Automatic Waste Segregation Machine

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Abstract: *As the population is growing, the amount of waste production has also increased in present era. Innovations always help mankind to make life simpler. The disposal and recycling of human waste has been a major issue in past few years. Now presenting an innovative way of sorting different type of dry waste efficiently which is a small step to make the country clean i.e. automated waste segregation machine. Waste segregation is already in practice which is done manually by humans and by using sensors. It is quite risky for humans to work in such hazardous environment and also reduces labour cost. Using sensors reduces health risk of workers but simultaneously increases the cost of the system. But in this innovative system the humans will be replaced by mechanical components, which will reduce labour cost as well as humans will no longer have to work in hazardous and stinky areas.*

I. Introduction:

India is a country having population of about 1,381,567,238 people which is 17.7% of world's population. A country with such a huge population will also produce waste in tremendous amount. For every common householder, the trash in his/her trash box is not a point of consideration, but knowingly or unknowingly it is becoming a major problem, as its management is a tedious job to do. So let us know what this term "Waste" stands for, waste is nothing but anything which is thrown away or cannot be used after primary use. Primarily waste is divided into two types "wet waste" and "dry waste". Wet waste are the common household waste which are decomposable in nature and which cannot be reused or recycled for example vegetable waste, remaining food, human waste, wood etc. Whereas dry waste are those materials which can be reused, recycled or non decomposable for example metals, plastics, non metals etc.

Traditionally sorting of waste is done manually by humans. The traditional way of sorting the waste in the country is not much efficient. It is labour intensive and also increases the health risk of labour who works in the hazardous environment. Many new technologies have come up, which segregate the waste using sensors but, the high cost of sensors makes the sorting process costlier. Due to all these reasons the need for new efficient technology arises which then led to foundation of this project. The main motive of this project is to design and manufacture a durable machine or system that will segregate the waste efficiently. In this system simple mechanical process and material are used to segregate the waste instead of high cost sensors. This machine is build by taking into consideration the magnetic property of the material, densities of material etc.

II. Literature review:

Waste Segregation and its management has been identifies as the major problem all over India. Plastic solid waste identification system based on near infrared spectroscopy in combination with support vector machine (Shichao Zhu , Honghui Chen , Mengmeng Wang , Xuemei Guo Yu Lei , Gang Jin NIR) can identify PSW with 97.5 % accuracy. The shape of samples can also be roughly discerned but the label on the sample would not be identified because the NIR spectrum was disturbed by the label. Compared to the hyper spectral imaging technology, this system can achieve similar recognition results while reducing costs considerably.[1]

Development of Automatic Smart Waste Sorter Machine (Mohammad Osiur Rahman, Aini Hussain, Edgar Scavino, Hassan Basri, and M.A. Hannan) emphasizes the development of a new method for an automated paper sorting system that utilizes an image processing technique with the K-NN classier. Another important idea that has been implemented in this pro-posed system is adaptability to new subcategories of the primary paper grades. The wide ranges of subcategories of paper grades are used to train the system to recognize new subcategories, and thus the system is scalable and able to provide robust decisions in paper grade identification. In the experiment, it is observed that the performance of the vision system is influenced by the lighting arrangement. Thus, in order to achieve the best performance from this method, the lighting consistency must be maintained during the enrolment and identification phases of this system.[2]

Waste Sorting Machine (1S.J. Ojolo, 2J.I. Orisaleye, 1 Adelaja, A.O., 3Kilanko, OA) has been developed which have been able to sort wastes from the University of Lagos into light weight and heavy materials. It was observed that wastes consist of approximately 32% of light materials which were separated by

the means of a fan blowing through a channel. The machine needs modifications of the magnetic end to efficiently separate ferrous metals from other metals. The machine can be manufactured at a well equipped mechanical workshop, using locally sourced materials and at a good price.[3]

Automatic Sorter Machine for Smart Waste Management System (Mahmudul Hasan Russel, Mehdi Hasan Chowdhury, Md. Shekh Naim Uddin Ashif Newaz ,Md. Mehdi Masud Talukder) is an excellent example of proper waste in sanitary landfills which usually provide the most economical option for disposal of solid waste. It will also ensure effective recycling system. Hence, the improvement of waste sorter will ensure economic and ecological development.[4]

Waste Segregator and Monitoring System (Aleena V.J.*, Kavya Balakrishnan, Rosmi T.B., Swathy Krishna K.J., Sreejith S, and T.D.) segregates the waste into three major classes: plastic, organic, and metallic. The proposed system would be able to monitor the solid waste collection process and management of the overall collection process. Inductive proximity sensor is used to detect the metallic waste. A blower mechanism is used to segregate dry and wet waste.[5]

Sensor Based Smart Dustbin for Waste Segregation and Status Alert (Kesthara .V, Nissar Khan, Praveen .S.P Mahesha .C Murali) is a step forward to make the manual collection and detection of wastes automated in nature. It would pioneer work for solid waste collection, monitoring and management processes. This project for the management of wastes is efficient, automatic segregation and time saving process than the currently employing method in which concerned municipal employee has to look for the filled waste bins manually across different spots in an area/street for checking regularly whether the waste bin is filled or not.[6]

