Plastic Bottle Reverse Vending Machine

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Abstract— These days the increasing in amount of waste generated by human's and limited landfill sites for dumping waste, recycling it is one of the novel approaches to manage the waste effectively. The present recycling practice in which the people need to bring the waste in bulk to the recycling centre might bother and become a discouraging factor for them to recycle. To overcome such an issue, an automated recycle bin designed and installed in many countries on subways, malls etc. with a reward featured is developed from a reverse vending machine (RVM) concept. In present time, Reverse Vending Machine is become very popular in countries like Greece, Japan, Europe, South Korea, America and China. Reverse Vending Machine (RVM) reduce employee work, saves time and energy also motivate human's being, even cost effective. In this paper we explain about the working of Reverse Vending Machine which start to work after inserting the plastic material into it. There are very attractive rewards for the users of Reverse Vending Machine, they get coins as a reward. Reverse Vending Machine process by accepting plastic items and gives coins as a reward according to the weight of plastic items. In this, Reverse Vending Machine supports only plastic items as an input, coins as an output.

Keywords: Green Coin, Plastic Bottle, RVM

I. INTRODUCTION

The volume of waste generation is growing rapidly year by year, it has increased over 47.3% in past 10 years. The common method of waste disposal is open dumping at landfills sites. This method is injurious to human health, plant and animal life. There are many type of plastic materials that we use daily, but not all the plastics are recycled. Plastic bottles of drinks are of the pervasive plastic issues. Relative to drinking straws and grocery store plastic bags, plastic bottles are more space consuming and readily compact down. For every six plastic bottles bought, only one recycled, five are thrown away eventually end up in landfills or ocean. Plastic takes nearly hundreds of years to decompose, poisoning the environment and wildlife and other living organisms within.

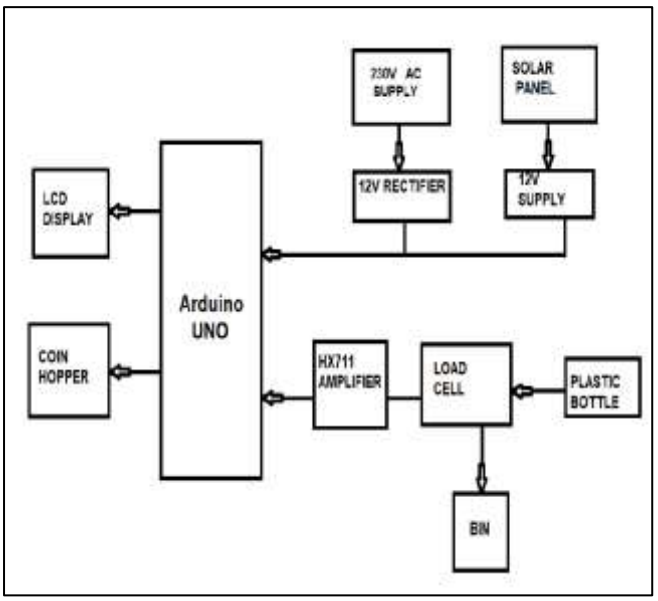
Polyethylene terephthalate is a plastic resign composed of two monomers namely modified ethylene glycol and purifies terephthalic acid. PET is mainly used for food and water packaging, because it is safe, transparent, strong and versatile. Up to 100 % of PET packaging can be made from recycled PET, and materials can be recycled again and again to reduce the amount of waste going to landfills. The other type of plastic and their recycling rate shown in table.

