Low Cost Computer Vision based Shape Detection in Textile Industries with Robotic Arm

R. JothiChitra

Abstract: ***This paper presents low cost automation system for textile industries where colour and shape are detected along with pick and place robotic arm. Edge detection techniques and Contour approximation algorithmare used for pattern detection.The main goal is to count the number of samples of each pattern or shapes. This system makes use of raspberry pi with a PI camera. The PI cam is used for capturing the image of the textiles being moved on a conveyor belt. The system is programmed using open CV platform. The simulation results using OpenCV environment coded with Python are presented.***

Keywords : Automation, Pattern Identification, Robotic arm, segmentation.

I. INTRODUCTION

Automation received great attention in recent years of its manifold application and its ability to overcome human assistance. Vision will be useful to scale automation to the next level for large scale production with less investment. Digital image processing where it allows much range of algorithm to be applied to input data and can avoid problem such as noise and distortion during processing. A low cost computer vision based colour and pattern identification is the midlevel process whose input is image and output is attributes for example object recognition and segmentation. Currently PLC based automation systems are being employed in the textile industries for such processes which require high installation and maintenance costs. Image processing is a rapidly growing technology and has a wide range of application in engineering disciplines. It is the method used to perform certain operations on an image. The image is imported for analysis and manipulation. The output can either be an altered image or a report concluded based on the analysis. Digital image processing has several advantages compared to analog image processing. It allows the use of many complex algorithms and mathematical operations, and offers more sophisticated performance. Colour and pattern are two powerful descriptors that helps in object identification and extraction from an image. Manufacturers from different industries such as paint, textile, medicine, cosmetics and food will attest to the importance of having the correct colour, texture and pattern. The use of vision systems in automation and control applications has several real-time constraints on image processing. Inspection of the pattern and nature of the material used in textile industries using the conventional manual method are not feasible owing to the design of the fabrics in textile industries. Computer vision involves the extraction, analysis and understanding of useful information from either a single image or a sequence of images. It is similar to imparting human intelligence and instincts to a computer. The aim of computer vision is not only to process but also provide useful results based on the observation. Our project aims to build a low cost colour and pattern identification system for textile industry. A approach for [1] automatic recognition of 2D shapes in low noise environment was presented. Further, in[2], a method for detecting object using geometric features and select cluster of image that matched the shape from large database was presented. In [3], rectangular shape using Edge detection was identified. In this work only rectangular shape only identified. Subsequently, in [4], articulated robotic arm which can shadow the movement of a human arm by using low cost sensors was designed and fabricated. In this work, servo motors are used as actuators for building the robotic arm. A robotic arm [5], which is made from low cost fabric and flexible plastics for industries, was presented. In this work, automation system for textile industries where colour and pattern are detected along with pick and place robotic arm.

The rest of the paper is organized as follows: Section II presents the proposed methodology for colour and shape detection. Pattern and Colour detection algorithm are discussed in Section III. Result and Discussion of prototype work are presented in Section IV. Section V describes the conclusion.

II.PROPOSED SYSTEM

This paper proposes automation system for textile Industries where colour and pattern are detected along with pick and place robotic arm. RGB colour model is used for the colour detection since it is additive and no transformation is required to display information on the screen. The main goal is to count the number of samples of each colour. The PI camera is used to monitor the conveyor belt and record images. The pictures are sent to the raspberry pi where it is processed using OpenCV for colour detection. Edge detection technology is widely used in forestry, engineering, fault diagnosis and more. In the proposed system, the shape detection is carried out using edge detection technology. A regular geometric features like square, Triangle and rectangle is important in practicing

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computer vision based application. Varieties of methods have been used till date for geometric extraction. One of the most popular methods is Hough transform technique to extract features. Algorithms like neural networks are deployed to train the computers.

The proposed method is colour and shape detection to perform automation in textile industries along with pick and place robotic arm. Image analysis involves feature extraction, segmentation and classification. The proposed project targeted towards textile industries for shape and colour detection, then construct the pick and place robot to replace human beings with automation. The main advantage of pick and place robot is to increase safety of the working environment, accurate and flexible work compare to human being as well as it reduces human error and number of workers. Figure 1shows the block diagram of colour and shape detection process of this proposed system is explained. Input image will be captured using pi camera. Subsequently, the process will be done in raspberry pi according to the estimated algorithm and result will be shown in LCD display.