III. Methodology

CONSTRUCTION

Stand is made up of mild steel 25 mm tube. It's having height of 700mm and breadth of 600mm and width of 300mm. This is made to mount rollers and belt over it and also to attach magnetic roller to it. The picture of stand is shown in fig 1

Fig 1 mild steel tube stand

Rollers are made up of 1inch pipe of mild steel material of length 290mm. A 16mm rod on both sides of hollow roller is welded to mount the roller on supporting plates which are connected to the bearings. As shown in the figure 2 and fig 3. A pair of 16mm UCFL bearings is attached to the rollers with help of nut and bolts. Similarly on the other side of o the stand another roller is being attached to the main frame using two supporting plates. This roller can be moved to-fro in horizontal direction using bolt and nut mechanism as shown in fig 5 This is used to tighten the belt. A dc motor of 10 rpm is connected to roller using chain sprocket arrangements to drive the rollers. As shown in fig 6.

Fig 2 front roller mounting

Fig 3 supporting plates

Fig 5 Rear roller mounting

Fig 6 roller mounting and fitting

A magnetic roller is design and fabricated to attract the magnetic particles. This roller is made up of nylon rod of 32 in diameter on which we have mounted 7permanent magnets of inner diameter 32mm outer diameter 72mm and thickness of 13mm with spacer of 34mm inner diameter 51 mm outer diameter and 25mm thickness are placed between them. A 16mm rod of 100 mm length is tightly fitted on both sides of this nylon rod so that this roller can be easily fitted on the supporting plates. This magnets and spacer arrangements are then wrapped with 24 gauge GI sheet as shown in below pictures.

Fig 7.nylon rod

Fig 8 spacer

Fig 9 Permanent magnet

Fig 10 Magnetic roller

Tank is made up of mild steel material of 2mm thick sheet with base length 600mm, top length 900mm, height 300mm and width 300mm.This tank holds two chain sprocket arrangement with plates attached to it at both top of the tank and the base of the tank respectively to remove lighter material from the top and denser material at the base respectively. This tank is water sealed as it filled with water.

Fig11 Cut section of tank

Fig 12 Tank

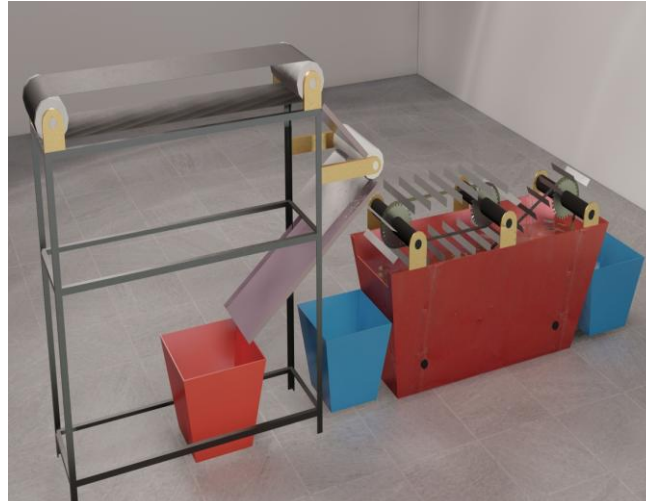
Fig13 3D model of the machine

Fig14 3D model of the machine

IV. Working:

This project mainly consists of three parts namely conveyer belt, magnetic roller and water bath separator. Crushed solid waste will fall on the conveyer belt and it will be moved to the length of conveyer belt using motor driven rollers. From the conveyer belt the waste materials will be set free to fall on the guide plate, which guides the waste towards the magnetic roller. Due to the magnetic field produce by magnets the metallic particles having magnetic properties falling onto the roller will get attached to it. These metallic particles having magnetic properties will be removed/ detached from the magnetic roller by using a plate which will be installed between the roller and the frame with minimum clearance. This detached magnetic particles will fall on a guide plate placed below it and will be collected in a separate bin. Materials other than metals which are not attracted by the magnetic field of magnets will fall into the water bath separator due to the influence of gravity. Here the materials of lighter density will float on water which will be removed using two sprocket chain arrangement fitted with plates, which will remove upper layer of lighter material(plastics) and collect it in a separate bin. The material of higher density will sink in water and settle at bottom of the vessel. It will be removed using three sprocket chain arrangement fitted with plates and will be collected into a separate bin.

V. Result:

Readings are taken by providing the proposed system with different waste materials and writing down the result in table shown below. Minimum one waste material of each type is used in crushed form.

SL NO	WASTE MATERIAL	SUCCESSFUL SEGREGATION	EROR IN SEGREGATION
1	Nuts and bolts	Yes	NO
2	Plastic bottle caps	Yes	No
3	Glass pieces	Yes	No
4	Small Plastic begs pieces	Yes	No
5	Small crushed aluminium pieces	Yes	No

VI. Conclusion:

- The proposed project segregates the waste efficiently into three categories metals with magnetic properties, plastics, metals with non magnetic properties and glass.
- Time of segregation process can be reduced by using different rpm motors.
- Using too high rpm motors may lead to inefficient segregation process.

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