iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 5 **Issue:** VI **Month of publication:** June 2017

DOI:

www.ijraset.com

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Volume 5 Issue VI, June 2017
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Automatic Metal, Glass and Plastic Waste Sorter

Syeda Madiha Samreen[1], Dr. Baswaraj Gadgay[2], Veeresh Pujari[3], Pallavi B.V[4]
[1]PG Student Dept. Of VLSI Design & Embedded Systems VTU PG Centre Kalaburagi
[2]Reasearch Guide & Professor VTU PG Centre Kalaburagi, Karnataka, India
[3]Assistant Professor VTU PG Centre Kalaburagi, Karnataka, India
[4]Assistant Professor VTU PG Centre Kalaburagi, Karnataka, India.

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. Here we propose 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 for metallic items, and capacitive sensors to distinguish between and plastic and glass 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, capacitive sensor***

I. INTRODUCTION

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. The common method of disposal of the waste is by unplanned and uncontrolled open dumping at the landfill sites. This method is injurious to human health, plant and animal life. This harmful method of waste disposal can generate liquid leachate which contaminate surface and ground waters; can harbour disease vectors which spread harmful diseases; can degrade aesthetic value of the natural environment and it is an unavailing use of land resources.

In India, rag pickers play an important role in the recycling of urban solid waste. Rag pickers and conservancy staff have higher morbidity due to infections of skin, respiratory, gastrointestinal tract and multisystem allergic disorders, in addition to a high prevalence of bites of rodents, dogs and other vermin. Dependency on the rag-pickers can be diminished if segregation takes place at the source of municipal waste generation.

The economic value of the waste generated is not realised unless it is recycled completely. Several advancements in technology has also allowed the refuse to be processed into useful entities such as Waste to Energy, where the waste can be used to generate synthetic gas (syngas) made up of carbon monoxide and hydrogen. The gas is then burnt to produce electricity and steam; Waste to Fuel, where the waste can be utilized to generate bio fuels. When the waste is segregated into basic streams such as wet, dry and metallic, the waste has a higher potential of recovery, and consequently, recycled and reused. The wet waste fraction is often converted either into compost or methane-gas or both. Compost can replace demand for chemical fertilisers, and biogas can be used as a source of energy. 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. 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. The purpose of this project is the realization of a compact, low cost and user friendly segregation system for urban households and scrap shops to streamline the waste management process.

Volume 5 Issue VI, June 2017
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II. RELATED WORK

CLAUDINE CAPEL et al., [1], said effective recycling relies on effective sorting. With a wide range of sorting technologies on the market today, WMW reviews the options and looks at the issues that are driving the development of new technology by Claudine Capel. European citizens will not have failed to notice that the sorting of waste, particularly at a household level, is becoming increasingly important. While the various EU countries currently take different stances on how and which waste to separate, the trend will be to separate as much useful waste as possible and deal with it in the most appropriate manner. Separating the different elements found in waste streams is essential for enabling the recovery of useful materials, minimizing the amount of material sent to landfill and allowing recyclable materials to find a new incarnation. Companies sort and recycle materials in order to extract value, but those operating in EU Member States are also bound by EU rules and regulations relating to the environment.

ASHUTOSH TIWARI et al., [2], the development of sensors at macroscopic or nanometric scales in solid, liquid, or gas phases, contact or noncontact configurations, has driven the research of sensor & detection materials and technology into high gear. The emphasis on detection techniques requires the use of spin crossover organic, inorganic and composite materials and methods that could be unique for sensors fabrication. The influence of length, composition and conformation structure of materials on their properties and the possibilities to adjust sensing properties by doping or adding the side-groups are the starting point of multifarious sensing. The role of inter-molecular interactions, polymer and ordered phases formation, as well as the behaviour under pressure, magnetic and electric fields are also important facts for processing of ultra-sensing materials. Advanced Sensor and Detection Materials highlights the key features that aid the design of new sensor and detection materials for a multitude of sensor and detection devices.

III.PROPOSED METHOD

The block diagram shown in Fig. 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, 1A which is connected through the motor driver and is programmed to run in clockwise direction by the Arduino.