	What is it used for?	Next life	Ease of recycling
Polyethylene Terephthalate (PET) 1	Soft drink bottles, food packaging such as punnets	Used to make more PET products	Easy
High Density Polyethylene (HDPE) 2	Milk cartons, cleaning products, yoghurt pots, soap dispensers	Garden furniture, pipes and more milk cartons	Easy
Polyvinyl Chloride (PVC) 3	Pipe fittings, window fittings, thermal insulation, car parts	Used to make more PVC products	Difficult
Low Density Polyethylene (LDPE) 4	Food bags, shopping bags, magazine wrapping	Bin liners, plastic furniture and floor tiles	Manageable
Polypropylene (PP) 5	Margarine tubs, microwave meal trays, fibres and filaments for carpet, wall coverings, vehicle upholstery	Clothing fibres, food containers, speed humps	Easy
Polystyrene (PS) 6	Some yoghurt pots, takeaway boxes, plastic cutlery, protective packaging, insulation	As more packaging	Difficult
Other 7	This includes other forms of plastic including composites, such as salad bags and crisp packets	Goes to landfill	Very difficult

Table 1: Types of Plastic Bottles

Increase amount of waste generated and the limited landfill sites for dumping the waste, recycling is one of best approaches to manage the waste effectively. We came up with an idea of automated recycle bin with a reward feature called reverse vending machine. A reverse vending machine (RVM) is a machine where people can return empty beverage containers like bottles and cans for recycling. The machine often gives back a deposit or refund amount to the end user. Reverse vending machines are a key part of container deposit systems in Europe and the United States, with 70% to almost 100% of all beverage containers being sorted and recycled. RVM machines sort containers in three ways: analyzing the material of the container (e.g. by IR-spectrometer), controlling of the shape of the container, checking the barcode. These three basic control-procedures prevent fraud from being collected. But at the same time, this equipment makes the RVM too expensive. In our project we planned to simulate the Reverse Vending Machine (RVM) on Strain Gauge Weight Sensor, Infrared Photoelectric Sensor to detect fraud. The objective to simulate the Reverse Vending Machine (RVM) is to effectively managing the waste for recycling purpose and decrease the level of pollution. In proposed Reverse Vending Machine, the user inserts plastic bottles (PET) into machine after this machine start to work. According to the weight of the bottle coins come out. Reverse Vending Machine can be implement in bus stop, railway station, colleges, malls, public places etc.

II. BLOCK DIAGRAM



III. LITERATURE SURVEY

[1] Razali Tomari a, Aeslina Abdul Kadirb, Wan Nurshazwani Wan Zakariaa, Mohd Fauzi Zakariaa, Mohd Helmy Abd Wahaba and Mohamad Hairol Jabbar "Development of Reverse Vending Machine (RVM) Framework for Implementation to a Standard Recycle Bin", IEEE International Symposium on Robotics and Intelligent Sensors (IRIS 2016), Procedia Computer Science 105 (2016) 75 – 80. The main objective of this project is, they implement the develop system into a standard recycle bin and maintaining the conventional procedure for the user to dump the waste. This product evaluates the value of the dump waste according to its weight, type and price of the recycle waste. The results of this project is from the BPU analysis, it can be conclude that the machine capable to successfully accomplished the user interaction tack with an average of 97% successful rate and average operating time of 35 seconds. As for the weight scale that responsible to measure the amount of dumped waste, from the assessment of various spots in the weight scale tray it can be deduced that the measurement is accurate up to ± 5.5 grams.

[2] Wisdom Gen P. Dumpayan, Matthew Lawrence M. De Mesa, Nathalie Danielle F. Yucor, Eden T. Gabion, Jacqueline D. presented the project "Two-way Powered Microcontroller-based Plastic Bottles 'Drop-and-Tap' Reverse Vending Machine with Stored Value System Using Radio Frequency Identification (RFID) Scanner Technology". At the heart of the system is a microcontroller which directs the operation of the various input (sensors and keypad) and output (display and motors) devices attached to it. The machine accepts plastic bottles and credits these as points, which in turn, can be used to buy products. The main drawback of the system is that, using RFID technology makes the RVM too expensive.

