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Integrated Smart Trash Bin

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Abstract: With the rapid growth in population, industrialization, urbanization large amount of wastes are being generated. The accumulation of different kinds of waste (harmful and harmless) are a result of the improper disposal scheme followed in our country. Due to this, waste lies littered in the surroundings, dumped on open lands and becomes a major threat to the environment. So, waste management becomes an important concern for the health and well-being of the society. Segregation makes it possible to reuse and recycle the waste effectively and the economic value of waste is best realized when it is segregated. So, it is very crucial to have some system to manage waste automatically which is currently not here. So, our idea is to make an automatic waste segregator which can identify the different types of waste and put them in different bins accordingly and automatically. This paper proposes a novel method where the provision is given to separate out metallic, non-metallic waste and plastics into respective bins with the help of sensing action of different sensors incorporated along the conveyor belt. Here we are using AVR (Atmega 16) as the main component, to control the entire process with ease and simplicity. The sensing unit consists of IR sensor, a metal sensor and LDR and laser assembly to detect and identify various types of waste. The main architecture of the segregator comprises of three prominent stages. They are the sensing stage, segregation stage and the crushing stage. The IR sensor marks the entry of waste and is also used to check the level of the bin. The piston compresses the plastic so that a single bin can hold up to 2 times more waste than a normal bin. The wastes moving through the conveyor belt will be moved into the different bins by using a flap mechanism. The AVR controls all the activities of sensor and flap mechanism.

Keywords: AVR -Advanced Virtual Risc, LDR- Light Dependent Resistor, IR- Infra Red

I. INTRODUCTION

Total waste in the world is enormous. Some of it is recycled but a lot is simply dumped, causing problems for people and the environment. Every year we dump a massive 2.12 billion tons of waste [1]. If all this waste was put on trucks they would go around the world 24 times. By 2100, the growing global urban population will be producing three times as much waste as it does today. That level of waste carries serious consequences for cities around the world. Disposing of waste has huge environmental impacts and can cause serious problems. The landfill is the most popular endpoint for solid waste, by a wide margin. Some waste will eventually deteriorate, but not all, and in the process, it may smell or generate methane gas, which is explosive and contributes to the greenhouse effect. Proper waste disposal is essential due to the fact that certain types of wastes can be dangerous and can contaminate the environment if not controlled [2]. When the waste is segregated into different streams such as wet, dry and metallic, the waste has a higher potential of recovery, and consequently, recycled and reused. Presently, the waste segregation is done manually by installing different bins for collecting different type of wet and dry wastes etc. But this method has lot of drawbacks, one being the unawareness of most people towards waste management. A primary objective of waste management is to protect the public and the environment from harmful effects of waste. Some waste materials are normally safe but, can become lethal if not managed properly. The idea is to make a waste segregator which can identify the different types of waste and sort them into different bins accordingly and automatically. This paper proposes a novel method where the provision is given to separate waste into respective bin by the sensing of different sensors incorporated along the conveyor belt. When the waste is segregated into different streams such as organic, metallic, plastic, paper and glass, the waste has a higher potential of recovery, and consequently, recycled and reused. The organic waste thus separated can be converted to electricity by using a bio gas plant and a heat engine which is supplied to the battery and it is also charged through solar panel which is also a part of energy management. The proposed system holds up to 3 times more waste than the normal bin.

A. **Technical background:** At industries, waste segregation is carried out by using the following methods. Larger items are removed by manual sorting. Then the refuse is sorted based on its size by using large rotating drums which is perforated with holes of a certain size. Materials smaller than the diameter of the holes will drop through, but larger particles will remain in the drum. For metallic objects electromagnets or eddy current based separators can be used. Near infrared scanners are used to differentiate between various types of plastics based on the ability of the material to reflect light [3]. X-rays can also be used to segregate materials based on their density. The methodology adopted in this paper to resolve the issue of waste segregation is by making the entire process automated and to implement it in the municipal level.

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B. Proposed solution: Here waste is pushed onto conveyer belt, the presence of waste is first identified by the use of Infra-red sensor at start end of the conveyor belt, the waste moves further for detection with metallic detector to detect it is metal or nonmetal. If it is detected as metal, conveyor belt stops and activate flap mechanism to dump the metallic wastes into bin 1 and if it is nonmetal it moves further with laser and LDR assembly for the detection of plastic or glass. When plastics or glass is detected, the conveyor continuous its motion to dump those wastes in the bin 3 and rest of the wastes are dumped into bin 2 by flap mechanism. To increase the garbage holding capacity of the bin, we are using a rack and pinion model piston to compress the wastes in bin 3 (plastics). The whole system is powered by a battery which is charged by a solar panel.