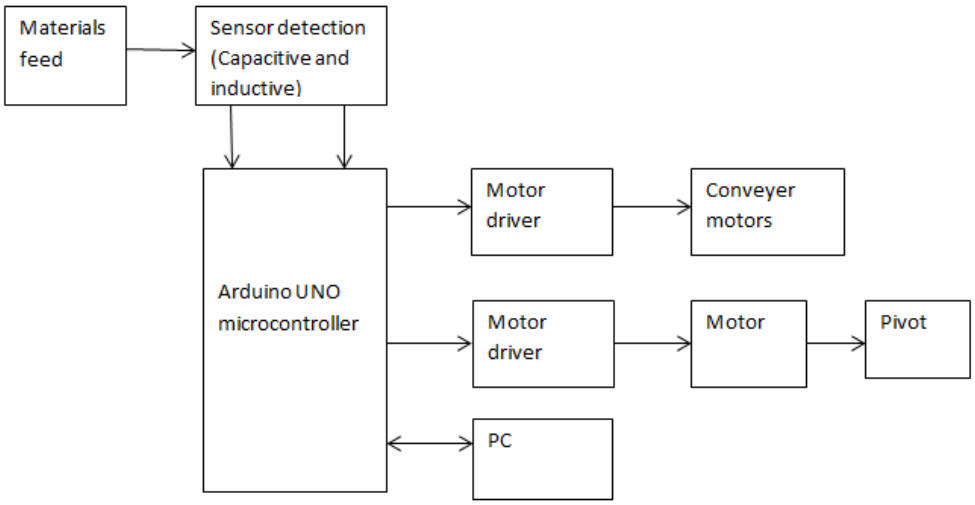

Fig. 1 Block diagram of proposed system

The object is placed on the conveyor, depending on the output of inductive sensor and capacitive sensor the motor driver drives the motor. If the material is metal then the conveyer stops and metal is collected in the metal bin. If the material is non-metal then the object moves in 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 into the glass bin. If capacitive sensor output is low then the conveyor motor continues to rotate in the same direction and the plastic material is collected in the plastic bin. Fig. 2 below shows the flow chart of the proposed design. The specification of components used is as follows:

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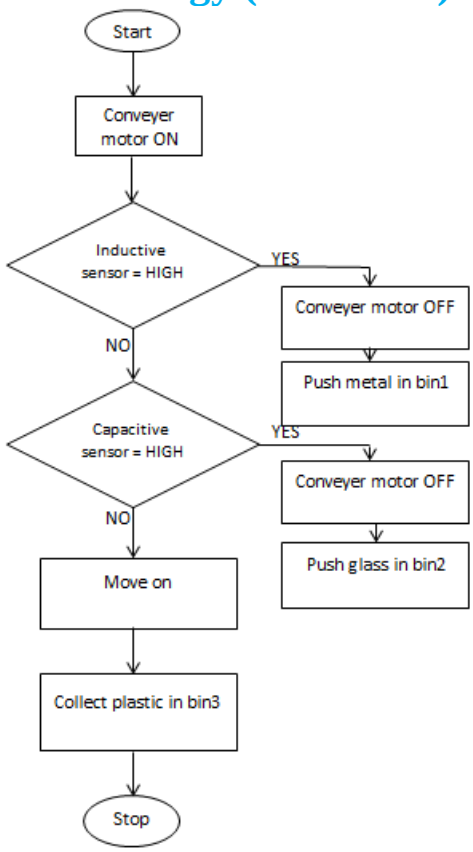

Fig. 2 Flow chart of proposed system

A. Arduino Uno

Act as a microcontroller, Arduino Uno is based on the ATmega328. It has 14 digital input/output pins, 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, and a reset button. The board can be programmed with Arduino Software (IDE). The board can operate on an external supply from 6 to 20 volts. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts. The ATmega328 has 32 KB flash memory. It also has 2 KB of SRAM and 1 KB of EEPROM.

B. Inductive proximity sensor

Inductive proximity sensors operate under the electrical principle of inductance. Inductance is the phenomenon where a fluctuating current, which by definition has a magnetic component, induces an electromotive force (emf) in a target object. To amplify a device's inductance effect, a sensor manufacturer twists wire into a tight coil and runs a current through it.

An inductive proximity sensor has four components; the coil, oscillator, detection circuit and output circuit. The oscillator generates a fluctuating magnetic field the shape of a doughnut around the winding of the coil that locates in the device's sensing face. Inductive Proximity Sensors being contactless sensors can be used for position sensing, speed measurement, counting, etc. They can be used in extreme conditions, such as oily, dusty, corrosive environment. Their application ranges from Automobile Industries to Steel Industries, from CNC/NC machines to material handling equipment, process automation, conveyor systems, and packaging machines.

C. Capacitive proximity sensor

Capacitive proximity sensors use the face or surface of the sensor as one plate of a capacitor, and the surface of a conductive or dielectric target object as the other. The capacitance varies inversely with the distance between capacitor plates in this arrangement, and a certain value can be set to trigger target detection.

