Waste Segregation Management Using Object Sorting Robot

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Abstract

Every year our world are facing a huge issue in the area waste goods management. The proposed system designed as an automated sorting of waste segregation management based on object recognition. sorting of different objects on a conveyor belt is generally carried out manually or by using sensors. In this paper we have proposed a low cost automated system which uses Arduino, moisture sensor, ultrasonic sensor, IR sensor, metal detector and a USB camera. We use Camera for detecting the object and the four different sensors are used for the sensing purposes. In addition to that a ultrasonic sensor for distance measurements and dc motor for conveyor belt applications and for sorting purpose. The system discard the objects which are not of desired object or size by pushing them out of the conveyor belt.

Keywords: waste separation system; dry waste; moisture sensor; metal detector.

1. Introduction

Sorting is a process in which two or more objects of similar or dissimilar objects, yet different characteristics are arranged in a systematic order. Sorting of waste units is extensively used in many industries like food processing industries, toy industries, etc., to segregate waste units into two or more classified types. With the increasing volume of wastage units by day to day life, fabricated products and items used for commercial purpose, comes the need for automatic fabrication, handling, processing,

sorting, packaging and shipping. This process is simplified by the employment of automation. Some tasks, especially those involving human help and physical interaction, are still hard to automate. Automation is the use of control systems like computers or robots for handling different process and automated machines to replace a human being and provides mechanical assistance. Automated systems generally use more complex algorithms which increases the cost of the design and the power consumed was extreme. This not

only reduces manual efforts, time consumed, gives more time for marketing, but also prevents danger which might occur when human beings work in the situation of hazardous environments. Automation greatly improves the productivity and is very claimbable. Traditionally, an industrial part-handling robot is dedicated to a high-volume production process and uses a specialized end effector (gripper) to retrieve the same part repeatedly from a known position and orientation. Unfortunately, this approach is a good match for some industrial applications in which a large variety of waste types need to be handled. More flexible industrial robotics solutions are needed to handle such unstructured production applications. There are still improvements that can be introduced and produced to

increase the efficiency of automated object sorting systems. This approach is ideal for large-scale manufacturing operations[14-16].

2. Literature survey

Our application is targeted at industrial factory floors where objects arrives on a moving conveyor belt need to be picked and sorted for packing purpose. The concept of object recognition based on different mechanisms was used in various intelligent systems these years. In 2010, F. Tombari and L. D. Stefano has proposed a novel Hough Voting approach for novel Hough voting approach for the detection of free-form shapes in a 3D space, to be used for object recognition tasks in 3D scenes with a significant degree of occlusion and clutter[1]. In 2013, Anthony Cowley has proposed a new approach to recognition of objects that enable a general purpose robotic platform to recognize and manipulate a variety of objects at a rate of one pick-and-place operation every 6.7 s, and work with a conveyor belt carrying objects at a speed of 33 cm/s[2]. In 2016, Lanang Febriramadhan has designed a 3 DOF arm prototype for the sorting of objects using inverse kinematics method. Followed by him Yonghui Jia, Guojun Yang also discovered a technique for sorting of objects based on color and he used Inverse Kinematics algorithm for the robotic arm design which might be used for the picking and sorting purposes. Himanshu Patel, Riya Joy both are combined proposed a new way of sorting of objects based on color using color sensor and IoT services in the year of 2018. At last in 2018 Yizhe Zhang has proposed a method for picking and sorting applications which is conveyor belt based method used to sort object by using different sensors and a 3D kinect Camera for capturing purpose. Although there are quite a lot of researches being made to differentiate waste in either domestic level or industrial level, some constraints may limits the innovation levels of technology[17-20].

3. Existing system

The existing system of method can be designed discriminate waste into residual and recyclable waste or non - recyclable waste only. This existing method uses moisture sensor only for the detection of dry waste or wet waste based on theoretical values. It needs manual help to start the work progress. This is because the moisture sensor detected a moisture content of 10 %. On the other hand, when the samples of dry waste are placed onto the prototype system, the servo motor rotated to 180 degree and the waste continued to stay on the conveyor belt until it reach to the end and entered the recyclable dustbin. The system cannot able to segregate the waste into more classification such as glass metal, dry waste etc., and this system was not that much efficient when we go for industrial applications shown in fig 1.
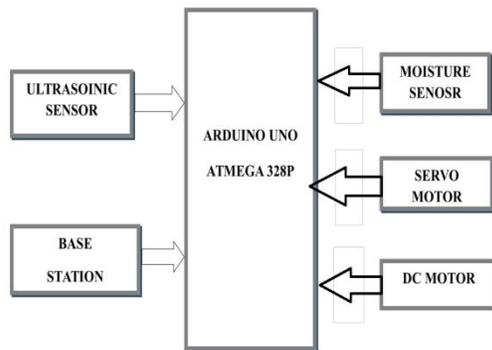

Fig 1: Block diagrammatic representation of existing system

4. Proposed system

By using our proposed concept we are able to overcome the drawback of the existing one. In our proposed paper web camera is used to overcome these disadvantages in previous system and it separates glass wastes based on pixel rate accuracy .In this work, a fully automated waste separation system to segregate recyclable and non recyclable waste of different classifications such as glass, metal, dry waste of household as well as industry wastes is proposed. Its main objective is to built a unique kind of algorithm to achieve new kind of approachability in the field of waste management. Segregation of the waste management had been fully automated used for both household and industry purpose shown in fig 2.

