DEVELOPMENT OF GOOD'S SORTING SYSTEM BASED ON COLOUR

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Abstract— **The paper presents a smart approach for a real time inspection and selection of objects in continuous flow. Image processing in today's world grabs massive attentions as it leads to possibilities of broaden application in many fields of high technology. The real challenge is how to improve existing sorting system in the modular processing system which consists of four integrated stations of identification, processing, selection and sorting with a new image processing feature. Existing sorting method uses a set of inductive, capacitive and optical sensors do differentiate object colour. This paper presents a mechatronics colour sorting system solution with the application of image processing. Image processing procedure senses the objects in an image captured in real-time by a webcam and then identifies colour and information out of it. This information is processed by image processing for sorting mechanism. The sorting process is based on a 2 phase operative methodology defined 1) a self-learning step where the apparatus learns to identify objects ; 2) an operative selection process where objects are detected, classified using a decisional algorithm and selected in real time. The Project deals with an automated material handling system. It aims in classifying the coloured objects by colour, size, which are coming on the conveyor by picking and placing the objects in its respective pre-programmed place. Thereby eliminating the monotonous work done by human, achieving accuracy and speed in the work. The project involves sensors that senses the object's colour, size and sends the signal to the microcontroller. The microcontroller sends signal to circuit which drives the various motors of the robotic arm to flick the object in the specified location.**

Index terms- **Robotic System; Micro-controller; Camera; Conveyor belt system; Servomotor; Image Processing, PC.**

I. INTRODUCTION

Industrial automation and robotics are at a high demand in the industry as both of them directly affect the growth of the industry. Quality and flexibility of the product is the important criteria of the industry. Use of industrial robots is leading automation industry to another transition. Color

based sorting is extensively used in many industries for sorting purposes to ensure the quality of the object is up to

the mark e.g. Food processing industries, pharmaceutical industries, automotive industries, agriculture industries. Such sorting reduces the human effort, labor cost and also time of operation. Most of errors caused by humans due to their limited potential are eliminated due to use of automated system supported by color based sorting using image processing. Efforts have been made to use a single assembly line for the classifying and sorting purpose of different objects using electronic systems, advanced sensors and image processing technique in Visual Basic 6 on the basis of characterization of each object.

Robots due to its ease of operation used in domestic, industrial and military purposes thus the horizons of this field are increasing day by day. The robotic arm used in this project work is used to sort the objects moving on conveyor belt depending upon its color properties into the predetermined categories. This robotic arm is controlled by the microcontroller used i.e. 89s51. This controller is programmed to move the dc and servo motors used in robotic arm. The robotic arm is manufactured using aluminum brackets which are durable and lightweight. The gripper is used to hold object which is fitted at the tip of the robotic arm. The software development is the vital task in the proposed project development.

The work is considered to sort objects such as lemon depending on its attributes such as color. Thus by using fully automated system the time required for the sorting process is reduced to the great extent, so proposed system is fast, accurate, economical, robust and cost efficient. The software used is Visual Basic (VB) 6.0 is an event driven programming language and associated development environment from Microsoft for its COM programming model. VB has been replaced by Visual Basic .NET. The older version of VB was derived heavily from BASIC and enables the rapid application development (RAD) of graphical user interface (GUI) applications, access to

databases using DAO, RDO, or ADO, and creation of ActiveX controls and objects.

II. LITERATURE SURVEY

The idea of the project was inspired and implemented by the technical paper published by the Shweta Patil, Sanjay Lakshminarayan, "Position Control of Pick and Place Robotic Arm"[5]. The conveyor and working of conveyors was studied from a reference paper of automation technology using conveyors [7]. Sensing devices, microcontroller chip and other IC's working were studied from the book Integrated circuits Digital Integrated circuits by "John. Myers" and on websites [8].

To overcome the problems of highly sophisticated robotic arm we design and implement the simple version with reference to the design illustrated in paper "Design and Development of a Competitive Low-Cost Robot Arm" [3].