[3] Aditya Gaur, Dilip Mathuria , Dr. Rashmi Priyadarshini proposed "A Simple Approach to Design Reverse Vending Machine", International Journal of Electronics, Electrical and Computational System IJEECS ISSN 2348-117X Volume 7, Issue 3, March 2018. This paper explains the simulation of Reverse Vending Machine with fraud detection with Strain Gauge Weight Sensor, Capacitive Proximity Sensors and Infrared Photoelectric Sensor to detect fraud. Reverse Vending Machine process by accepting plastic items and gives coins as a reward according to the weight of plastic items. The system will work efficiently and cost effective in implementing the design of creating the recycle machine's programmable hardware-based detection system using a capacitive proximity sensor, an infrared photoelectric sensor and strain gauge weight sensor which is readily available in the market and very cost efficient.

IV. METHODOLOGY

There are three steps involved namely: input step, processing step and output step.

- Input step: There are many type of plastic materials available out of which single use plastics are highly recyclable, single use plastics includes bottles, cans etc., this machine is designed to acept only PET bottles. RVM acccepts 1 or 2 litres empty PET bottles of any shape. Once user bring the bottle near the inlet , it is detected then inlet will open, user can place it.
- Processing step: Afer placing the bottle, load cell check the wight of the plastic bottle. It's length is detected by IR sensors, as shown in the figure. Then bottle is accepted otherwise returned back to the user. Because of the low weighing empty bottles HX711 amplifier is used, which amplifies the impact of load cell then bottle falls into the bin kept within the unit. Signal is passed to the Arduino UNO.

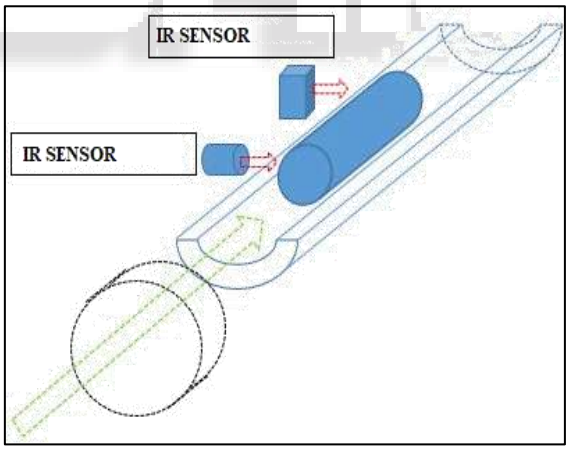


Fig. 3.1: detection of lenth of bottles by IR sensors

- Output: According to the weight of the bottle, coin is popped out to the user from the coin hopper. Below table shows the coins according to weight of bottles.

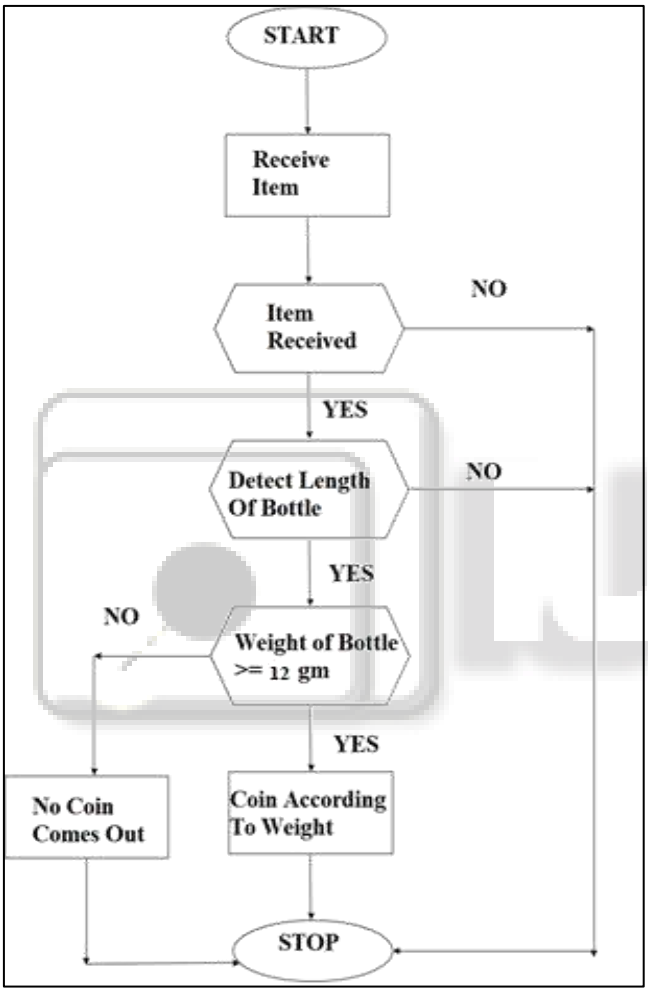
Weight Required to each Coin to pop out	Resultant Weight	Coin User gets	Number of Bottles getting filled in the Bin
120gm	120gm	First	3
120gm	240gm	Second	6
120gm	360gm	Third	9
120gm	480gm	Fourth	12
120gm	600gm	Fifth	15

