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Automation of Plastic,Metal and Glass Waste Materials Segregation using arduino in Scrap Industry

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Abstract: **The nation and world is facing a huge problem today of disposal, segregation and recycling of solid waste, and improper management of these wastes are hazardous and dangerous to human health and ecological system. There is a rapid increase in capacity and categories of solid waste as a result of urbanization, constant economic growth, and industrialization. Global Waste Management Market reported that the amount of waste generated worldwide produced is 2.02 billion tones. "Wastes are not always waste if it is segregated as it was". To properly manage the waste it has to be handled, segregated, transported and disposed so as to reduce the risks to the public lives and sustainable environmental .The economic value of waste is best comprehended when it is segregated. Currently there is no such system employed of segregation of glass, plastic and metallic wastes at industrial level. This paper proposes an Automation of Waste material Segregation in scrap industry. This method is easy and simple solution of segregation of three types of wastes glass, metal and plastic. It is designed to sort the trash into metallic waste, plastic waste and glass waste ready to be processed separately for the next process of operation. The Method uses inductive sensors metallic items, and capacitive sensors to distinguish between and dry waste. Experimental results show that the segregation of waste into metallic, plastic and glass waste has been successfully implemented using the Automation of material segregation (AMS) method.**

Keywords—AMS,inductive sensor;capacitiv sensor; scrap industry.

I. INTRODUCTION

The generation and disposal of waste in large quantities has created a greater concern over time for the world which is adversely affecting the human lives and environmental conditions. [1]. Wastes are the one which grows with the growth of the country. Segregation of waste is important for proper disposal of vast amount of garbage modern society produces in an environmentally sensible mode. People became adapted to tossing things away and never realize the consequences of their action. The common method of disposal of the industrial waste is by uncontrolled and unplanned, and exposed dumping at the river sites and open areas. This method is injurious to plants, human health and animal life.

This liquid leachate generated because of improper disposal and mixed waste contaminates land, water at surface and ground that becomes source of harmful diseases and degrades value of environment and other resources of nature.
[2:4]. The waste becomes valuable if it is segregated and recycled the recent advancements in technology [3] has also made waste to become useful entity with conversion of waste to different forms and harness energy such as Waste to Energy, in this conversion method the waste can be employed to generate synthetic gas (syngas) made up of carbon monoxide and hydrogen. The gas after burning can be used to produce steam and electricity; Waste to Fuel, for generation of bio fuels.

When the waste is segregated into basic streams. The metallic waste could be reused or recycled. Even though there are large scale industrial waste segregators present, it is always much better to segregate the waste at the source itself. The benefits of doing so are that a higher quality of the material is retained for recycling which means that more value could be recovered from the waste [3]. The occupational hazard for waste workers is reduced. Also, the segregated waste could be directly sent to the recycling and processing plant instead of sending it to the segregation plant then to the recycling plant.
Currently there is no system of segregation of glass, plastic and metallic wastes at an industry. J.S. Bajaj [4] has suggested that a least cost, most appropriate technological option for safe management should be developed. The purpose of this project is the realization of a compact, low cost and user friendly segregation system for urban households to streamline the waste management process.

A. Technical Background

The mixed waste is sorted based on the conventional methods at the industrial level [5]. Normally most of the unused and waste materials are found to be metal, glass, plastic etc. These materials can be recycled for further use. The first step towards recycling is the segregation of waste [11, 12]. The primary aim of objective of proposed work is to

segregate materials [14] such as metals, plastic bottles, glass and bottles [15]. Here two sensors are used namely inductive proximity sensor and capacitive proximity sensor. For level detection infrared sensors are used to indicate the bins are full.

The three materials found mostly in solid waste are Metal, Glass and Plastic [16]. These are the materials that can be recycled and the first step towards recycling is segregation. There are numerous benefits of recycling the waste materials.