II. DESIGN AND IMPLEMENTATION

A. BLOCK DIAGRAM

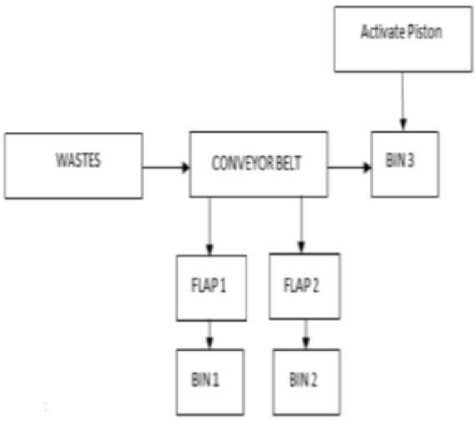

Fig.1. Block diagram of INTEGRATED SMART TRASH BIN

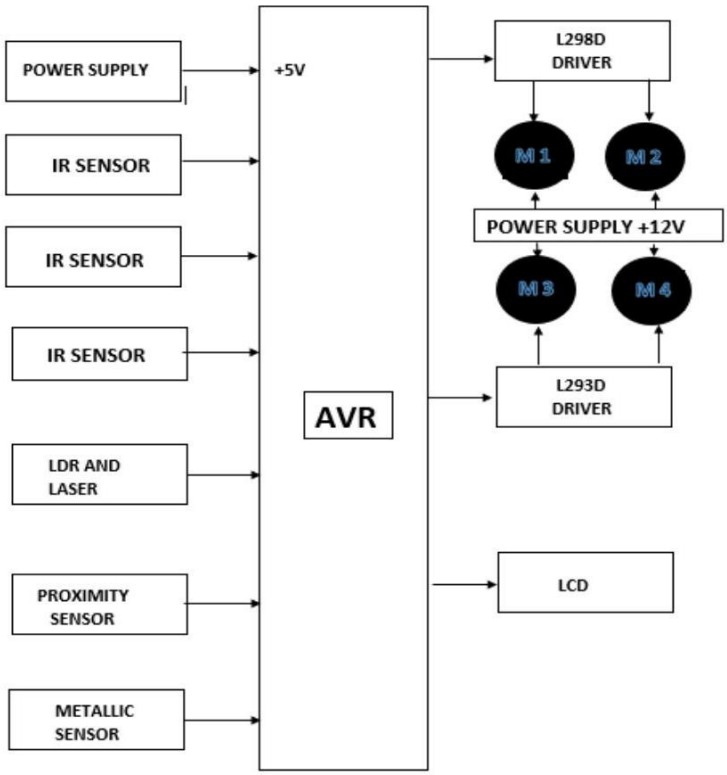

Fig.2. Internal Block diagram of IST BIN

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The process begins with the entry of waste. Waste moves along the conveyor belt, metal detector detects the metallic waste which will then be separated into bin 1 by using flap mechanism. Non-metallic waste containing paper, glass and plastics will then move along the belt, where glass and paper can be identified by using LDR and laser arrangement and is then separated into bin 2 by using a flap mechanism. Plastics will then be introduced into bin 3 where it gets compressed by a piston arrangement. This provision helps in increasing the waste holding capacity of the bin and as a result the efficiency of bin is thrice that of normal bin. The microcontroller used is AVR. It provides the required control signal for the different sensors, motor driver circuits and GSM. A supply of +5 V is given to the microcontroller by using a regulated power supply. The different motors are controlled by motor drivers and a supply of +12V is provided. Here four IR sensors are used. One of them marks the entry of waste and the rest are used to check the level of waste in different bins. Metallic sensor is used to detect metallic waste so that it can be separated. For identifying plastics LDR and laser arrangement is used. LCD is used to indicate the level of waste in all the bins.

B. ALGORITHM

Step 1: Start
Step 2: Check if waste has entered or not, if not goto step 7
Step3: If yes, move conveyor
Step 4: Check if metal or not, if not goto step 11
Step 5: If yes, stop conveyor
Step 6: Activate flap mechanism, then goto step 2
Step 7: Check level of tray 1, tray 2, and tray 3 is full or not, if not goto step 2
Step 8: Send message and display LCD
Step9: Check if the start button is pressed or not, if not goto step 16
Step 10: if start button is pressed, goto step 2
Step 11: Check if plastic or not, if not goto step 14
Step12: Move to bin 3
Step 13: Activate piston, then goto step 2
Step 14: If others, stop conveyor
Step 15: Activate flap mechanism, then goto step 2
Step 16: Stop.

