iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 6 **Issue:** III **Month of publication:** March 2018

DOI: http://doi.org/10.22214/ijraset.2018.3520

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue III, March 2018- Available at www.ijraset.com

IoT Based Waste Segregation System with ThingSpeak Control

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Abstract: ***Industries create large amounts of waste by their daily activities. Recycling the waste generated by industries benefits business as well as helps in keeping the environment safe and clean. In the recycling process, first the wastes have to be segregated according to the material type. It is difficult for the industries to segregate the waste. The existing technique of waste segregation segregates the waste according to their dry or wet nature and its metallic nature. The drawback of the existing technique is that IoT implementation is not cost effective. In this work, magnetic metals like iron, nickel, cobalt, etc., non-magnetic metals like aluminium, brass, etc., and other wastes like glass, plastic, papers etc., are segregated by using sensors. The conveyor belt is turned on manually after the waste is dropped on them. The sensors attached to the frame of conveyor belt detect the type of waste material. The detected wastes are separated from the other wastes and collected in the trash barrel, which is placed beneath the conveyor belt. Thus the wastes are segregated and collected in different barrels to make sure that the process of segregation is simple for the industries and further it can be recycled. The complete process is controlled by the Raspberry Pi. Further this work allows control through web server "ThingSpeak" and the operating status of the system (On and Off Status) is obtained as SMS and e-mail to the person concerned.***

Keywords: Thing speak, Raspberry pi, metallic and non-metallic waste.

I. INTRODUCTION

The IoT is a concept in which surrounding objects are connected through wired and wireless networks without user intervention. In the field of IoT, the objects communicate and exchange information to provide advanced intelligent services for users. Owing to the recent advances in mobile devices equipped with various sensors and communication modules, together with communication network technologies such as Wi-Fi and LTE, the IoT has gained considerable academic interests. Things (Embedded devices) that are connected to Internet and devices can be controlled from the internet is commonly called as Internet of Things. In our system, the Smart sensors are connected to the internet to get the real time information of the barrels. Owing to the characteristics and merits of IoT services, waste management has also become a significant issue in academia, industry, and government as major IoT application fields. An indiscriminate and illegal discharge of waste, an absence of waste disposal and management systems, and inefficient waste management policies have caused serious environmental problems and have incurred considerable costs for waste disposal of small and large scale industrial units as a result of which they simply dump their waste in the open spaces and near the water bodies. The wastes are often more toxic and hazardous. In the recent years, there has been a rapid growth in population which has led to more waste disposal. So a proper waste management system is necessary to avoid spread of deadly diseases.

II. EXISTING SYSTEM

The conveyor belt is moved with the help of the DC geared motor and the wastes which are spread in conveyor belt starts to move. The Hall Effect sensor is placed at the beginning of the conveyor belt, which senses the magnetic metals. After sensing the magnetic metals the actuator which is placed near the Hall Effect sensor pushes the magnetic materials to the trash barrel. Likewise, non-magnetic metals, non-metals and glasses can be segregated with the help of Proximity Inductive sensor, Proximity Capacitive sensor and IR reflective sensor respectively. A separate actuator is placed near each sensor in this segregation process. After sensing the type of material the signal is sent from the sensor to the Raspberry Pi. The Raspberry Pi provides the control signal to all the actuators after receiving the signals from the sensors. The actuator takes control action by pushing the wastes to the trash barrel. The entire system is controlled by Raspberry Pi 3B.

III. PROPOSED SYSTEM

The proposed methodology uses a capacitive sensor and inductive sensor which detects the waste materials like metallic and non-metallic waste. Further with the help of drive motor's linear movement the waste is rejected. This entire process is controlled by

raspberry pi and ThingSpeak web server is used for control.

A. Conveyor System

A conveyor system is a common piece of mechanical handling equipment that moves materials from one location to another. Conveyors are especially useful in applications involving the transportation of heavy or bulky materials. Conveyor systems allow quick and efficient transportation for a wide variety of materials, which make them very popular in the material handling and packaging industries. In this work, it is used to carry the waste particles. The conveyor system used in this work is shown in fig.1.

