Design and Fabrication of Waste Sorting Robot

V.P.Srinivasan
Department of Mechanical Engineering
Sri Krishna College of Engineering and Technology, Coimbatore, Tamil Nadu, India

R.Kalidhasan
Department of Mechanical Engineering
Sri Krishna College of Engineering and Technology, Coimbatore, Tamil Nadu, India

U.S.Jiviithesh
Department of Mechanical Engineering
Sri Krishna College of Engineering and Technology, Coimbatore, Tamil Nadu, India

P.M.Logesh
Department of Mechanical Engineering
Sri Krishna College of Engineering and Technology, Coimbatore, Tamil Nadu, India

R.Kiran Prasad
Department of Mechanical Engineering
Sri Krishna College of Engineering and Technology, Coimbatore, Tamil Nadu, India

Abstract- The volume of waste is projected to increase from 64-72 million tons at present to 125 million tons by 2031. Untreated waste (a mixture of biodegradable or wet waste and non-biodegradable waste) from Indian cities lies for months and years at dumpsites where land was originally allocated for developing landfills for safe disposal of only the residual waste. The decomposition of organic matter in the airless heaps of waste at these dumpsites contributes to global warming by Green House Gas emissions. Nearly 20% of methane gas emissions in India are caused by landfills. The trash dumped in the landfills is prone to catching fire due to the heat generated by the decomposition of waste. Thus segregation of mixed waste is the first and foremost method for decomposing the waste. To overcome this problem we are proposing our waste sorting robot.

Keywords – Watermarking, Haar Wavelet, DWT, PSNR

I. INTRODUCTION

The World Bank study revealed that India was the world's highest waste-generating nation. According to a 2016 estimate given by the study, India's annual waste generated is likely to touch 387.8 million tonnes in 2030 and 543.3 million tonnes by 2050. Landfills continue to be one of the main methods of waste disposal despite their relatively high potential to pollute the environment [1].In India now we are moving towards sorting waste into biodegradable and non biodegradable. This waste sorting robot help is segregating steel, moisture content substance and dry substance separately. The classification relies too much on labor, and technical problems such as large workload, low efficiency, and poor safety [2]. The principles of selection and creation of rational methods of disposal and recycling of wastes are based on the fact that the problem of waste is an interconnected environmental-economic and technological problem, and the waste itself should be considered as technogenic raw materials of complex organo-mineral composition. Thus, the main responsibilities of individuals are to define methods for segregate waste [3]. Segregation of the waste materials has been a key huddle in recycling consumer waste. Sorting is a multi-stage process used to transport the waste materials to the appropriate collection facility. Separation of recyclable and non-recyclable waste is the first stage in sorting [4]. The research efforts are involving robotics for waste management falls broadly into two categories namely, garbage collecting robot and recyclable scavenging robot [5]. Presently, there is no automated system for segregation of wet, metallic and dry wastes where it further segregates dry into plastic and paper at domestic level [6]. The significance and the financial importance of waste is realized only when it is segregated. Currently there are no such systems for auto segregation [7]. The basic machines tumble the waste

to separate sizes and types while the more sophisticated machines do stuff like in-flight sorting which is even cooler than it sounds. As the trash falls off the conveyor belt – in mid-air – they use infra-red to detect the material composition of the object and then shoot a beam of air at it to redirect the object – in mid-air – onto the appropriate [8]. The robot grabs valuable targets based on their position and posture and places them into the corresponding recycling area based on their category. The prototype machine can automatically sort construction and demolition waste (C&DW) with a size range of 0.05–0.5 m. The sorting efficiency can reach 2028 picks/hour, and the online recognition accuracy nearly reaches 100% [9]. A particular focus is given to spectroscopic techniques that pertains the material selection process with a greater emphasis placed on the NIR technology for material identification. Three different studies that make use of NIR technology are shown; they are an example of some of the possible applications and the excellent results that can be achieved with this technique [10]. In India, around 65 million tons of wastes are generated annually, and over 90 percent of them are Municipal Solid Waste that includes organic waste, recyclables like paper, plastic, wood, glass, etc. In that, 75- 80% of the waste gets collected and 22- 28% is processed and treated [11]. The robot kinematics parameters are optimized to improve the sorting efficiency through experiments in a real system, and it was concluded that when the conveyor speed was kept at around 0.25 m/s, better sorting results could be achieved. Increasing the speed and shortening the acceleration/deceleration time would reach the maximum efficiency when the load would allow it. Currently, the sorting efficiency reached approximately 2000 pieces per hour, showing a high accuracy [12]. On the automation control part, it can be divided into two major parts. The first one is obstacle sensing and distance measurement. On this part we should handle the 3-sonar logic in order to determine the object's direction and distance. The other part is the bin motion that should react according to the signal it receives, such as some turning and braking motions [13]. Combining MobileNet and Single Shot Detectors for fast, efficient deep-learning based object detection. If we combine both the MobileNet architecture and the Single Shot Detector (SSD) framework, we arrive at a fast, efficient deep learning-based method to object detection [14]. This work proposes a smart waste sorting system which consists of hardware and a software system. It aims at efficiently sorting out wastes so that it would be easy for the group to segregate them on a huge scale basis.

II. DESCRIPTION OF COMPONENTS

2.1 Arduino Mega

The Arduino Mega 2560 is a microcontroller board it has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

Figure 1. Arduino Mega 2560

2.2. Polypropylene

Polypropylene (PP) is a thermoplastic addition polymer made from the combination of propylene monomers. It is used in a variety of applications to include packaging for consumer products, plastic parts for various industries including the automotive industry, special devices like living hysters, and textiles. The significant properties of polypropylene include chemical resistance, elasticity, toughness, fatigue resistance, insulation, transmissivity, etc.