C. Flow diagram of IST bin

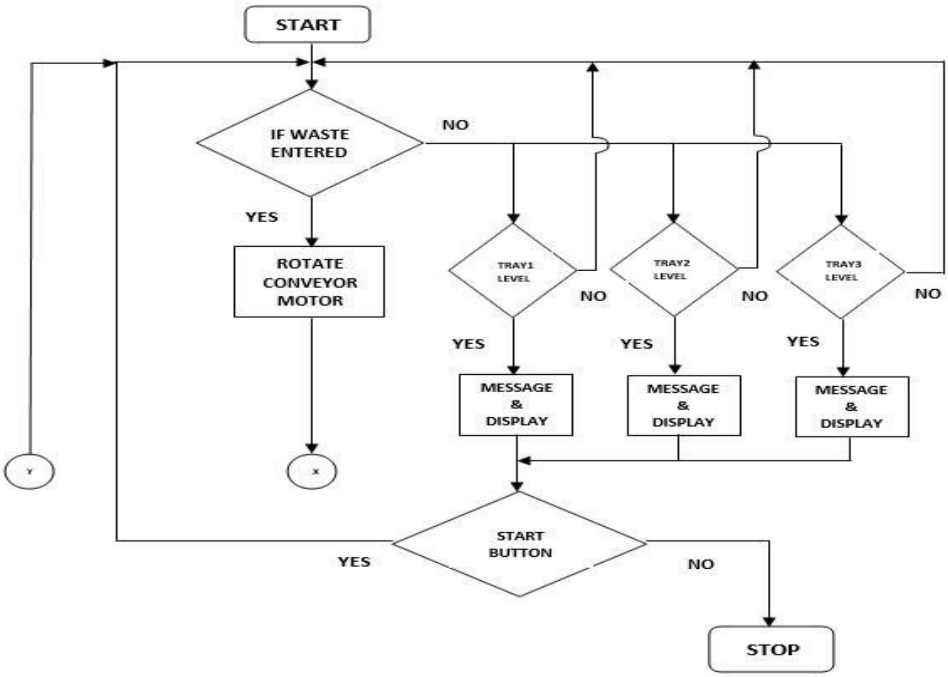

Fig.3a: Flow chart of IST bin.

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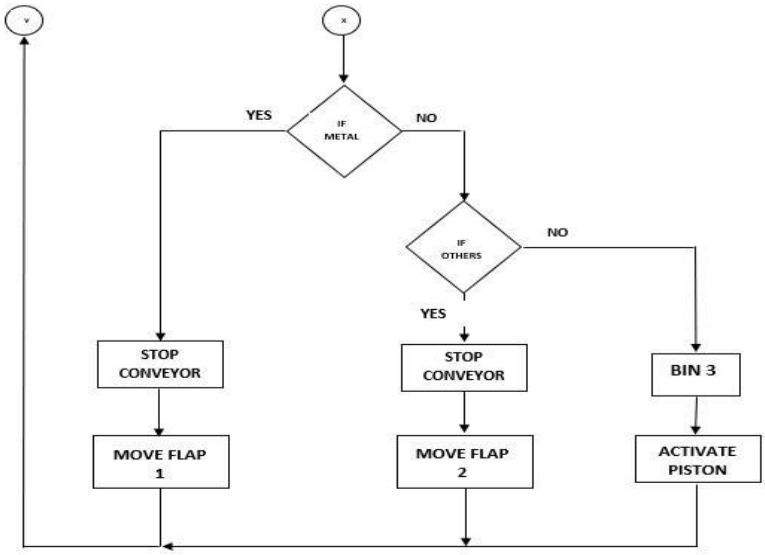

Fig.3b: Flow chart of IST bin

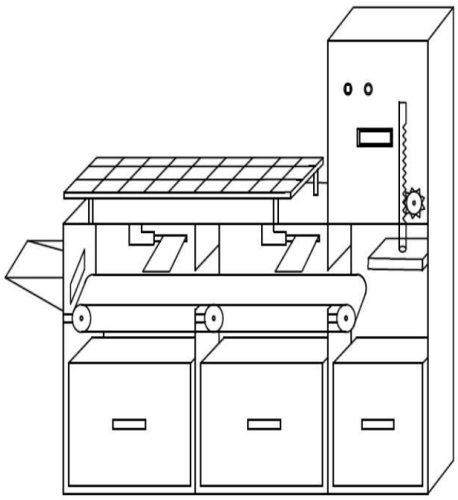

Fig.4 CAD diagram of IST bin

Fig.5 Hardware of IST bin

III. EXPERIMENTAL RESULTS

Table 1. Detection status of wastes with metal test detector and LDR laser arrangement

TEST	MATERIALS	DETECTED	NOT DETECTED
1	METAL CANS	YES	-
2	PAPERS	YES	-
3	PLASTIC BOTTLE	YES	-

Table 2. Results of metal, papers, plastic material

MATERIALS TESTED	TRUE ACCEPTANCE	TRUE REJECTIONS	FALSE ACCEPTANCE	FALSE REJECTIONS
METAL	85	-	-	15
PAPER	80	5	-	15
PLASTICS	87	-	-	13