The compilation of system and interfacing of different components, sensors, servo motors, Hardware and software interfacing of the system is prescribed by the "Software Interfacing of Servo Motor with Microcontroller"[9]. More detailed study of embedded systems was accumulated with reference to the website "wikibooks on embedded systems"

[10].

Color histograms were first proposed by Swain and Ballard [11] as a first approach for object recognition. Other features such as orientation, gradient magnitude were added to the histograms by Schiele and Crowley [14]. The conceptual study of image processing and algorithm for the same studied by "Digital Image Processing ", which includes threshold value of an object image, sensitivity check, RGB color palette working, histogram of an image, background data suppression (i.e. removing redundant data which appears in each frame), color recognition and difference calculation for sorting purpose and storing reference image data[13].

Circuit diagram and system flow was redesigned with reference to the block diagram published in the paper

"OBJECT SORTING ROBORT USING EMBEDDED SYSTEM" [12]. Keeping in view the techniques developed for object recognition MATLAB, SCILB, VB 6 has the most powerful tool box for image improving, enhancing and categorizing different images using different features such as color, dimensions and texture of the object. Generally signal processing is used in the analysis of the color of an object, the detection of different colors is done through image processing technique using VISUAL BASIC.

III. PROPOSED SYSTEM

Block diagram description: The block diagram consists of microcontroller MCS951 as the main controller and other peripherals are connected to the different ports of microcontroller. Power supply, input & output IR transceivers, LCD display, DC motor controlling mechanism for both conveyor & robotic arm, relay switch mechanism for selecting a particular DC motor for operation, USB to serial interface block for taking an input from a simulation software, etc.
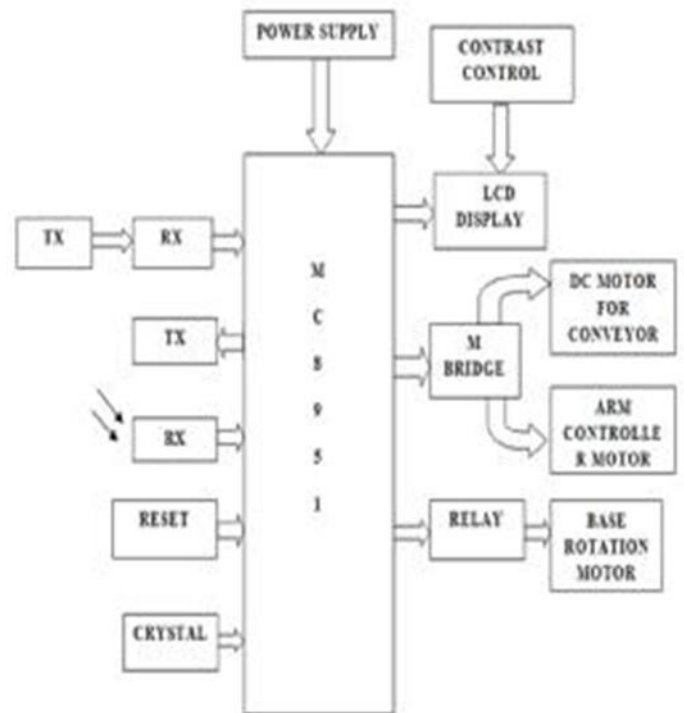

Fig 1: Block diagram

IV. FLOW CHART & WORKING

Working: A conveyor belt is used with dc motor of 12V at one side of the conveyor belt and other side is kept free rotating. A 1.3 MP camera is mounted about 25 cm above the belt and powered by a 5V power supply. When objects are passed on this conveyer belt, these objects are scanned using webcam which acts as a color sensor. To provide uniform lighting, fluorescent tubes, placed above the conveyor, were used. The position of the lighting tubes was adjusted to provide uniform, well illuminated and free from shadows images of object. The light source and cameras were mounted on a frame. A reference image of the object is scanned at first for reference parameters of RGB value and is displayed on computer screen with USB. When objects are passed images are scanned and processed in Image Processing Tool.