Figure 2. Polypropylene

2.2. DC motor, servo motor and DC motor with encoder

This is a new compact size motor at a low cost. The supply voltage range is 10-12V with the polarity markers at the base of the motor. The overall body of the motor is made up of metal. Servo motor is used for controlling the opening and closing of the ramp, thus the ramp opens when the dustbin rotates to the respective position after detected by the sensors used. DC motor encoders are used for speed control feedback in DC motors where an armature or rotor with wound wires rotates inside a magnetic field created by a stator. The DC motor encoder provides a mechanism to measure the speed of the rotor and provide closed loop feedback to the drive for precise speed control.

2.3. Switched mode power supply

A switched-mode power supply is an electronic power supply that incorporates a switching regulator to convert electrical power efficiently. Like other power supplies, an SMPS transfers power from a DC or AC source to DC loads, such as a personal computer, while converting voltage and current characteristics. They are also storage component like inductors or capacitors that supplies power when the switching as at its non-conduction state.

Figure 3. Switched mode power supply (SMPS)

2.4. L298 driver

The L298 Driver is a high voltage, high current dual full bridge driver designed to accept standard TTL logic levels and drive inductive loads such relays, solenoids, DC and stepping motors. Two enable inputs are provided to enable or disable the device independently of the input signals.

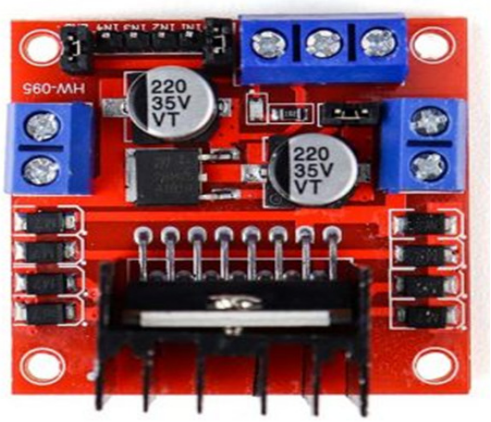

Figure 4. L298 Driver

III. WORKING PRINCIPLE

It is a multipurpose Bluetooth controlled vehicle which is used as a movable dustbin with the waste sorting feature. The robot can be accessed from any location using the IOT interface app, then you can through your waste into the ramp opening, after collecting the waste, it is screened using the inductive and moisture sensor. By using these sensors the waste is segregated into different categories like metal waste, wet waste, and dry waste. The inductive sensor helps in detecting the metals using the change in magnetic field principle. Moisture sensor senses the wet waste by the water content and if not detected by both the waste is regarded as dry waste. Inductive proximity sensor Senses all metals. Inductive sensors operate on the basis of Faraday's Law. Because only metallic objects have inductive properties, inductive sensors can't be used to detect plastic or cardboard or other non-metallic objects. Moisture sensor Senses organic wastes. Moisture sensor uses capacitance to measure dielectric permittivity of the surrounding medium. In soil, dielectric permittivity is a function of the water content. The sensor creates a voltage proportional to the dielectric permittivity, and therefore the water content.

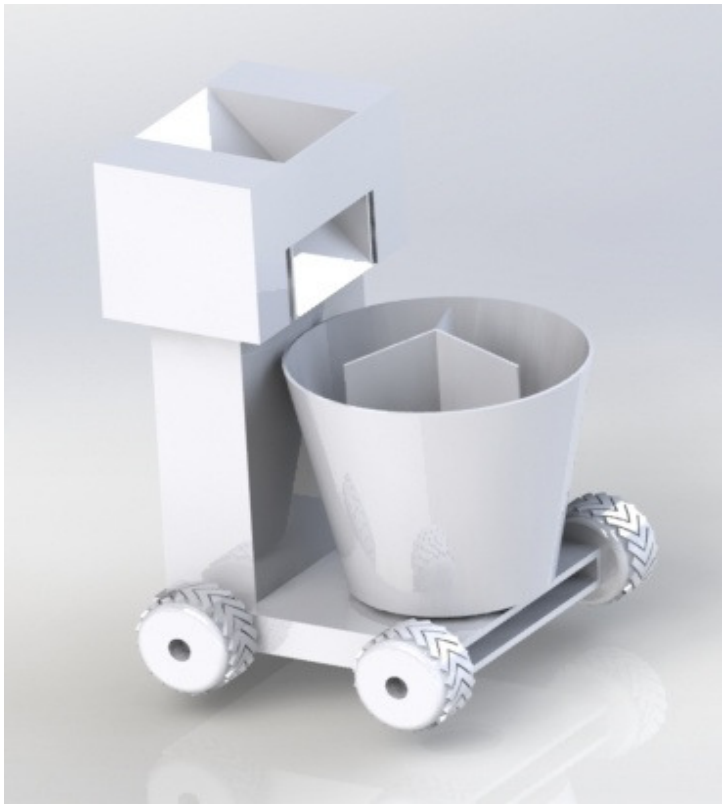

Figure 5. Waste Sorting Robot

IV.CONCLUSION

This waste sorting robot helps in eliminating the mixed waste by segregating the household waste which is the very first level in the waste disposal. Time taken in the overall process that involves segregating the waste is reduced and it enhances the efficiency of the process. Waste management is thus implemented in a small scale which can be integrated with various other systems and processes and then can be implemented in larger scales. Human error and human accidents are eliminated in a large scale. The waste sorting robot is successfully completed and tested.

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