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IMAGE PROCESSING AND PLC BASED AUTOMATED BISCUIT SORTING SYSTEM

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ABSTRACT

Food processing and handling industry is one of the growing industries and includes various applications like cutting, baking, packaging, grading and sorting of various food products etc. Automated sorting system is widely used in food industry. In this paper, the technique of image processing based automated biscuit sorting is discussed. In this, biscuits would be sorted according to color and size. It uses integration of MATLAB and PLC for sorting. Effectively it reduces the labor and working time. And biscuits can be sorted efficiently and in hygienic way through reduced manual handling.

Keywords: MATLAB, PLC, Biscuit Sorting

I. INTRODUCTION

It is always important to have an inexpensive but accurately calibrated environment when dealing with any automated system. As we know that, bakery industry is one of the important sectors in our day to day life. There are so many automated systems which are upcoming in this industry. Biscuit sorting is an essential process from customer and owner point of view.

As we know that, several years ago, biscuits were sorted manually in many bakeries. But this process is not accurate. Therefore probability of dispatching defective pieces was quite high. The time required for whole process was so high. Now a days, food sorting technology is evolving to meet producer demand for faster machines and precise performance.

When the need of biscuit sorting arises, at that time biscuits were sorted manually. To overcome the disadvantages of the conventional sorting system, there is need of automatic biscuit sorting system. In the automated biscuit sorting system, image processing technique is used for the sorting purpose.

Because of this automated system, biscuits are sorted without any harm, in reduced working hours. Hence it is used in all over food industry to sort the objects. Again it has many other application areas like, in medical field, tablets can be sorted by this technique. It can also be used to sort the nuts and bolts in the mechanical industry. Because of the less labor required and more accuracy, this system is popular.

II. DESCRIPTION

Automated biscuit sorting system based on image processing is designed and developed to sort the biscuits based on the parameters like size and color. This system will be helpful in reducing labor, time and cost. It is also helpful to maintain the quality of finished products with better customer satisfaction.

The objective of this project can be explained as follows-

1. Manufacturing and assembly of sorting system.
2. Image processing of biscuits using camera and results are obtained for sorting the biscuits.
3. Interfacing of image processing software i.e. MATLAB with PLC.[1][2]

II. PROPOSED MECHANISM OF THE SYSTEM

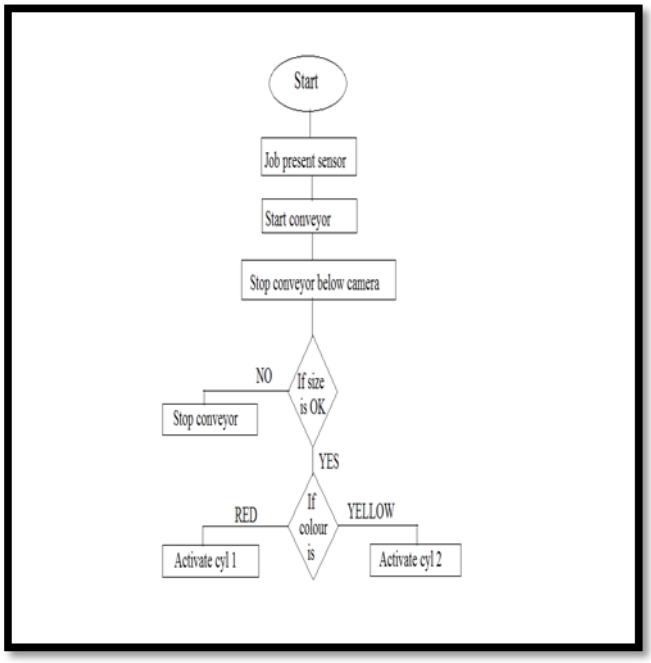

Fig. 1. Flow chart of the system operation

Here, job is sensed with the sensor on the conveyor. If job is present then conveyor motor will be started. By using sensor, the conveyor will be again stopped when biscuit will come below the camera. Then the image of that biscuit will be taken by the camera for image processing. After that, if the size of biscuit is not proper then conveyor will be stopped there only. If the size of the biscuit is ok then it will proceed to the end of the conveyor. According to appropriate signals for the given colors, there will be movement of the respective bins. Design of the set up can be given by following image-

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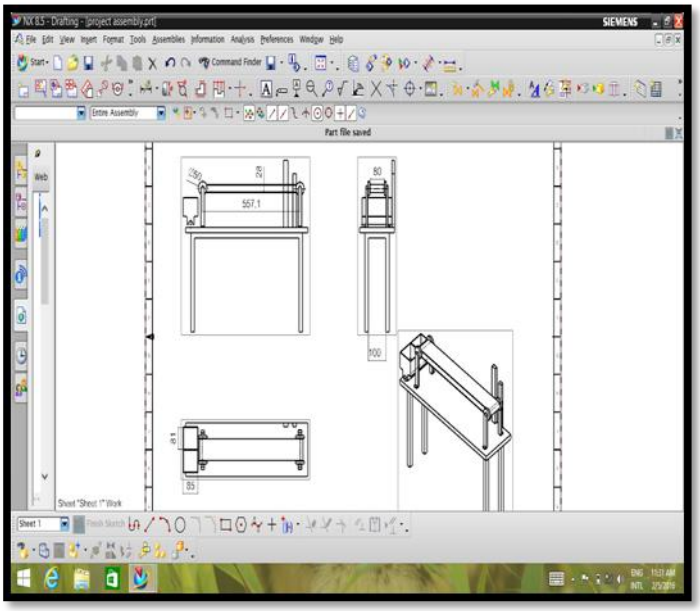