In our system, we used Embedded C language in order to run the conveyor belt of the sorting system and to sort the wastage units according to their types such as metal and dry waste.
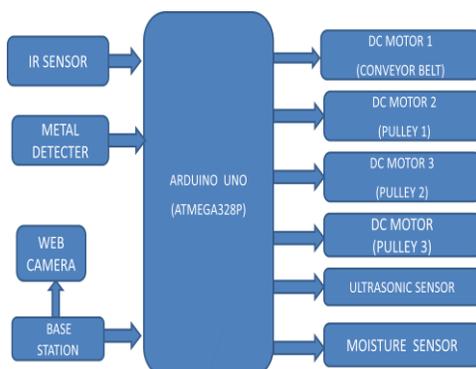

Fig 2: Block diagrammatic representation of proposed system.

5. Methodology

5.1. System architecture

The system consists four types of sensors namely Ultrasonic sensor, IR sensor, Metal sensor, moisture sensor and also, a web camera which might be used in segregation management. These sensors are used to detect what of kind waste such as metal, glass, or dry waste. The sensors values are very useful in the separation of waste unit management. Web camera is used to find whether the captured waste is glass or not. A driver circuit is connected with Arduino UNO device to supply the power in terms of voltage required by the dc motors
which are all used to run the conveyor belt and the for the purpose of segregation.

6. Result and outcome

The first functionality is analyzing the wastes according to their classification and extracting the detected and recognized waste using the three pulleys which runs using dc motor on the conveyor belt. Image processing and classifier technique based waste segregation management system which sorts the waste according to their types by using sensor systems. The experimental setup of this proposed system was shown in Figure 3. All these sensors are used to detect what of kind waste such as metal, glass, or dry waste. The sensors values are very useful in the separation of waste unit management. Once the conveyor belt started the actuator setup sorts the waste into different types immediately through different types of sensors used. Manage the waste in different type of box by using automation. In this system we detect the dry waste, glass and metal types waste automatically using classifier techniques.
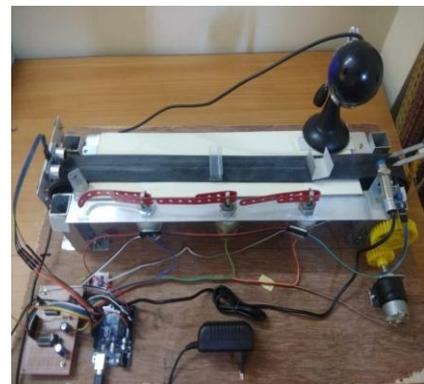

Figure 3: Experimental Setup of Proposed System

The experimental setup system consists of three actuators for the classification and segregation of wastes**.** Figure 4 shows the working of first actuator of the system. In this work the first actuator is programmed to segregate the waste type of dry waste or moisturized content wastage. The moisture content waste in the form of objects are detected and segregated with the help of moisture sensor based on predefined practical values.

Figure 4 represents the working of second actuator in experimental setup shown below. The second actuator in the proposed system used to segregate the waste type of metal items. The metal wastes are detected by using of metal inductive proximity sensor which mounted on the left side of the conveyor belt setup. It detects the metal waste based on the electromagnetic field mechanism ranges between 120 to 1050 Hz.

Figure 4: The Working Of First Actuator In Experimental Setup

Figure 5:. The Working Of Second Actuator In Experimental Setup

The third and final actuator shown in Figure 5 is predefined to separate the glass or transparent type waste programmed in Embedded C. The glass or transparent type waste are segregated with the help of web camera which having the specification of 5MP based on pixel rate accuracy using python Open CV library. Here, the system used to capture and detect the transparent waste by using image processing technology.

6. Future Scope

The future scope of the product will be increase by optimization of size of product. Due to few limitations of using Arduino UNO device implementation, alternatively the product designed with NODE Micro Controller Unit and additional sensors elements, because NODE MCU basically having Wi-Fi Module internally. Reduction in the time taken for the object identification and detection could be another improvement.

7. Conclusion

Image processing and classifier techniques as an enabler of various applications including waste management. The task of sorting different   objects from the general waste items   using image processing techniques and classifier techniques has been successfully implemented. Specifically, it aims to present a large set of models dealing with the efficient waste management. Special attention is paid on the waste collection and segregation. Several modules of object recognizing and sorting were successfully designed and implemented. The proposed system has the special feature which is useful in segregation of household waste. Room for improvement remains in the areas of waste management segregation and conveyor belt setup customization. Our solution is based on the idea of Image processing infrastructure, which should provide enough information to handle the sorting of wastes more efficiently.

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