Scrap shops play a vital role in maintenance of solid waste that is generated. **S**crap consists of recyclable materials that are byproducts from product consumption and manufacturing, such as parts of vehicles, building supplies, and surplus materials. Scrap has economic value, particularly recovered metals, and non-metallic materials are also recovered for recycling. Recycling of scrap materials is the key for effective waste management and it's economical too.
The methodology adopted in this paper to resolve the issue of waste segregation is by making the entire process automated and to the reduce cost such that it could be adapted in a scrap industry.

B. Proposed Solution

Waste is pushed onto conveyer belt, the presence of waste is first identified by use of Infra-red sensor at start end of the conveyor belt, the waste moves further for detection with inductive sensor to detect it is metal or nonmetal. If it is detected metal, conveyor motor rotates to in a direction to collect the metallic waste, for nonmetal it moves further with capacitive detection of plastic or glass. With detection of plastic it rotates in other direction or moved by pivot to collect in other bin.

C. Organization of the Paper

The paper is ordered as follows: Section II covers the design methodology and implementation of the AMS, which has a comprehensive description of the implementation of each block. Section III contains the results and discussion of the experiments performed to show the performance of the various blocks of the AMS. Section IV has the conclusion of proposed method.

II. DESIGN AND IMPLEMENTATION

A. Block diagram

The Block Diagram shown in 1 represents the automated waste material segregator where three types of materials are segregated namely Metal, Glass and Plastic. The controller used is Arduino UNO. An object is placed on the conveyor which runs on a motor of 12v, 2A which is connected through the motor driver and which is programmed to run in clockwise and anti-clockwise direction by the Arduino. The object is placed on the conveyor, depending on the output from IR sensor and Inductive sensor the motor driver the motor either in clockwise if the material is metal or anti-clockwise direction if the material is non-metal.