A program was developed to capture and record the surface images of the object. Image processing tool used is Visual Basic 6 in PC. In order to remove the background from fruit images, firstly an image from the background is captured. By determination of R, G and B values for all pixels of background, standard deviation of the images are calculated and stored in the database. Scanned image is compared with the reference pixels of the object. While comparing if the image of object does not match within the threshold value of the reference RGB pixels, it is discarded from the conveyor belt by using a robotic arm.

The robotic arm is controlled by a DC motor and cut off switch. A signal is sent to microcontroller 89S51 from PC via USB to Serial converter device (PL2303), as microcontroller cannot detect the USB signal directly sent by Image Processing Tool. In microcontroller 8951 port 3 is used for serial transmission and reception of USB to serial data. All ports are bidirectional i.e. input and output signals can be processed at same port. LCD display (16X2) is connected to port 0 of 8951 MC. This LCD will be used to detect any errors if the system doesn't work properly and it also displays the variables and parameters (RGB pixels) of the processed image.

Pin 18 and Pin 19 of micro-controller is connected with a crystal oscillator and capacitors to provide a frequency of 11.0592 MHz for clock cycles. Two 12V relay switch mechanism is connected to port 2 of MC 89s51 and 2 BJT NPN BC5129 transistors connected to relay acting as switch control for relay. Relay 1 is connected to 12V DC motor of conveyor and relay 2 is connected to robotic arm.

When signal '0' is sent to relay 1 via transistor DC motor, relay is OFF and when signal 1 is sent the relay 1 is ON and DC motor starts. Relay is active ON normally OPEN of a 3 pin relay. A signal 1 is sent to robotic arm when the scanned object produces a result that doesn't match with the date of the reference image. This signal activates the relay switch which controls the robotic arm and robotic arm takes one complete rotation and hits the target object and removes it from the conveyer line.

Power supply: A 230V 50 Hz AC is step down to 12V 1Amp DC using step down transformer and is again rectified using bridge rectifier. Now the rectified and filtered 12V DC output is supplied to DC motor (conveyor), robotic arm. Now the 12V DC is brought down to 5V DC using IC 7805 voltage regulator. This 5V DC is provided to MC 89S51, LCD display, relay and fluorescent lamp.

SOFTWARE:

The software which will be used to implement this project will be Microsoft Visual Basic 6.0. We will use this software as it is the most latest in the market and is very user friendly in comparison to its counterparts. The first step will be to develop a program to store the parameters and the RGB pixel values of a reference object.

Secondly we will create a sensitivity and threshold range within which the software will allow the object to pass. As

soon as a n object appears that doesn't fall within the prescribed threshold range that object will be discarded by the robotic arm.
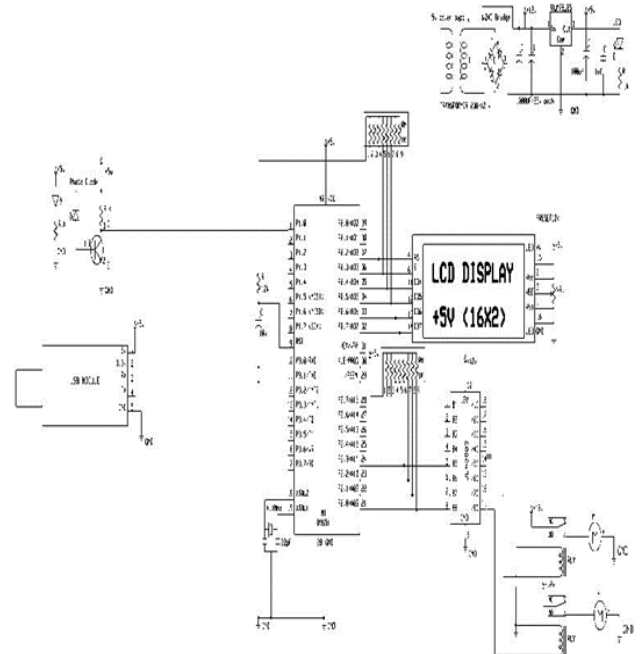