Fig.1 Conveyor System

B. Thing Speak

Thing Speak is an open source Internet of Things (IoT) application and API to store and retrieve data from things using the HTTP protocol over the Internet or via a Local Area Network. Thing Speak enables the creation of sensor logging applications, location tracking applications, and a social network of things with status updates

Thing Speak has a close relationship with Math works, Inc. In fact, all of the ThingSpeak documentation is incorporated into the Math works' Mat lab documentation site and even enabling registered Math works user accounts as valid login credentials on the ThingSpeak website. The terms of service and privacy policy of ThingSpeak.com are between the agreeing user and Math works, Inc. The web server used to control is shown in Fig.2

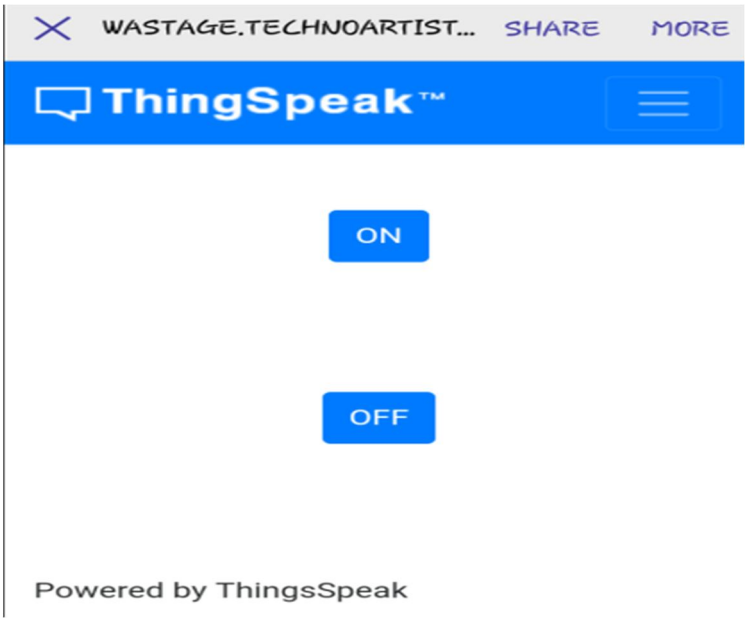


Fig.2 Web Server

C. Geared Motor

Geared motor may be an AC or DC motor coupled with a gearbox. The additional mechanical gears are provided to alter the speed/ torque of the motor. The gear assembly helps in increasing the torque and reducing the speed. Using the correct combination of gears in a gear motor, its speed can be adjusted to any desirable unit. In this work, Geared motor is used to move the conveyor at an rpm of 60 to120. This is being controlled by the ThingSpeak server.

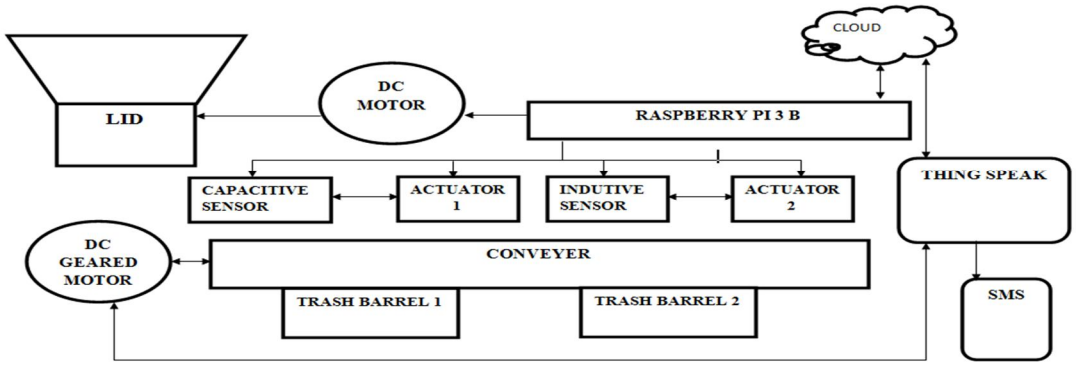
D. Raspberry pi

The allure of the Raspberry Pi comes from a combination of the computer's small size and affordable price. Enthusiasts envision using the small form-factor PC as a cheap Home Theatre PC (HTPC), or secondary low-power desktop. Institutions, like schools and businesses, could benefit from deploying a fleet of computers for a fraction of the cost of traditional desktop towers. The small size makes for an easy-to-hide computer that sips power and can be mounted behind the display with an appropriate case. It could also be used in niche applications, like digital signage. While it will not blow away any recent hardware in performance, it does make for a cheap secondary computer which could be useful for troubleshooting and researching solutions if the main rig fails to boot as well. In this work, Raspberry pi is used to interface the sensors, actuators and motors.

E. Relay

A relay is an electrically operated two way switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal. In this work, 5V relay is used to control the motion of the belt. In case of defect detection the relay trips the geared motor and actuates the actuators.