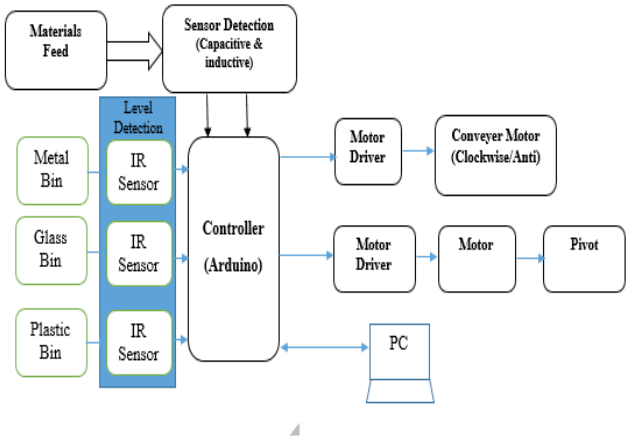

Fig.1. Block diagram of Automated Material Segregator

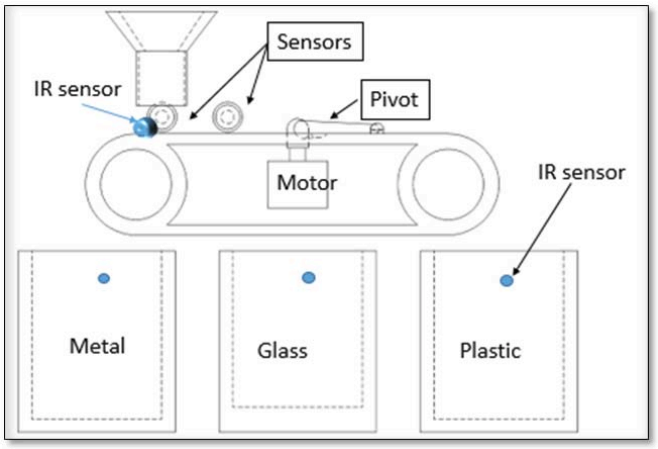

Fig.2. Experimental set up of automated material segregator

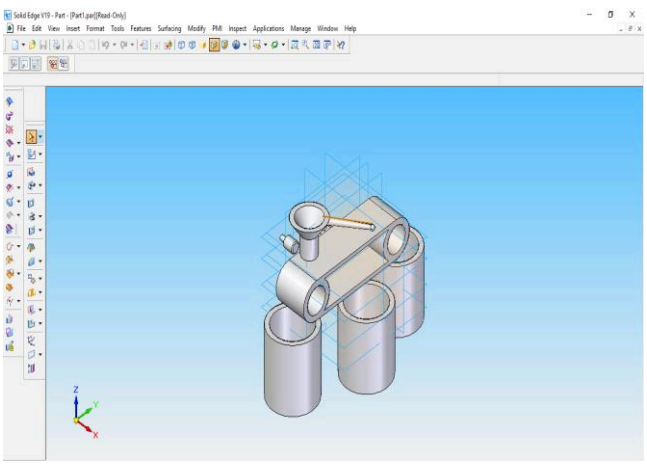

Fig.3. 3D model of automated material segregator

Metal is collected in a bin wherein IR sensors are used for level detection. The non-metal object moves in anti-clockwise

direction towards the Capacitive Sensor, if the capacitive sensor output is high meaning to say the material is glass then the motor driver stops the conveyor motor and the Arduino controller drives the Motor so as to push the glass material to the bin which is also equipped with IR sensors. If capacitive

Sensor output is low then the conveyor motor rotates in the same anti-clockwise direction and the plastic material is collected in the bin with IR sensors for level detection.

The figure in Fig .2 illustrates the experimental set up including all the components used and Fig .3 shows 3D model of experimental set up of automated material segregator. The various components used are explained in the coming part.

B. Flow diagram of Automated material segregation

The figure in Fig 4 and Fig 5 illustrates the flow diagram of automated material segregator including all the components used. The mechanical body of the project is built and following details are observed.

