping waste. The user then close the door and eventually can claim the points by touching the RFID card(Fig.4(f)) that calculated based on the type of dumped waste. The prototype demonstration by the user in an exhibition shows promising results although it still in the prototype phase. We are now planning to perform experiments at a higher-level scale by a high-volume user, e.g., 1000 users.
3.2 Analysis of the SRB

The second assessment aim is to determine the SRB functionality in typical way using two parameters. Metallic things are identified by means of the inductive proximity sensor track, and the course doesn’t notice any substances further than metals. Capacitive proximity sensors are non-contact devices that can detect the presence of other wastage. They utilize the electrical property of capacitance and the change of capacitance based on a change in the electrical field around the active face of the sensor and capacitive sensor senses the plastic wastages. Both results indicate a promising outcome of the developed laboratory prototype. For the time taken to accomplish the task of both operators, it can be observed from the experiment that the time required for accomplishing the task becomes decreased as the user familiar with the SRB operation. Quantitatively, the user 1 takes an average of 37.33 seconds to complete the whole sequence, while the user 2 takes an average of 33.91 seconds.

3.3 IoT Monitoring of SRB

In this experiment the SRB will be monitored by the IoT. It shows the initially from level of the dustbin to points allotted to the person. In this development we show of the two user's valid points in the think speak channel. Fig(5(a)) it shows the level of the dustbin. Fig(5(b)) it displays the metal wastage points allotted to the user 1. Fig(5(c)) it displays the plastic wastage points allotted to the user 2.

IV. CONCLUSION

The detector of metal or non-metal is done by dumping them into the hardware, i.e., Arduino and verified for many objects call into the system. Waste categories namely metal and non-metal sorted using automatic waste separator is described in the proposed system. It is the better option for the safe management and also it is of low cost. For urban household, college and offices a compact, low cost, and user-friendly separation system through this system to streamline the waste management process.

REFERENCES


