Design and Manufacture the Model of Plastic Color Sorting

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Abstract

In this research, a plastic color sorting for recycle was developed. This is a model and only undergoes a classification cycle so productivity and accuracy are not high. When fully researched and put into practice, it will be the optimal solution for sorting in recycled plastic pellets processing plants as well as color classification in products other. The machien model has many advantages as: the price is cheap, so, it is able to observe a wide area per unit area. The ability to learn color, user interface screens, view objects, and calculated parameters are clearly displayed. The system can be made, operated and repaired easily without the expert's expertise.

Keywords: *Color sorting, image processing, plastic recycle, plastic shred.*

1. Introduction

Plastic is also known as polymer, used as a production material to create variety of item. It contributes significantly to the service of human life, supports for the development of many profession and economy field as: Electricity, electronics, telecommunications, transportation, fisheries, agriculture,…. [1] Along with the development of science and technology, Plastic is also applied and becomed the substitute material for traditional materials, which is seemingly irreplaceable as Wood, metal, silicat ...[2]. So, plastic industry increasingly plays an important role in the life and production of nations. Plastics products are diverse and increasingly used in many sectors and industries.

Figure 1. Some common plastic products

In 2015, the plastic industry produces and consumes nearly five million tons of products. If plastic products per person in 1990 was only 3.8 kg / year, it has now increased to 41 kg per year. This increase shows the increasing demand for plastic products in the domestic market. Many businesses have built up reputable brand names in the country like: Binh Minh plastic pipes, Tien Phong's plastic, Rang Dong's plastic packaging, Tan Tien's plastic; PET bottle and bottle of three layers of Oai Hung, …

In addition to color sorting of plastic recycle by hand or an electronic sorting machine, other sorting systems have been developed. Pelletier and Reizuer [3] reported that plastic color sorting could be more efficiency with the high speed camera. Although electronic color sorting has been shown to be efficient, hand sorting is more popular in Vietnam. Flotation separation and density characterization of raw material have been extensively investigated [4, 5]. However, when sorting was conducted with multive color plastic, complete sorting was not achieved

2. The Design of Plastic Color Sorting Machine

As a branch of development of the whole plastics industry in general, recycled plastic is increasingly being encouraged by governments, because it does not only protect our environment, but also contribute to create many new products from the plastic which seems to have not used, While the supply for these items are still much shortage. Plastic recyclable products are mainly products of plastic packaging such as PET plastic bottles, food packaging ... [6]. Recycled granulated plastic is the raw material for the recycling of plastic products.
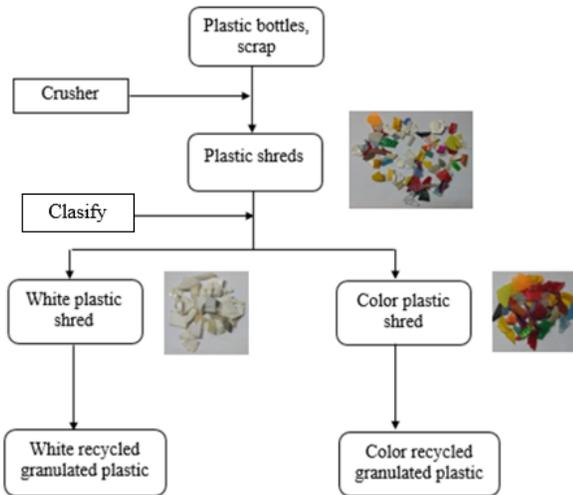
Figure 2. Diagram of recycled plastic grain production line.

Figure 3. Photo realistic plastic shred after grinding

At present, most businesses only produce recycled plastic granules, to supply to factories. The creation of recycled white plastic particles, It will contribute to a huge growth in sales. But to create this kind of plastic requires solving the "classification" on the diagram, the input material must be completely white plastic. If classified by hand, the accuracy and productivity are not high. Derived from that problem, we have conducted research on the application of image processing, in order to design and manufacture plastic color sorting machine which is especially white plastic.

Design system to distinguish product color by camera. From there, the model fabricates the verification of the precision, the interface screen to visualize the sorting process.

Each recycled plastic shreds, after passing through the crusher, will carry a certain color, we will proceed with the installation:

+ The camera system is programmed to sort resins.
+ A system of pneumatic nozzles to change the direction of white plastic to distinguish it from the rest of the plastic.

Plastic billets need to be identified after passing through the crusher, forming plastic pieces of completely different shapes and sizes. How does the plastic move in line and dilate the focus of the plastic so that the camera can easily identify and output the compressed air signal from the nozzle to change its direction of motion of white plastic.