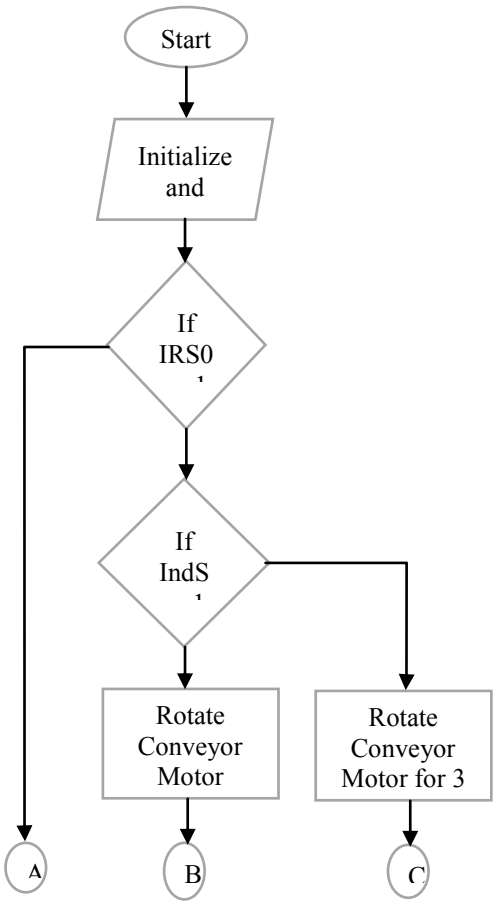

Fig.4. Flow diagram of Automated material segregator with inductive sensor

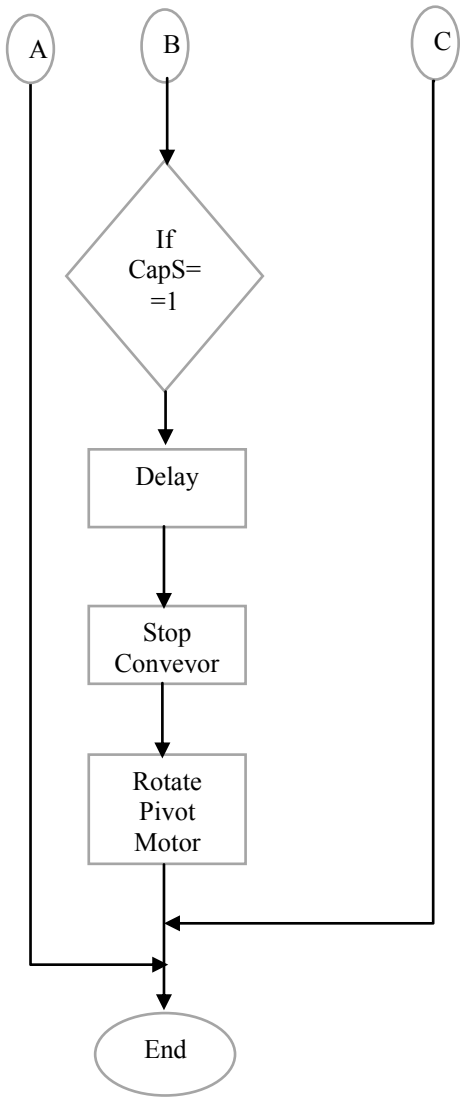

Fig.5. Flow diagram of Automated Material Segregator with capacitive sensor

The conveyor model rotates right when both IR sensor as well as Inductive sensors are high indicating that the material detected is metal. It is collected in the bin.

- The conveyor model rotates left only when IR sensor is high and Inductive sensor is low indicating that the material is either glass or plastic.
- The conveyor model continues to move left until the capacitive sensor output goes high which indicates the presence of glass and is collected in the bin.
- If the Capacitive sensor output is not high, then the object is treated as Plastic and is accumulated in the bin.

The reading for change in the capacitive count value is determined and object for metal, glass, plastic on conveyor is shown in Table 1. The experiment is carried out for small volume of the waste objects, and a minimum quantity of one object each for waste objects (glass, plastic and metal) materials like key chain, rubber, plastic toy, cold drink tin, glass were used for the experiment. The large value of capacitive count value greater than threshold indicates glass is collected and dumped in glass collecting bin by pivot motor with IR sensor for fill indication. The proposed system is tested with diverse materials each category has been considered with acceptance and rejection rate of the proposed system. Table 2 details the results of different category of results with true, false acceptance and rejection rate. The Fig 6 shows the detection of metals with 90% true acceptance and 10% false rejection of metal type materials here a cold drink can was used for the experiment. Once the material is detected wit true acceptance rate with high percentage than motor is rated in clockwise direction to collect metals in metal bin. In second case the detection of glass materials shown in Fig.7 with 93% true acceptance 2% true rejection and 5% false rejection of glass type materials here a glass jar can was used for the experiment. Once the material is detected with true acceptance rate with high percentage than motor is stops with pivot movement to glass is collected in glass bin. The detection of plastics as shown in Fig.8 with 98% true acceptance and 2% false rejection of plastic type materials here a plastic toy car was used for the experiment. Once the material is detected with true accepted rate with high percentage than motor is rotated in anti-clockwise direction to collect plastic material in plastic bin.

TABLE I. DETECTION STATUS OF WITH CAPACITIVE AND INDUCTIVE SENSORS

Test	Materials	Detected	Not detected
1	Metal Tin	Yes	
2	Glass Bottle	Yes	
3	Plastic bottle	Yes	

TABLE II. RESULTS OF METAL, GLASS, PLASTIC MATERIAL TEST

Materials Tested	True Acceptance	True Rejection	False Acceptance	False Rejection
Metal	90			10
Glass	93	2		5
Plastic	98			2

