

Recycling Sorter and Crusher Machine

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Abstract. Recycling household waste such as plastic bottle and aluminium involve separation of material and reducing of size. Most of the household waste mainly consists of plastic, aluminium, paper and other types of waste. Aluminium and plastic material will be sorted accordingly and it will be crushed to a smaller size. In this project Proteus will be used to design electrical hardware and perform a simulation. Software design is divided into two parts that consists of designing the controller and programming using C language. The hardware development consists of two major parts; mechanical parts and electrical parts. Peripheral Interface Controller (PIC) will be used as a controller of the system to perform the sorting and crushing activities. The machine is expected to be able to differentiate between plastics and aluminium and crushing it into smaller pieces to reduce the storage sizes.

Introduction

Recycling is a process of returning waste materials to their raw material components to make new products and thus garbage is collected. They are being used again as raw materials to make something new. Aluminium, glasses, plastics and papers are often recycled. Recycling helps to save the earth's resources, saves energy and reduces pollution [1]. The process involved several steps: separating materials from the waste stream, collecting them, process them and ultimately reusing them either as an entire new product or as part of a new product. There are many modern methods of recycling. Some of these are curbside, drop-off centers, buy-back centers and deposit/refund program [2].

The Ministry of Housing and Local Government (MHLG) has designated 11th of November as National Recycling Day. At present, the recycling rate in Malaysia is 5%. This is comparatively low compared to other developed countries such as Germany (74%), Belgium (71%), Austria (67%), and the Netherlands (66%). The Ministry of Housing and Local Government aims to achieve a recycling rate of 22% by the year of 2020 [3]. Curbside recycling method is collecting recycle materials from houses at the curb. Items are usually set out in large bin and pick-up by the truck. Besides that, the recycle bins are also placed at selected location such as shopping complex, bus station and other public places for people to recycle their household waste at their convenience. The recycling campaign was launched with very little understanding about the factors that influenced individual recycling behavior. Moreover, recycling bins have been misused and between 40 and 60 per cent of their contents were found to be non-recyclable items [4].

Unfortunately, due to less awareness of the importance of separating the waste correctly according to the material types, the waste is mixed in the bins. To deal with this issue we need a method to distinguish the waste type according to its materials. Besides separating the material, size of the waste itself also need to be reduced due to storage problem. By reducing the waste

size more waste can be stored in the bin at the curbside. A prototype of sorting and crushing machine will be developed for handling mixed materials and storage problem at the curbside.

Problem statement

The recycle waste collected from curbside needs to be sorted into their categories based on the materials type such as aluminium, papers or plastics which are the most popular waste from household. Even though the recycle bins provided at the curbside are specifying by different color for different materials, the public are still mixing the wastes. In order to prevent mixed material in the same bin, the wastes need to be separated at the curbside. Material such as aluminium, paper and plastic can be separated, as it contributes a large amount to the waste.

Literature review

Generally the average per capita generation of solid waste in Malaysia varies from 0.5 to 0.8 kg/person/day depending on the economic and geographical status of an area. For example, it is 1.7 kg/person/day in rural areas [5]. At present the waste management approach being employed is the landfill but due to rapid development and the lack of space for new landfills, authorities in most major towns in Malaysia are looking at other waste management approaches. One of the approaches is waste recycling as attested by the Malaysian government's is adopting of this approach as a long-term strategy for solid waste management.

Recycling stages consist of initial and secondary processes. The first stage of recycling consists of sorting and separation, washing size reduction, pressing and briquetting and granulation. There are many recycling technologies depends on type of material and its complexity. Sorting and size reduction of components are a part of III degree recycling [7]. A model of universal recycling technological processes with various groups of materials are connected altogether creating a production plant which the whole recirculation process was process was analysis and proposed [7].

R.Nowosielski proposed a model of the integrated recycling technology using the concept of BAT (Best Available Techniques) which taken into account the balance between the costs and the environmental benefit. The procedure for selection of BAT involves the technical feasibility, environmental benefit (minimum emission to air, water, and minimum quantity of waste and minimum energy consumption) and economical feasibility of many solutions which apply for best available techniques [8]. The authors also suggest a scheme of the integrated recycling technology which has to be so universal to make possible complex processing and recovery of waste.

Jenifer Carless in her book "Taking out the Trash: A No-Nonsense Guide to Recycling" stated that there is variety of advanced technology and equipment being used in recycling is actually varied. The equipment comes in all sizes for the smallest to the largest job. Some companies specialize in one or two products, while others have developed a range of products to cover almost every aspect of recycling.

Objectives

The aim of this project is to develop a sort and crush machine that are able to separate the waste according to its material group and crush to reduce the waste size. The objectives of this project are:

1. To develop a sorting machine which is able to separate plastic, aluminium and glass.
2. To integrate the sorting machine with crusher machine.
3. To create the prototype of the machine in sorting and crushing machine.

Methodology

Development of the software. An electronic or electrical hardware design need to be simulated by using Proteus. Software design is divided into two major parts; designing the controller using Proteus and programming using C language. The hardware that is designed using Proteus will be simulated together with the hex code obtained from C language. The successful result will be used to design the hardware.