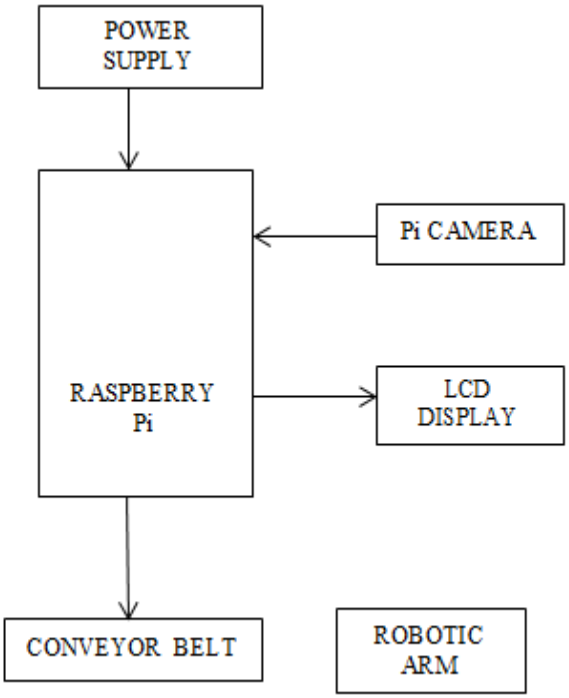

Fig.1. Block diagram of colour and shape detection

Binary image is given as input to the OpenCV and then few structural operations are performed. Then it is converted into grey level images threshold functions are performed in the grey level images to get corner boundaries. Suitable approximation is performed after threshold function. Hardware implementation of the proposed system consists of conveyor belt and robotic arm. Conveyor belt consist of two turning rotor which is run with the help of DC motor. Figure 2, shows the block diagram of the pick and place robotic arm has 4 dc motor,2 servo motor, regulated power supply, Atmega 328 microcontroller. The robotic arm is placed on the moving vehicle, movement is done with the help of dc motors and pick and place operation is done with

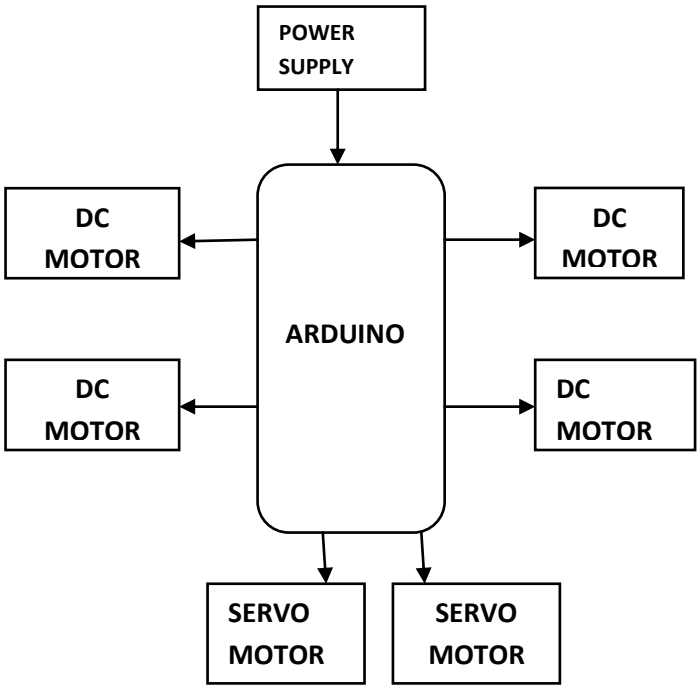

Fig 2: Block diagram of Pick and Place Robotic arm

the help of servo motor. For controlling the motor, microcontroller is used Input signal is given from a wireless play station, which is interfaced with micro controller, then the signal is decoded in the controller and the controlled signal sent to the DC motor or Servo motor. In Figure 3, features Geometric shapes like triangle, rectangle, square and other regular shapes are extracted for comparison with input image.

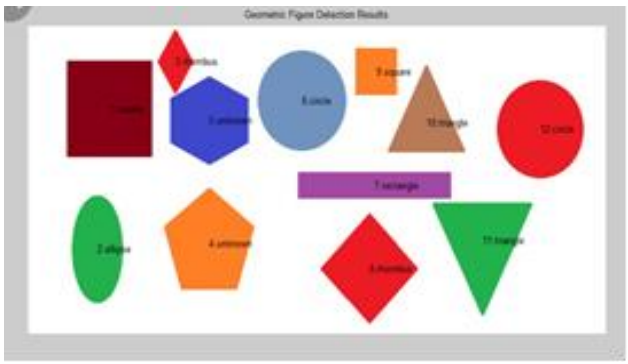

Fig.3. Regular Geometric shapes

III.PATTERN AND COLOUR IDENTIFICATION

The Edge detection technique is used for shape detection. It detects the shape by detecting discontinuities in brightness. By applying an edge detection algorithm to an image significantly reduce the amount of data to be processed and filter the unwanted images, while preserving the important structural properties of an image. The Edge detection is performed using contour method.

Contour approximation algorithm is used for reducing the number of points in a curve with a reduced set of points.