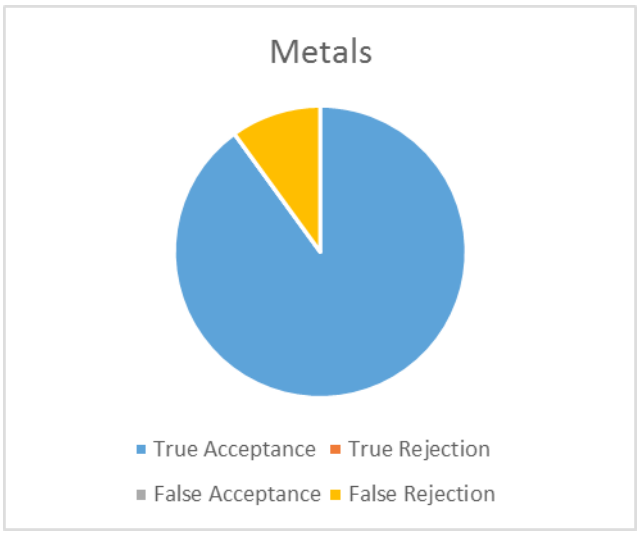

Fig.6. Results for metal detection 90% true acceptance

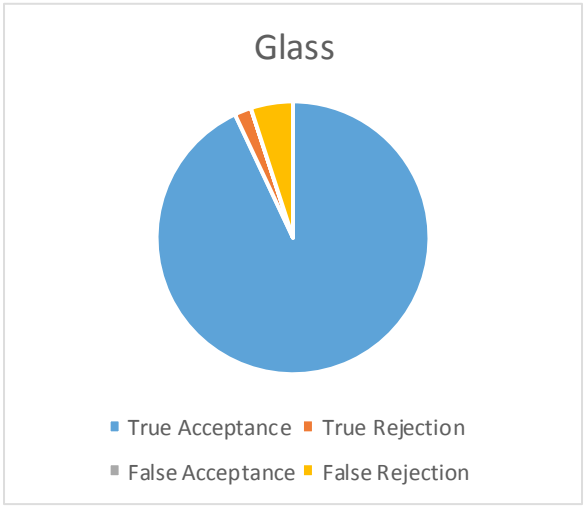

Fig.7. Results for Glass detection 93% true acceptance

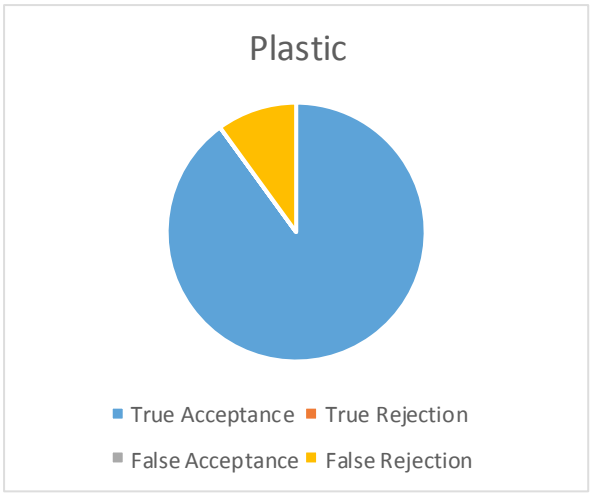

Fig.8. Results for Plastic detection 98% true acceptance

IV. CONCLUSIONS

The proposed method is an efficient solution to the current waste management problem which effectively segregates metal, glass and plastic which can also be used to segregate wet waste, dry waste etc. This system can be effectively deployed in industrial material segregation, scrap shops etc. The Automated Material Segregation system (AMS) effectively employs inductive proximity sensor to identify metallic items, and capacitive proximity sensors to. Our proposed work aims at segregation of waste materials in particular metal, glass and plastic. It is the first step towards recycling. Recycling the waste materials has a huge impact on the economic condition of the country since recycling of plastic can reduce the manufacture of plastic using renewable resources and it also has an immense effect on the environment by effectively managing the solid waste. However, many up gradations can be done to our existing project. Some of which are listed below.

- Advanced processing techniques can be incorporated once the waste has been segregated.
- The Capacitive sensors available read only the digital values hence capacitive sensors which can read analog values needs to be designed which can then be used to segregate any kind of material depending on the di-electric constant of each material. This could well reduce the overall cost of the system
- Methods for individual material feeding for local use so that the segregation can be per-formed continuously once the waste is dumped.
- Image sensing can be used to segregate materials through Image processing technology

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