IV. IMPLEMENTATION



An actuator is placed near each sensor in this segregation process. After sensing the type of material the signal is sent from the sensor to the Raspberry Pi. The Raspberry Pi first sends signal to turn off the motor and also provides control signal to corresponding actuator. The actuator takes control action by pushing the wastes to the trash barrel. The pushing of waste takes five seconds. After five seconds, when the actuator retraces, the motor turns on again, letting the waste to move on the conveyor for detection.

V. RESULTS

A sample of 10 waste materials was supplied as input to this system. The observations are tabulated in Table.1.

Sample Size	Successful Segregation	Unsuccessful Segregation	Success Rate (%)
10	9	1	90
10	8	2	80
10	8	2	80
10	7	3	70
10	8	2	80

Table.1. Rejection Results

VI. CONCLUSION

It was observed that the system was able to detect the metallic and non-metallic waste and was able to segregate them successfully. However the system failed to detect and segregate plastic waste and this can be further improved by using different sensors.

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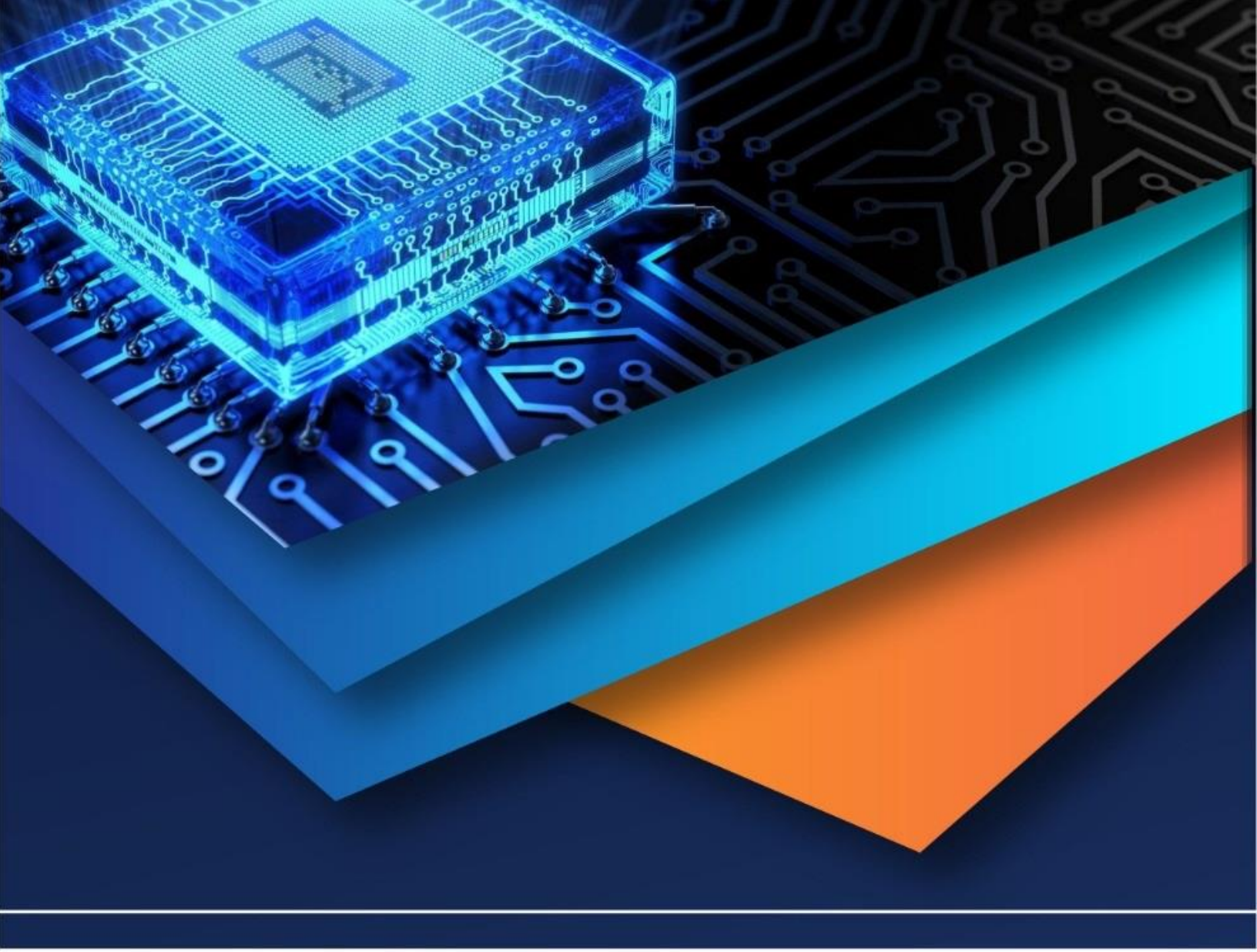

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