Development of the hardware. Basically hardware development consists of two major parts; mechanical parts and electrical parts. The mechanical part will involve in designing the outlook or shape and size of the sorter and crusher. A study of current available sorting or crusher machine need to be carried out in order to understand their working mechanism. The working mechanism of the sorter and crusher need to be established, before moving to the next part.

The second part is an electrical circuit design. In this section the circuit will be designed to control the operation of the sorting and crushing process. In this section Peripheral Interface Controller (PIC) will be used as a controller of the system to perform the sorting and crushing activities.

Graphical Design.

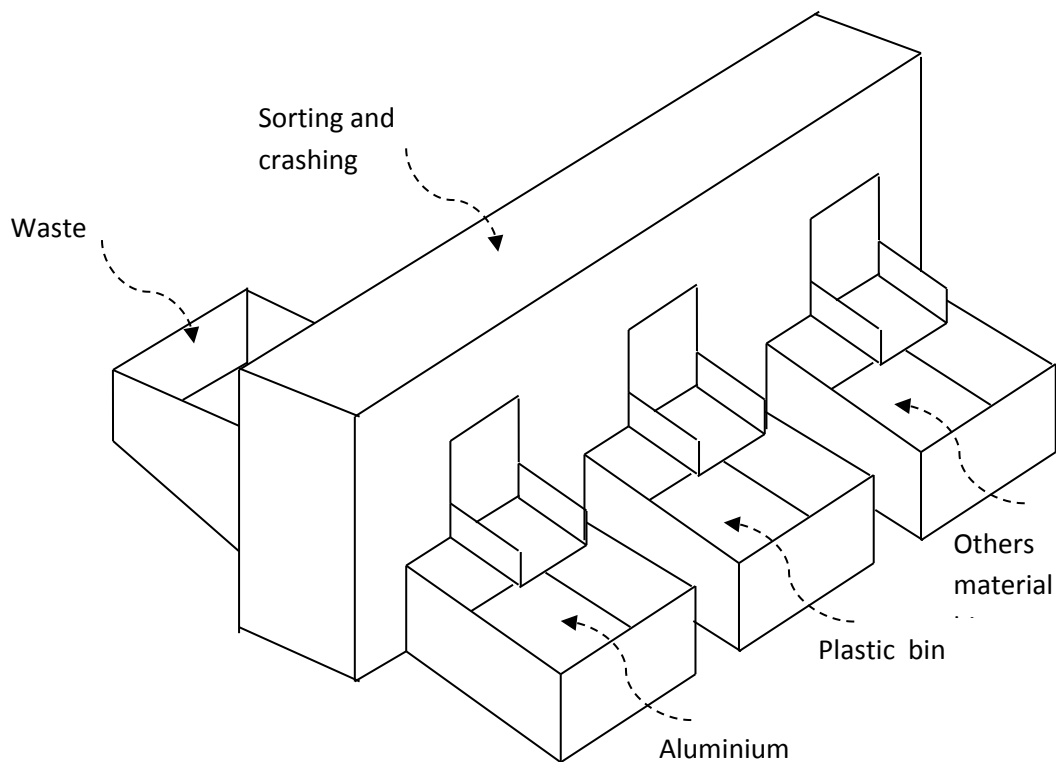


Figure 1: Design of Sorting and Crashing Machine

Diagram of Main Controller Circuit.