The basic method to replace the visual classification by the human eye is to use an artificial eye: Camera. The camera can replace the eyes in getting the surrounding image. However, people with eyes combined with the brain have billions of neurons, which can distinguish and process images from simple to complex. As for the construction of a camera system for image processing, the results of image acquisition and processing depend greatly on the program and image processing algorithms acquired from the camera. With each product classification application will have a particular characteristic. To make research topics highly feasible and relevant to their abilities the team has chosen the direction of application: research application of image processing of webcams in the classification of plastic by color. Webcam is a simple camera format that is used for recording and exchanging images without high quality and is much cheaper than the dedicated camera. The use of webcams is appropriate for students' pocket money and offers a high-tech, low-cost capability. Here, the team uses the logitech webcam.

Figure 4. Logitech 270 webcam.

Select the Microsoft Visual Studio software as a supporting tool for the study of the subject, because this software is very popular and effective technology for students to read data from the webcam and implemented

the comparison method with the sample image and exported control commands to the model to carry out the product classification by color.

To work on the topic should find out the following tasks:

- Learn Visual Studio tools related to image processing, how to communicate between this software and webcam. Learn the structure and principle of a digital image processed on a computer. Digital image structure: images from webcams to Visual Studio process R, G, and B color images. Each color is represented on a color matrix. So, there are all 3 color matrices, In each color matrix there are numbers that are quantized from 0 to 255, with 0 being the darkest color, 255 is the brightest color. To store and process an image data block of three color matrices as above, it is necessary to have a computer with high speed and high memory. In particularly, with the processing of images from the webcam, real-time elements need to be guaranteed. It means that each time a comparison is made between the received image data and the standard data, it is only allowed to take a certain amount of time, and if it is larger then this data will be lost from the webcam transmitted.

- Select the Arduino Mega microcontroller, connect the middle of the camera, Visual Studio software and pneumatic system. Microcontroller will provide the program to read the data received by the webcam and processed through Visual Studio and also to output the compressed air control signal.

Figure 5. The Arduino Mega 2560.

- Compressed air valve 5/2 one coin, take the operator, when the signal will be compressed and fired plastic white out.

Figure 6. The solenoid 5/2 valve

- Design and manufacture of vibrating chute systems to enable the plastic expanders to be separated, unframed, embryonic motions at the right speed, maximum support for color recognition, analysis of webcams.
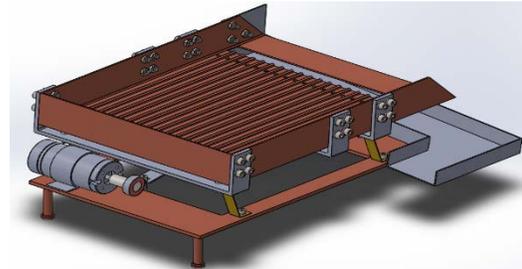

Figure 7. Cluster of shake separator embryo

The research process is as: the system design, the framework of the model for the installation of the webcam, at a suitable distance with the lighting system so that the optimal color image recognition. Installation of two trough system: Vibration system I with the low speed To dilate the primary embryo; vibration system II with faster than last one to let the far-reaching embryos increase the classification accuracy. Connect your webcam to your computer, install the drivers, get the files you need, and write programs for the Visual Studio problem. Connect the Arduino to the computer to receive the signal, and with the compressed air through the role 5V to output the signal.

3. Machine Testing

Design, manufacture and successful test of color plastic sorting machine. First, the plastic will be supplied to the hopper, when it goes through the vibration system I, the workpiece will be separated, towards the vibration system II, until approaching the end of the process, the plastic will be scanned and analyzed by the webcam. If the white plastic is true, the Arduino circuit will output the signal to the gas valve to shoot the white plastic ingot out. Conversely, the embryo will go through and move in a different direction.

Figure 8. Plastic color sorter model

- Acceptance test results:

500g Original plastic

After the 1st classification

Figure 9. The sorting result of plastic material

- Analysis and evaluation:

In the original plastic mixture 500g contains: 200g white plastic, 300g plastic color. After classifying:

+ In yellow tray contains: 210g, including: 187g white plastic, 23g colored plastic. White resin ratio is 85%, equivalent to 93.5% of white resin.

+ In blue tray contains: 290g, including 13g white plastic, 277g colored plastic. White resin ratio was 4.9%, equivalent to 6.5% white asphalt.

4. Conclusions

This is a model and only undergoes a classification cycle so productivity and accuracy are not high. When fully researched and put into practice, it will be the optimal solution for sorting in recycled plastic pellets processing plants as well as color classification in products other

- **Advantages**:

+ Price is cheap, able to observe a wide area per unit area.

+ The ability to learn color, user interface screens, view objects, and calculated parameters are clearly displayed.

+ The system can be made, operated and repaired easily without the expert's expertise

- **Disadvantages**:

+ Due to the shape of any embryos should remain the status of embryo concentration in 2 to 3 shred, not separated.

+ Due to the need to use a computer, it takes some extra space.

+ Due to budget constraints, the blank is filtered only once, so the filtration is not only 80%.

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