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The experiment is carried out with few waste objects (paper, plastic and metal) materials like paper wastes, plastic bottles, cold drink can etc. were used for the experiment. The proposed system is tested with various materials each category has been considered with acceptance and rejection rate of the proposed system. Table 2 details the results of various categories of waste with true, false acceptance and rejection rate. The Fig 6 shows the detection of metals with 85% true acceptance and 15% false rejection of metal type materials here a cold drink can was used for the experiment. Once the material is detected it is collected in bin 1. In second case the detection of paper wastes shown in Fig.8 with 80% true acceptance 5% true rejection and 15% false rejection. Once the material is detected the conveyor belt stops, and flap mechanism activates, and paper is collected in bin2. The detection of plastics as shown in Fig.7 with 87% true acceptance and 13% false rejection of plastic type materials here a plastic bottle was used for the experiment. Once the material is detected the conveyor belt continuous its motion and finally, plastics get collected in bin 3 leads to the activation of piston for crushing mechanism.

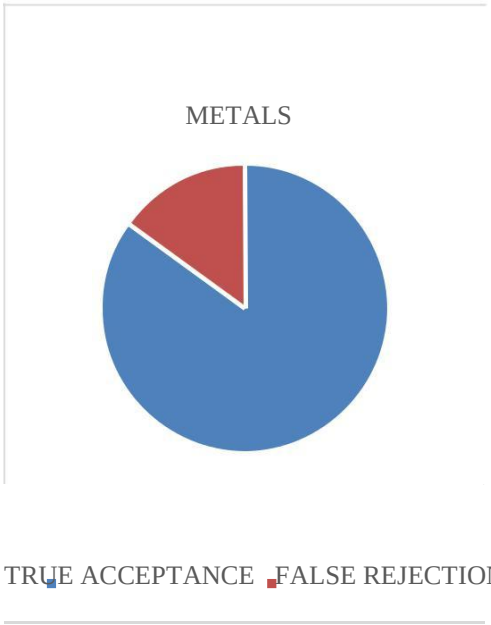

Fig.6. Results for metal detection 90% true acceptance

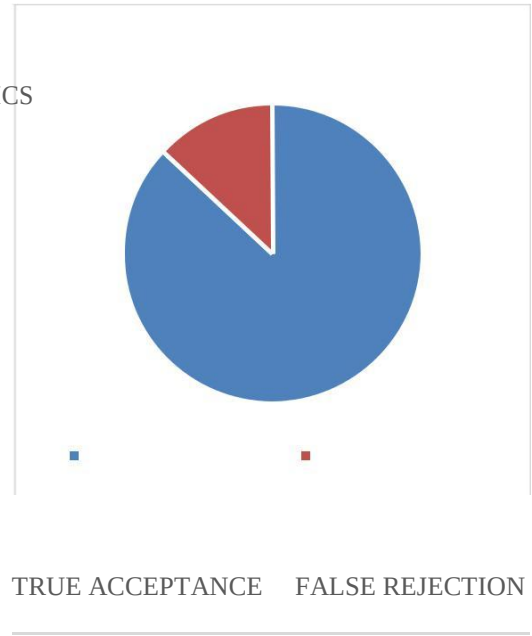

Fig.7. Results for plastic detection 87% true acceptance

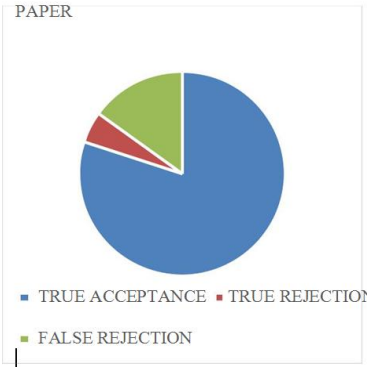

Fig.8. Results for paper detection 80% true acceptance

IV.CONCLUSION

This paper proposes an automatic waste segregation system using AVR microcontroller. The system separates out the metallic wastes, non- metallic wastes (glass and paper) and plastics with the help of some sensors and segregating units. It has an advantage of reduction in manpower with improved accuracy, increase in the speed of waste management and also avoiding the risk of working at hazardous places. Along with these facts it can hold 3 times more waste than the existing garbage system. This is typically an eco-friendly waste segregator that works efficiently with the conventional source of energy, i.e. Solar energy.

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V.FUTURE SCOPE

The project can be implemented with enormous results in large scale that benefits the society. In future, a compressor arrangement can be introduced for compressing the glass and paper that has been separated. A GSM module can be used as a provision for sending message to the concerned authority about the fully filled bins. Bio-waste can be inserted into a biogas plant attached to the bin. Biogas produced as a result of this arrangement can be used to produce electricity for powering the battery in addition to solar energy. A special provision can be included in order to extinguish re occurring inside the trash bin. Implementing LED panel for advertising purposes is portable.

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