120gm	720gm	Sixth	18
120gm	840gm	Seventh	21
120gm	960gm	Eighth	24
120gm	1080gm	Ninth	27
120gm	1200gm	Tenth	30

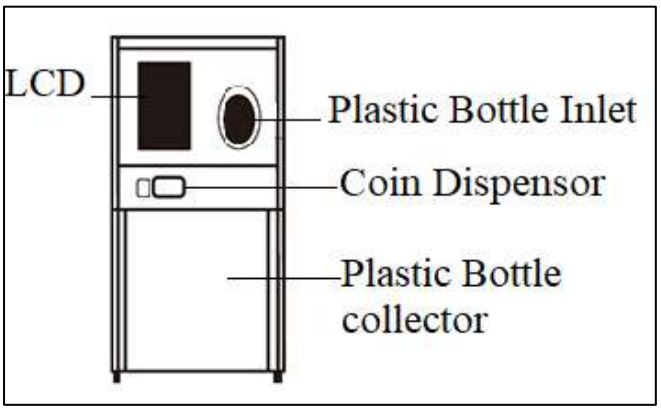
Table 2: Coins Output

Note: 1000 ml water bottle is approximatly 40 grams and the height of RVM is 24cm. So 3 bottles required to fill the criteria of 120gm and dispenses a coin and the size of model designed is 1.2 kg (total 30 bottles can be filled).

V. FLOW CHART



VI. MODEL



VII. ADVANTAGES

- The Machine is useful for waste management.
- The individual recycling the waste is rewarded with Coins.
- This system can be installed at various places just like ATMs.
- Also can be installed at places where high amount of plastic is disposed in environment.
- Can be installed at public transportation stations like railway stations and bus stops to issue tickets in return of plastic bottles.

VIII. DISADVANTAGES

- The system needs proper maintenance and care.
- Need to install the equipment in every place.
- Initial investment of system is high.
- In type of collected containers.

IX. CONCLUSION

- The module is reduces the physical strain of a person about 80% for performing a required task(collection and segregation of plastic).
- Utilization of renewable energy source.
- 1000litre capacity empty PET bottles is readily segregated and available for recycling.
- The Module is designed for 1.2kg weight of Plastic, hence compact and easily transported and installed.
- The model can be installed in Commercial complexes, Railway stations, Malls etc .

X. FUTURE SCOPE

There is endless scope of research and improvements for reverse vending machine. However in many countries reverse vending machine is not popular due to high initial investment and maintenance cost. Simply they are not affordable and hence are not implemented. In this project, we designed a low cost reverse vending machine .the remaining challenges and scopes of this work are:

- Improved detection accuracy of sensor system.
- Sorting system for different materials.
- Redemption of reward points.
- Implementation of IOT.
- Lower energy consumption.
- Implementation of barcode scanners.
- Implementation of image recognition procedures inside the RVM.

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