Fig. 2. Solid model of the proposed system

IV. IMAGE PROCESSING

Image processing is a form of signal processing for which input is given as an image such as photograph, video etc. The output of this can be an image or a set of characteristics of the image. Here, optical and analog image processing is possible. But usually digital image processing is referred. Computer graphics and computer vision techniques are closely related to this.[2][3]

MATLAB-

MATLAB is a language for numerical computation, visualization and programming. Using MATLAB you can analyze data and develop algorithms along with applications. It helps to get the results faster than the traditional programming languages like C++, Java etc. [4][5]

Applications of MATLAB-

1. Communication system
2. Image and video processing
3. Control systems
4. Testing and measurements
5. Digital signal processing

V. COMPONENTS USED

- Conveyor-

Food grade material is used for the conveyor as it is used to sort the biscuits. It is of total 595 mm in the length and 80 mm in the width.

- Rollers-

Conveyor belt is placed on these rollers. These rollers are of dumbbell size. This will avoid the slippage of the belt. The rollers are 50 mm in diameter.

- Gear motor-

To maintain the slow speed of the conveyor belt, gear motor is required. It helps to break down the conveyor speed. It is to be driven at 10 rpm speed.

- Camera-

For taking the images of objects, HD camera is to be used. It will help to provide the images of objects for image processing to MATLAB.

- Bins-

Two bins are provided to receive the sorted biscuits. These are provided right below the end of conveyor. Two separate bins are provided to receive the biscuits according to their colours.

- Proximity sensors-

2 proximity sensors with the range of 15 to 16 cm are provided for sensing purpose. These will be used to sense the object on the conveyor and to stop the conveyor for inputs.

- Pneumatic cylinders-

Two pneumatic cylinders are provided for the motion of bins. They are of the stroke 5 cm. Separate brackets are provided for the attachment of these cylinders.

- PLC-

It is to be used for controlling of the motion of conveyor. It is used because; more inputs and outputs are required. It will be Allen Bradley.

- Bearings-

For the proper fitting of the rollers, bearings are used. Bearings having specification '6001'are used.

VI. ADVANTAGES

Advantages of the automated biscuit sorting can be given as follows-

1) High accuracy is maintained through the set up.
2) Less number of labours is required.
3) Time consumed for this process is very less.
4) Good standard of hygiene is maintained as manual handling is avoided.
5) It is a non- destructive system.
6) Probability of getting defective biscuits is very less.
7)More customer satisfaction is achieved.[6][7]

VII. RESULT

1. The biscuits are sorted in two separate bins according to their colors. Here, the shape of the biscuits is kept constant.

2. The biscuits which are not of desired size are rejected by stopping the conveyor.

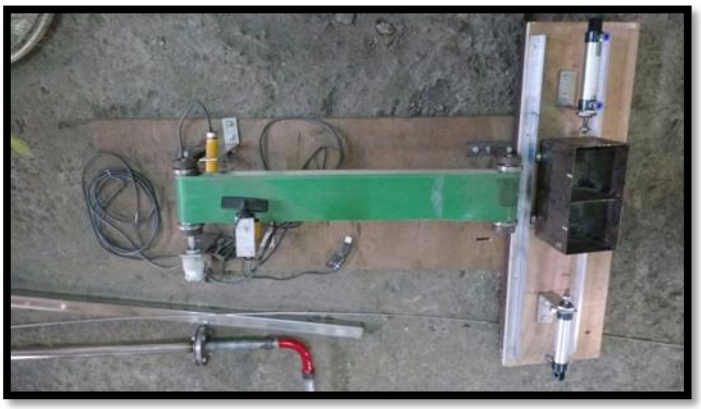

Fig.3. Actual set up for the automated biscuit sorting

VIII. CONCLUSION

The biscuit sorting system can be implemented in medium scale or large scale bakeries successfully for sorting and packaging the biscuits in batches based on various colors and sizes. This can also be extended for sorting similar shaped biscuits in one box and sort based on cracks on the surface or even based on undercooked and overcooked biscuits.

In this system, information about color and size was processed into sequence of commands that were transmitted to the driving unit of handling device. The system was able to perform successful sorting operation with the help of vision application. Testing with non-specified color (other than selected colors) gave 80 % accuracy while testing with defined color resulted in 100 % accuracy. Thus with required modifications and scaling in the system, similar systems can be used successfully for grading and sorting of various objects as discussed in future scope.

IX. FUTURE SCOPE

There are so many application areas where this sorting system can be used. These can be given as follows-

- Medical field- This technique can be used in the medical field to sort the tablets or capsules having different sizes and colours.
- Mechanical industry- It can be used to sort the nuts and bolts of different shapes and sizes in the mechanical industry.
- Food industry- This can be again used in the food industry for sorting of vegetables and fruits based on color, shape, days after plucking, etc.[8][9]

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