The sensing surface of a capacitive sensor is formed by two concentrically shaped metal electrodes of an unwound capacitor. When an object nears the sensing surface it enters the electrostatic field of the electrodes and changes the capacitance in an oscillator

circuit. As a result, the oscillator begins oscillating. The trigger circuit reads the oscillators amplitude and when it reaches a specific level the output state of the sensor changes. As the target moves away from the sensor the oscillator's amplitude decreases, switching the sensor output back to its original state.

D. Geared DC motor

In a gear motor, the energy output is used to turn a series of gears in an integrated gear train. There are a number of different types of gear motors, but the most common are AC (alternating current) and DC (direct current).

In a gear motor, the magnetic current (which can be produced by either permanent magnets or electromagnets) turns gears that are either in a gear reduction unit or in an integrated gear box. A second shaft is connected to these gears. The result is that the gears greatly increase the amount of torque the motor is capable of producing while simultaneously slowing down the motor's output speed. The motor will not need to draw as much current to function and will move more slowly, but will provide greater torque.

E. L293D Motor driver

L293D is H-Bridge based motor driver board for driving DC motors and is ideal for robotics applications. It acts as an interface between the controller and the motor. It can drive two DC motors simultaneously in either direction.

IV. RESULTS

The entire set up and results are shown below

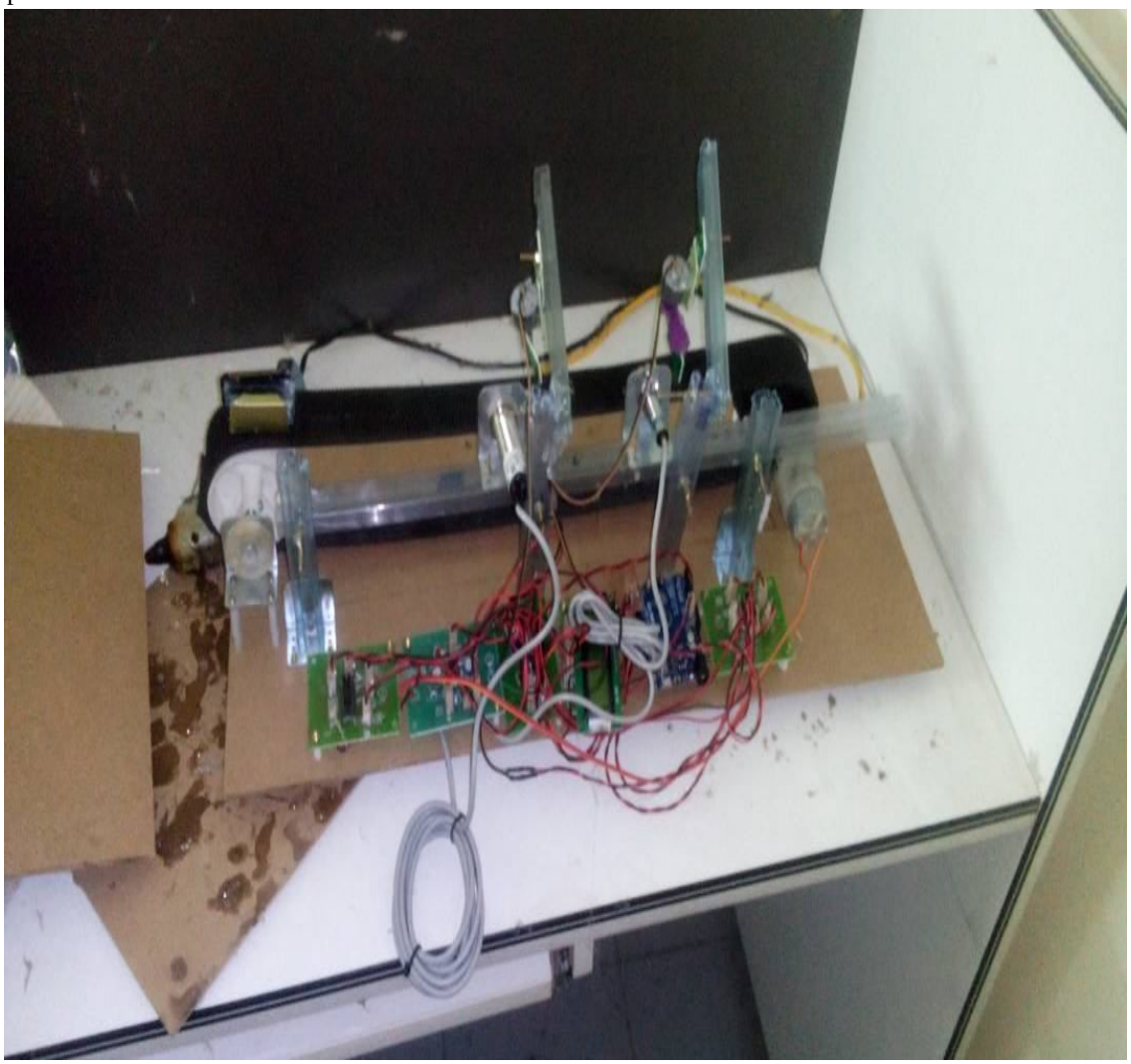

Fig. 3 Proposed design implementation

Volume 5 Issue VI, June 2017
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Fig. 4 Results

