

# Nut Bolt Sorting Using Image Processing by Robotic ARM

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## ABSTRACT

The main intention of this project is to elaborate and simplify how different products manufactured in a factory can be put on a single conveyer for its proper distribution and data logging in a random sequence. To upgrade this process, images captured by the webcam can be processed with image processing techniques using software like MATLAB. This image processing technique and color detection techniques are applied for the taken image and the appropriate output is obtained in this project.

The goal is to develop a conveyor belt which will play a vital role in small scale as well as large scale industries for and logging the data, consequently reducing the cost of labor and multiple conveyors. The system leverages a conveyor belt with 2 motors, a mechanism to sort the products and a Webcam in proximity of the apparatus. The webcam is mounted in parallel to the assembly line focused on the products on the conveyors in order to have known the product and its sequence. The apparatus sends image processed readings and measurements over wires to a microcontroller for further processing. Code running on the microcontroller in conjunction with a code in MATLAB generates an output on the appropriate pins configured by user by a program, which controls the speed and direction of the conveyor belt. This quality in MATLAB image processing toolbox and Arduino has made it possible. This research thus implements an industrial assembly line with methodology in image processing.

**Keywords:** Sorting Mechanism, Conveyor Belt, Image Acquisition, Camera, MATLAB, Microcontroller

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## I. INTRODUCTION

Nowadays various automation techniques are being adopted & researched on for increase in productivity, for better accuracy, eliminating the human errors and for safety. Normally, sorting of the objects is done by manually. It consists of 4 integrated stations called distribution, testing, processing and handling. Old sorting method uses a set of inductive, capacitive and optical sensors do differentiate object color in the testing station. Handling is done by using a programmed manipulator. No vision capability exists in the system to improve its performance and flexibility. In this case, there is a possibility of minor error which will affect the accuracy in sorting. Also for huge systems, time and manpower required will very high. Automated systems can

be used to remove such human errors and also it saves time and money.

Elementary conveyor belts were used since the 19th century. In 1892, Thomas Robins began a series of inventions relating to conveyor systems, which led to the development of a conveyor belt used for carrying coal, ores and other products. Recently conveyor belt systems are not only used in mining industries but also applied in cement industries, food factories, power plant, and production industries etc. So it is essential equipment for in house material transportation today.

A conveyor Belt is ultimate and widely used option in most of the manufacturing industrial applications where ever there is need for complete assembly line automation like chemical industries, bottling plant, food

processing and packaging factories. The entire process from production to sort products for packaging is carried on a single conveyor belt and the processes are done in between, while they are moving. So here, one such conveyor belt application is explained. Determining real time and highly accurate characteristics of small objects in a fast flowing stream would open new directions for industrial sorting processes.

This is the project to build a single conveyor belt for multiple objects in a random sequence, for its proper distribution and data logging. In this project 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 MATLAB on the basis of physical and color characterization of each object. The project involves color identification of an object which is done by a webcam capture the image and sends the signal to the ATMEGA microcontroller. The microcontroller in response to the received signal; generates an appropriate control signal which is send to the circuit which drives the various motors and it also synchronizes the movement of the belt with the sorting mechanism. Based upon the image detected, the linear actuator pushes the object to the specified location.

It aims in classifying and sorting the captured objects which are coming on conveyor belt by placing them in their respective pre-programmed place. The GUI based system helps to control and monitor the whole conveyor belt. With this it is possible to calculate the number of items with their respective length and weights which will make packaging much easier and controllable. Due to this only one conveyor is sufficient instead of many, Thereby achieving high accuracy and speed in the work; while eliminating the monotonous work done by human.

## II. PROBLEM STATEMENT

The main intention of this project is to elaborate and simplify how different products manufactured in a factory can be put on a single conveyer for its proper distribution. earlier we have used a robotic arm for object sorting, but there are certain limitations of robotic arm such as, first parameter is time constraint, robotic arm takes more time to move from one position to other position as robotic arm works on pick and place methodology. While picking up the object and placing it to desired location takes a more time. so sorting will take a more time, and other parameter is cost, the cost of production of project using robotic arm is more as compared to robotic arm sorting of object using conveyer belt is more cost effective.

The idea was introduced to reduce the human efforts and the time required for the sorting. But the first implemented sorting mechanism 'the robotic arm' was just another whole machine designed to a single objective i.e. sorting and reduced human efforts.

## III. LITERATURE SURVEY

[1] An integral automation of industrial fruit and vegetable sorting by machine vision By F Pla, JM Sanchiz, JS Sanchez - Proc. 8th IEEE International Conference on Emerging, 2001 Working of our system is very simple. Initially when product is on the conveyor belt, Sensor will detect the presence of the particular product & give signal to the microcontroller. Then microcontroller will send this signal to the computer by serial interfacing. Image processing software (Matlab) of the system will send the signal to the camera for capturing the image. Once image is captured, the software will process on the captured image and will generate signals according to requirement and which in turn the signals will be send back to microcontroller. Accordingly the microcontroller will control the conveyer belt & robotic arm. Robotic arm will pick & place the given component according to the color. If color is not matched with a given requirement, the product will be rejected. This cycle will be repeated number of times as per requirement.