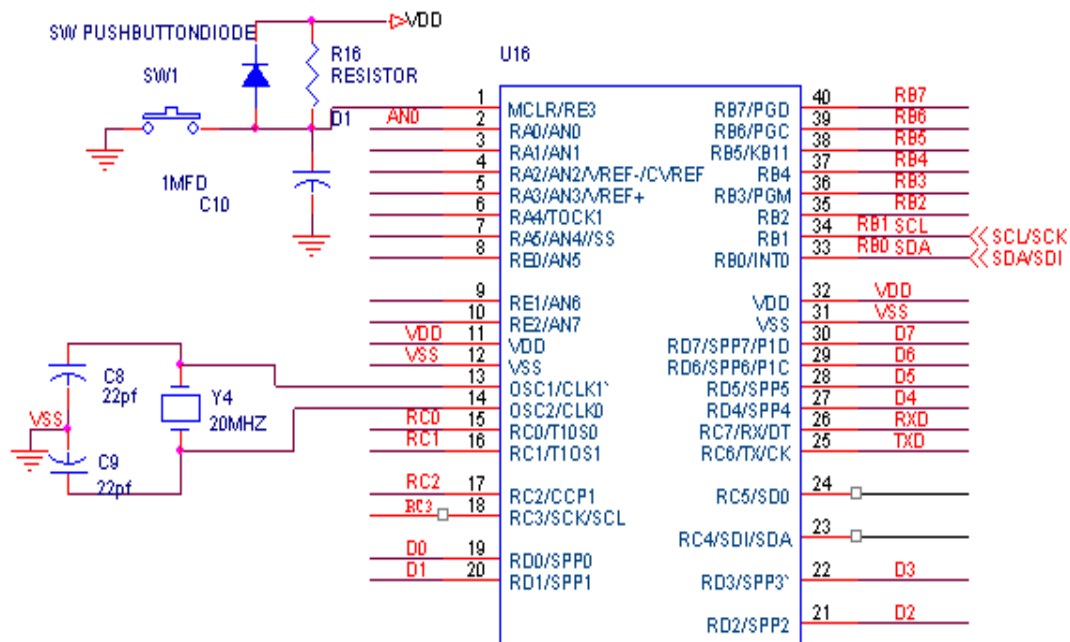


Figure 2: Main Controller Circuit Diagram using pic16f877a

Flow Chart

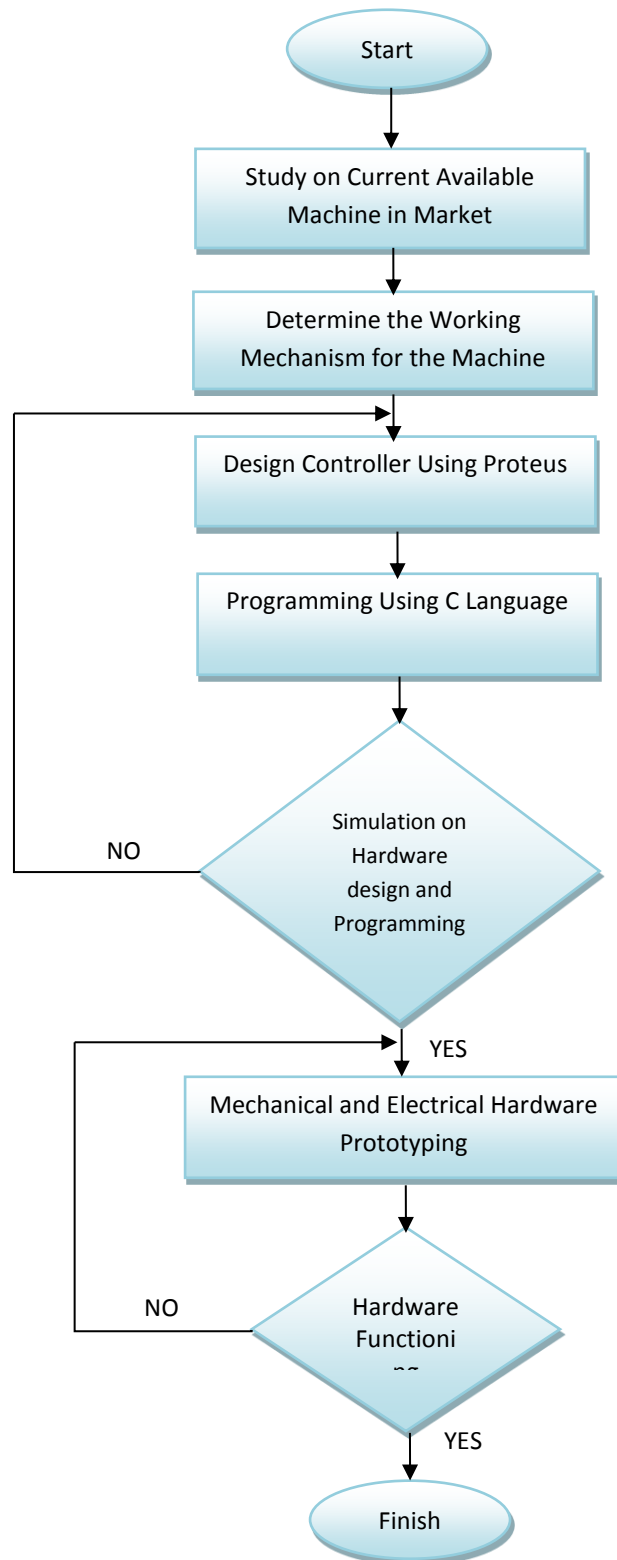


Figure 3: Project Flow Chart

Scope of the project. This project can be categorized into two major parts. The first part is the hardware development which involves mechanical, electronics and electrical design. In this part the sorting process can identify aluminium and plastics materials. Other than this material will be categorized as unidentified and will be placed in the same side. Peripheral Interface Controller (PIC), metal and plastic sensor will be used to identify the material type accordingly. The motor will be used as a key component for crushing process.

The second part involves the simulation using Proteus and C language. The simulation part is to determine the feasibility of the working hardware. Once the successful result obtained the real hardware can be fabricated.

Conclusion

There are various types of sorting machine that are used to sort the different type of material and it is widely practiced in industry. The machine size also varies from each other depends on its capability of sorting and other application. Normally the machine is custom design base on customer requirement.

The machine is expected to be used in community curbside which the machine size is not too large or too small to perform sorting activity when the waste is loaded in the machine. In order to utilize small space to store large quantity of waste, the size of the waste is reduce by crushing it to small pieces.

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