Fig: 2. Circuit Diagram

A. Object Placement:

It is first part of the system in that all objects which we have to be sort are placed on the conveyor belt. We have taken object as fruit in that a lemon. Hence we have to place different size, shape and color lemons on the conveyor belt. Object placement should be done as one lemon get sorted after that another lemon is placed on the conveyor belt. After placing a lemon on the conveyor belt then start conveyor belt for further processing.

B. Capture Image:

When an apple placed on conveyor belt is cuts first IR sensor pair. The camera used in this case will be overhead and it will take the snapshot of the object for Color sensing purpose. With the help of camera real time image of the object is taken. This image should be good quality and which is send to PC

C. Image Processing:

Pixel: Pixel is the building blocks of an image. In other words, a pixel is the smallest possible image that can be detected on your screen.

Binary Image: An image that consists of mainly black and white pixels.

Grey scale Image: It contains intensity values ranging from a minimum (absolute black) to a maximum (absolute

white) and in between varying shades of grey. Typically, this range is between 0 and 255.

Fig 3: Flow Chart

Color Image: An image is composed of the three primary colors, Red, Green and Blue. Hence is called as RGB image.

RGB value: All colors which we see around us can be made by adding red, blue and green components in varying proportions. Hence, any color of the world can uniquely be described by its RGB value.

First we take a reference image which will be used to compare different samples. This reference image is converted into binary image and its RGB pixel values are calculated. According to the RGB pixel value some threshold value is decided for the samples.

By using Microsoft Visual Basic 6.0 the RGB pixel value of the object is compared with the stored reference pixel

value, if the pixel value falls within the threshold then the object is allowed to pass through the conveyor belt. If the object fails to meet the required standards then it is rejected by roboarm.

E. Roboarm:

This is used to send an object to different position. If object is of good quality then it gets down to the trolley at the end of the conveyor belt. If object is bad quality then second IR sensor pair is cut and the relay sends a trigger to roboarm thereby activating the roboarm. Then it flicks the object in a preplaced rejection bin. It is a type of mechanical arm, usually programmable, with similar function to a human arm. The arm may be the sum total of the mechanism or may be part of a more complex robot. The links of such a manipulator are connected by joints allowing either rotational motion or translational displacement.