V. CONCLUSION

The proposed method is a solution to the current waste management problem which will effectively segregate metal, glass and plastic. The Automated Material Segregation system (AMS) effectively employs inductive proximity sensor to identify metallic items, and capacitive proximity sensors to differentiate between plastic and glass waste. This system can be effectively deployed in industries for material segregation, scrap shops and urban households.

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ISSN: 2321-9653

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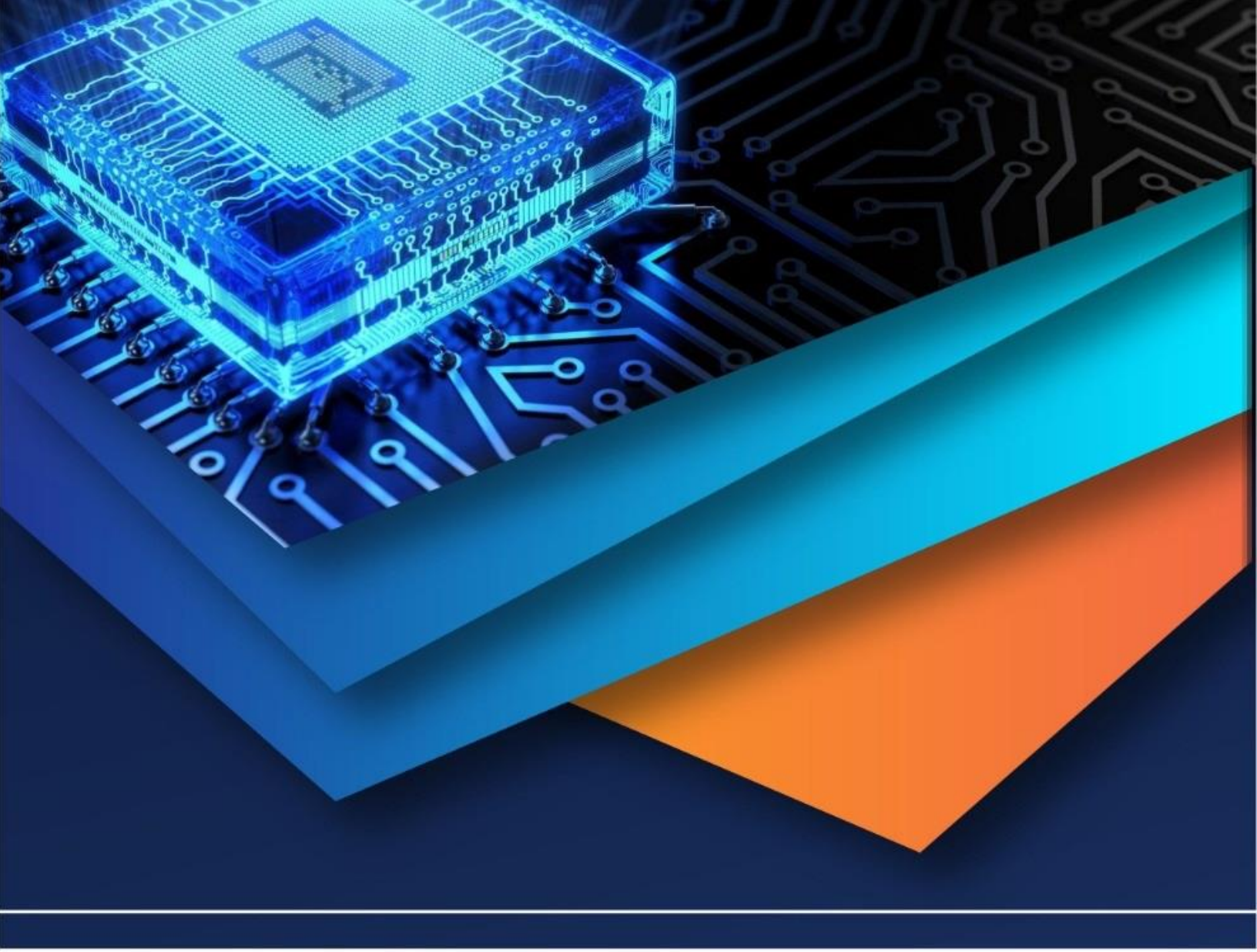

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