This algorithm is commonly known an Ramer-Douglas Peucker algorithm. To perform contour approximation, first compute the perimeter of the contour followed by constructing the actual contour approximation. If the approximated contour has three vertices, then it must be a triangle and if a contour has four vertices, then it must be either a square or a rectangular. Figure 4, depicts threshold image which is the input image of edge detection techniques.

Fig.4. Threshold of Image

Fig 5 . RGB based colour identification

RGB colour model is used for the colour detection. Figure 5 shows the RGB based colour identification using OpenCV.

IV.RESULT AND DISCUSSION

The simulation results of colour and shape detection using OpenCV environment coded with python presented in Figure. Shape detection of regular geometric shapes upto 5 vertices like circle, square, rectangle, pentagon were executed using contour approximation algorithm based on edge detection technology which results in good accuracy. Figure 6, shows the sample results of colour detection. Figure 7, depicts the sample simulation results of shape detection.

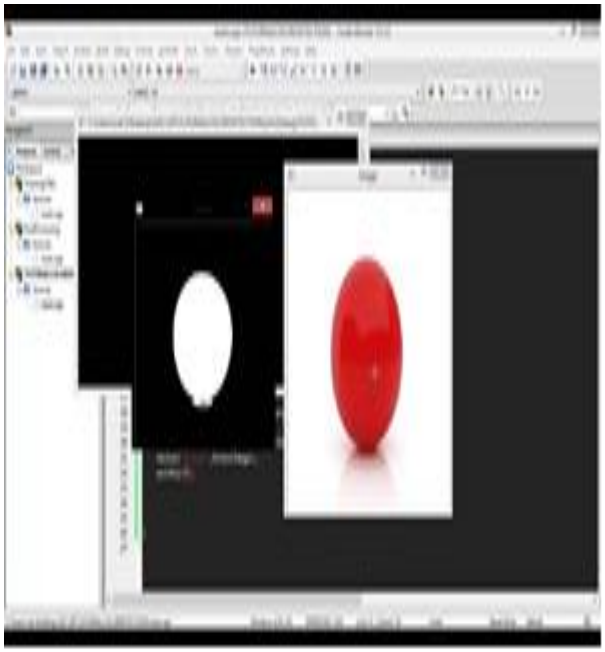

Fig 6. Sample results of colour detection.

Figure 8 shows the Robotic arm used to pick and place the samples in textile Industries.

Fig 7. Sample result of shape detection.

The project also proposed an aluminium extruded conveyor belt along with articulated pick and place robotic arm to facilitate complete automation in textile industry. Conveyor belt are basically wide belt with two or more turning rotor run with the help of DC motors. Input samples of different shapes and colour will be place in conveyor. Samples in conveyor belt are picked using pick and place robotic arm. In pick and place robotic arm, the movement of wheels with the help of DC motors. Pick and place with the help of Servo motor. Signals are controlled using Atmega328 microcontroller. An aluminium extruder conveyor belt and articulated robotic arms are designed and constructed with special features including low investment and to reduce human errors.

Fig 8. Robotic Arm

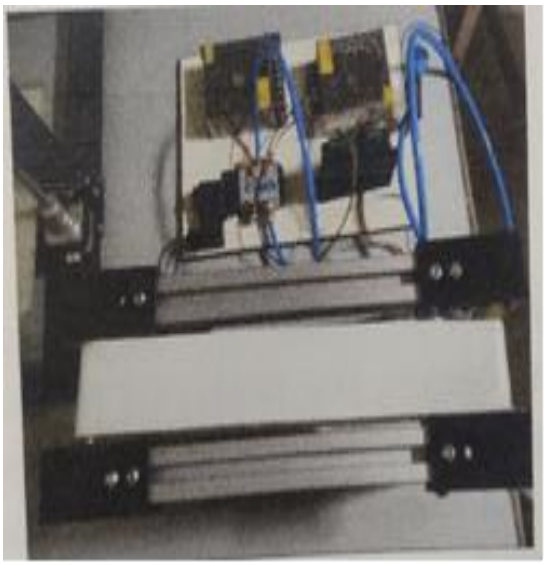

Fig 9. Conveyor Belt

Figure 9, shows Robotic arm with Vacuum ejector for pick and place samples in Textile Industries and Aluminium extruded Conveyor Belt for carrying samples with forward and reverse movement.

V.CONCLUSION

In this proposed system implementation of shape and colour identification is executed using OpenCV software along with pick and place robotic arm to facilitate automation in textile industry. The system has an advantage of accuracy, time consumption, low cost and overcome the human error. As this system replaces PLC based textile automation with raspberry Pi it has overcome technical problems. This project helps to automate large scale production in a textile industry with less investment and it also minimize the work load of a human being and human errors happening in industries. The future work of this project aims to recognize irregular shape apart from regular geometric shapes. The work also target to identify the defects in given textile samples to increase quality of the product.

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