F. Servomotors:

Servomotors are nothing but DC motors. Servomotors have built in gearing system and feedback loop control circuitry. These motors do not require any type of driver circuitry. When the shaft of the motor is at the desired position, power supplied to the motor is stopped. If not, the motor is turned in the appropriate direction.
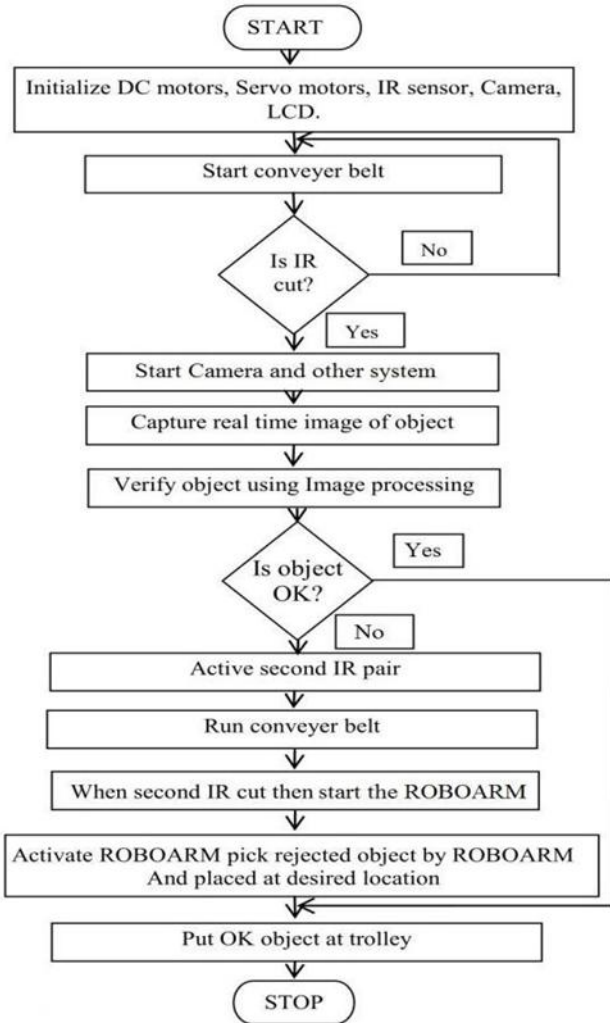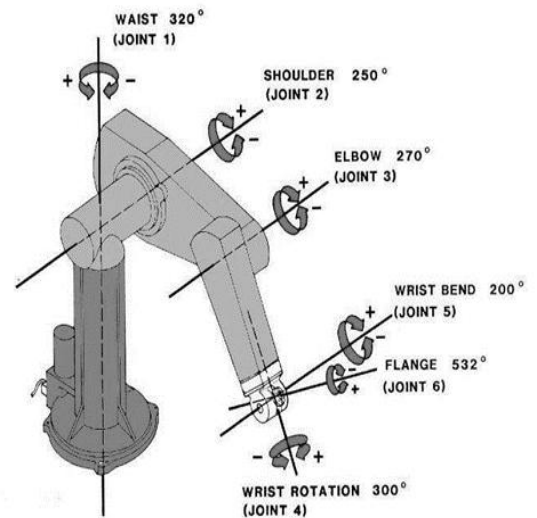

Fig 4: Robotic arm

V. ADVANTAGES

1. High efficiency
2. High speed of operation.

3. High precision: margin of error reduced to great extent.
4. High degree of intelligence.
5. Low failure rate with long life.
6. Reliable operation and maintenance
7. Fully automatic operation.

VI. APPLICATIONS

1. in food industry to identify rotted fruits and vegetables.
2. in small scale and large scale industries, to sort the products based on the various parameters e.g. color.
3. in production units to scan and identify the defects in raw materials.
4. in malls (to segregate and separate different clothes, toys, bags etc.) and in small shop.
5. in fruits and vegetable farming areas (rural areas) where installation of expensive sorters is very difficult.

VII. FUTURE SCOPE

The proposed system will be a demo version, so for a large scale production the number of robotic arms, cameras and length of conveyor system can be modified. Advance design of robotic arm can be further used to pick large and heavy objects and sort them effectively. Generally image capture is a big challenge as there is a chance of high uncertainty due to the external lighting conditions. Same way while collecting object from conveyor system by a roboarm there is variation in the weight and size of a object so further design can be modified so fruits can be collected stably. Speed and efficiency of a system can be further improved by using ARM9 or ARM11 processor for the same purpose. Automatic Trolley system can be designed to guide the sorted objects to their desired locations.

VIII. CONCLUSION

The sorting machine sorts the objects depending upon the colors of the objects successfully with the help of the roboarm and VISUAL BASIC 6.0 program in image processing. The USB webcam serves as an eye of the system which captures the real time image of the objects. The roboarm identifies the faulty quality object and rejects it at predefined place, while good quality object continues its motion on conveyor belt and finally drops into object carrier system. The LCD displays the object count with the status about the quality of the object. The servomotors used in the roboarm plays the vital role as control movement of the roboarm wholly depends control signal given to servomotor. Hence to operate the system accurately the synchronization between IR sensors, dc motors of the conveyor belt and roboarm is very essential. So this project is useful to reduce the human labor and for error free production.

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