

Design and Development of Image Processing and Microcontroller Based Inspection and Sorting System

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Abstract: — Inspection of components and sorting out defective components is necessary for providing quality products to customers in manufacturing industries. The components also need to be handled with reduction in handling time and human efforts. Hence above processes should be automated. Image processing can be used to sort out defective components from the good ones and also sort the components based on their shapes. Automated Guided Vehicle (AGV) can be used for carrying components to various stations by following shortest possible path. The paper discusses an inspection, sorting and handling system for four different types of jobs which would be inspected first using MATLAB. The expected jobs according to their shapes would be placed various sections of a tray on AGV. These jobs would be unloaded on respective stations by following shortest path using a microcontroller.

Keywords: AGV, Image processing, Microcontroller, MATLAB

I. INTRODUCTION

Material handling means providing the right amount of the right material, in the right condition, at the right place, at the right time, in the right position and for the right cost, by using the right method. It is simply picking up, moving, and laying down of materials through manufacture. It applies to the movement of raw materials, parts in process, finished goods, packing materials, and disposal of scraps. The cost of material handling contributes significantly to the total cost of manufacturing. Advancements in manufacturing technology allow companies to rapidly produce products. It requires warehouses to accommodate temporary, selective storage. Improved product handling and speed can be achieved with the implementation of an automated guided vehicle. Agv is highly flexible as a result of remote communication. [2]

In order to determine the fitness of anything made, man has always used inspection. Industrial inspection is of recent origin and has scientific approach. The results are usually compared to standard. Inspection may be visual inspection or involve some sensor. Inspection of components and sorting out defective components is necessary for providing quality products to customers. Edge detection is another method for inspection industry. It is an image processing technique for finding the boundaries of objects within images. It works by detecting discontinuities in brightness. [1]

II. OBJECTIVES:

- Inspection of components based on dimensional accuracy.
- Shape wise sorting of components.
- Shortest path determination of agv to the particular bin.
- Design of navigation and steering system for agv.
- Obstacle detection and taking suitable action

III. PROBLEMS WITH CURRENT SYSTEM:

a. Current material handling:

Material handling systems also have consequences that may be distinctly negative. These are-

- Additional investment.
- Lack of flexibility.
- Vulnerability to downtime whenever there is breakdown.
- Additional maintenance staff and cost.
- Cost of auxiliary equipment.
- Space and other requirements.

b. Current Inspection Handling:

- Visual inspection is not totally accurate
 - Time consuming for complex jobs
- Repetitive task resulting in operator fatigue and efficiency reduction
- More labour is required and they should be skilled.

The above limitations or drawbacks of adopting automated handling and inspection have been identified not to discourage the use of modern handling equipment but to emphasize that a judicious balance of the total benefits and limitations is required before an economically sound decision is made.

IV.METHODOLOGY

4.1 Flowchart

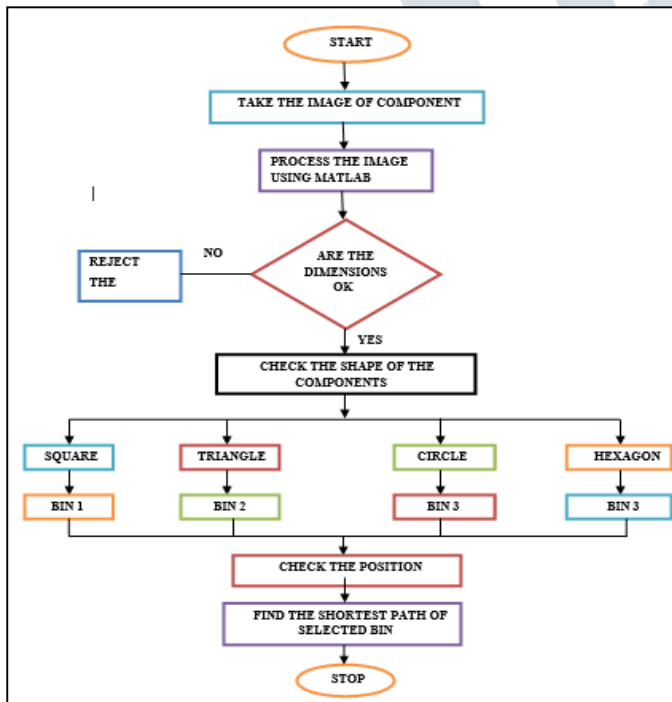


Fig.1. System flow chart

4.2.System components:

4.2.1. Hardware

A. Microcontroller arduino uno :
The arduino uno is a microcontroller board based on the atmega328. It has 14 digital input/output pins, 6 analog inputs, 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. The uno differs from all preceding boards in that it does not use the ftdi usb-to-serial driver chip. Instead, it features the atmega8u2 programmed as a usb-to-serial converter. [6]

B. Bluetooth modules

Bluetooth is a wireless technology standard for exchanging data over short distances (using short-wavelength uhf radio waves in the ism band from 2.4 to 2.485 ghz) from fixed and mobile devices, and building personal area networks (pans). Range is approximately 10 meters. These modules are based on the cambridge silicon radio bc417 2.4 ghz bluetooth radio chip. This is a complex chip which uses an external 8 mbit flash memory.

These low-cost bluetooth sub-modules work well with arduino and other microcomputers. Hc- 05 is a more capable module that can be set to be either master or slave. Hc-06 is a slave only device. (it looks physically just like thehc-05). Hc-06 not cheaper. These small (3 cm long) modules run on 3.3v power with 3.3v signal levels, they have no pins and usually solder to a larger board.

The module has two modes of operation, command mode where at commands are sent to it and data mode where it transmits and receives data to another bluetooth module. "Breakout" boards that make these easy to use are available and recommended. These mount the sub-module like that shown on the right on a slightly larger board. The green hc-05 sub-module is soldered on top of the blue bt board. The hc-05 module includes the radio and memory chips, 26 mhz crystal, antenna and rf matching network. The right section of the bt board has connection pins for power and signals as well as a 5v to 3.3v regulator, led, and level shifting.[5]

c.Sensors:

The sensor needs to fulfil the following

Factors:

- should be easily available.
- should be economical
- should require less space.
- should be easy to use.
- should have optimum sensitivity
- should have desired range of sensitivity.

Hence considering the above requirements related to the proposed system inductive sensors and ir sensors were decided to use. They fulfil all requirements for the proposed system. Inductive sensor can be used to sense the metallic object where the ir sensors are used to follow the guide tape or path to keep the agv on track. the sensor provides a digital output. The sensor outputs a logic one (+5v) at the digital output when an object is placed in front of the sensor and a logic zero (0v), when there is no object in front of the sensor. This digital output can be directly connected to an arduino. [4,7]

4.2.2.software:
A.MATLAB:

Matlab based image processing is a very convenient platform and very easy to construct an algorithm. An image is a matrix of pixel values. Matlab considers every input as a matrix. For this reason matlab provides an easy tool for image processing as a user can easily access each and every pixel value from the image matrices and edit it. Moreover there is an 'image processing tool box built in matlab for this purpose.

Mainly users deal with three types of image, hence three different matrices. Black and white or binary image matrix consists of only zero and one, one being the brighter portion and zero being the dark part. Generally images are 8bit and corresponding image matrix is 256x256. gray scale image is also a 2 dimensional matrix with each element value varying from 0 to 256. Like gray scale image rgb image can be denoted by matrix with each pixel values varying from 0 to 256. in case of rgb image, three separate matrices for each red, green and blue components overlap to form a rgb image of 256x256x3 dimension. Since we are now well acquainted with image as a matrix, now any mathematical operations can be performed on an image that can be done with a matrix. [3]

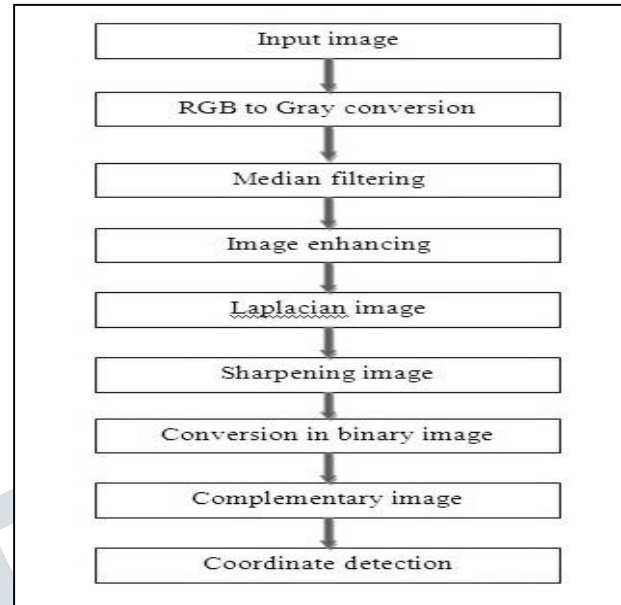


Fig. 2. Image processing flowchart-

4.2.3.SYSTEMS IN AGV:
A. Drive system:

For driving the agv the dc motor are used. Four dc motors are attached to four wheels, each one. the dc supply is given to the dc motor by using battery.

B. Steering system:

The agv get turned through 90 deg and in 45deg by controlling the direction of rotation of motor. this is according to shortest path traced by agv. the signal to motor is given through microcontroller program. the agv get turned by using the ir sensors. Sensors helps agv to turn accurately with keeping agv on track.

C. Braking system:

The ir sensors and colored tape are used to stop the agv and to follow the path of the tape. Colored tape is initially less expensive. When agv reaches to particular station it senses the color of tape and gives signal to microcontroller to stop the agv.

D.Navigation system:

The bluetooth module is used for navigation system.the module has two modes of operation, command mode where at commands are sent to it and data mode where it transmits and receives data to another bluetooth module. This type the agv will travel as per module command.

According to incoming signal the agv will provide service to each station with the help of preloaded path. Agv use colored tape for the guide path. The agv is fitted with three ir sensors to follow the path of the tape and keep agv on track. Colored tape is initially less expensive. Agv moves one station to another according to lookup table present in it.

4.2.4. Shortest path determination :

The system consist of number of stations interconnected using arduino uno. Arduino is a microcontroller development board, which consist of 14 input output pins and 6 analog input pins also has facility of serial communication.

The main station is loading station, consist an arduino which takes input from all of other stations. Stations to be serviced send signal to the loading station whether they are ready or not. Jobs coming to the loading station from conveyor are tested by capturing image and processing them with the help of matlab software.

If job is ok then it will be loaded in to the vehicle, if not then it will be discarded by the system and kept aside by simply reversing conveyor. The automated guided vehicle is another important part of this system which consist four wheels directed by arduino uno. L293d motor driver is used to drive them. The signal coming from main station through bluetooth is received by hc-05 bluetooth module present on the vehicle and connected with arduino.

According to incoming signal the agv will provide service to each station with the help of preloaded path. Agv use colored tape for the guide path. The agv is fitted with three ir sensors to follow the path of the tape and keep agv on track. Colored tape is initially less expensive. Agv moves one station to another according to lookup table present in it.

V.RESULTS

Images of various jobs under consideration were taken by camera and processed for the shape detection and inspection process using matlab After conducting series of operation as shown in fig.2 the output binary image was obtained as in fig.3 and 4. The final setup of the system including loading and unloading station and paths for AGV is built as shown in fig.5

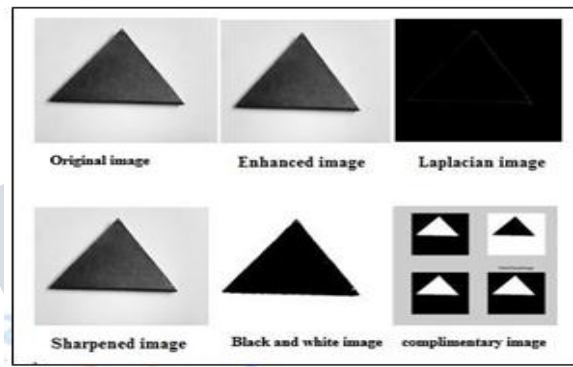


Fig.3. Processed Images



Fig.4. Output Image



Fig.5. Loading And Unloading Stations

VI. CONCLUSION

Image processing using MATLAB provides accurate results for shape and size detection of jobs and sort them in an easier way. The nodes or stations and the associated paths are less in number and hence microcontroller offers an easy and economical solution for shortest path determination.

VII. ACKNOWLEDGEMENT

The authors would like to thank Prof. S.M. Karmuse for guiding in MATLAB. The thanks are extended to Prof. Dr. V. R. Naik, HOD of Mechanical Engineering Department and Prof Dr.

P. V. Kadole Director of DKTE'S TEI, Ichalkaranji for their guidance and support.

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