[2] Vishnu has explained a fully functional sorter machine can be implemented by using a structure of parallel and independent channels in order to increase the overall throughput which results with a forecasted performance. The project can work successfully and separates different objects using sensors. The sensor handling systems which drive the pick and place robot to pick up the object and place it into its designated place can work if accurately designed. There are two main steps in sensing part, objects detection and recognition. The system can successfully perform handling station task, namely pick and place mechanism with help of sensor. Thus a cost effective mechatronics system can be designed using the simplest concepts and efficient result can be observed In this paper, An object sorting system for domestic/industrial control has developed using the concepts of Image Processing, Robotics Mechanism and parallel communication without help of DSP processor. The model developed is user friendly. Hence for fast manipulation the algorithm implemented in the MATLAB is suitable for our sorting problem. Result of sorting the object may not work for 100 percent but it is working for nearly 90 to 94% in case of our algorithm. It can be improved by increasing the accuracy and it depends on atmospheric factors.

[3] Prof. D. B. Rane<sup>1</sup>, Gunjal Sagar S.<sup>2</sup>, Nikam Devendra V.<sup>3</sup>, Shaikh Jameer [3] In this paper, the sorting machine sorts the objects depending upon the colors of the objects successfully with the help of the rob arm and MATLAB program in image processing. The USB webcam serves as an eye of the system which captures the real time image of the objects. The robo arm picks the faulty quality object and places it at predefined place, while good quality object continues its motion on conveyor belt and finally drops into object carrier system. In this LCD displays the object count with the status about the quality of the object. The servomotors used in the robot arm plays the vital role as control movement of the rob arm wholly depends control signal given to servo motor. Hence to operate the system accurately the synchronization between IR sensors, dc

motors of the conveyor belt and robo arm is very essential. In today's era, small scale and large scale industries faces common hindrance like shortage of time and workers which leads to inefficient manufacture. A proper result for the above problem can be achieved using robotics. Furthermore, for meticulous result, image processing methods can be beneficial. This paper broach one of the applications to sort objects using robotic arm. This method of sorting is quick and doesn't require continuous surveillance, thereby increasing the growth of the industry. Hence it leads to better production and income. In this paper, computer vision is carried out with assistance of Open CV and the robotic arm, which is motored by microcontroller. Different algorithms build in microcontroller, enables the robotic arm to either sort the objects based on fault like missing drill holes, improper shape or some other faults. Key Words: Binary Segmentation, MATLAB, Robotic Arm.

[4] The 8051 Microcontroller Architecture, Programming, & Applications. By Kenneth J. Ayala . This research showed that even four key features are sufficient to classify an Orange fruit. As it is observed that Blue color is least significant hence can be neglected for classification & maturity prediction; further reduces the key features required for prediction to three. Out of various techniques used Linear Regression proved to give hest results and this technique can be further explored to predict the life span of the fruit Edited Multi-Seed Nearest Neighbour technique designed is more or less equal effective like that of Nearest Neighbour Edited Multi-Seed technique devised can be more effective if used with me than two seed points Oranges doesn't ripe in uniform manner hence the image of other surface is need for proper prediction. All the misclassifications while texting are found to fall in this category. Hence future scope lies in using two images of opposite surfaces rather than using single colour image of a fruit (lemon sorting & cranberry sorting Damaged Orange fruit detection is one big challenge which not handled in this research. It was observed that damages like Bruises, Rugs, Fungal Infections, Hail Stone marks, etc. produce marks on the skin; hence these can be also detected applying same advance algorithm.

A. Development of an autonomous ball picking robot. This paper is about the design and development of an autonomous ball picking robot. It aimed to improve the capabilities of a pre-existing 6-Axis robot. Image processing was done using two cameras and an external computer. One camera finds the location and also determines the colour, while, the other camera is used for feedback control of the robotic arm. This paper shows how outside sensors and processing can control a robotic arm to sort objects by colour. This paper's major drawback was that it proposed a system which could only differentiate based on colour.

B. Real time colour-based sorting robotic arm system. In this paper, a robotic sorting arm system was presented which could sort objects based on its colour. In this robotic system, a camera captures image frames of the object and image processing is done using Opens to recognize the colour of the object. The position of the object is calculated by its mass centre in image. Using Inverse Kinematics algorithms, the control input for the robotic arm is calculated and then sent to an Adriano microcontroller. The

microcontroller drives the motors on the robotic arm to sort and position the objects according to their colour. The major drawback of this project was that it could only sort objects based on colour.

C. Object sorting robotic arm based on colour sensing In this paper too, a system was proposed to sort objects based on their colour. A robotic arm is used to pick and sort the objects. This is controlled by an ARM 7 based system. A light to frequency converter is used to sense and differentiate objects based on their colour. three different colours could be separated, red, green and blue. The major drawback of this paper was that the proposed system didn't differentiate based on the shape of the object.

#### IV. PROPOSED SYSTEM

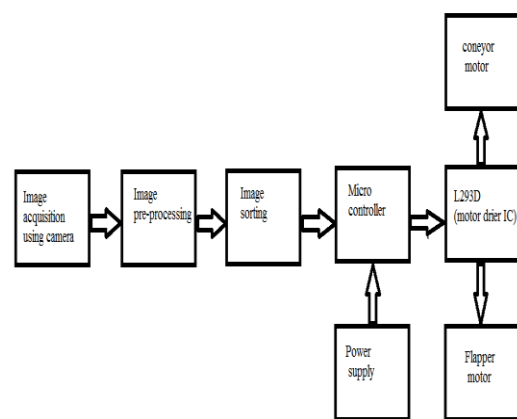


Fig 4.1. Block Diagram

#### BLOCK DIAGRAM DESCRIPTION:

##### 4.1 IMAGE ACQUISITION:

To start with when the object on the conveyor is detected by the camera, image is captured by the camera and is sent to the MATLAB workspace. The input image obtained from the webcam cannot be directly given for processing. Pre-processing is done on the image such as thresholding. Then only object image is converted in binary format. This final threshold image of object is now ready for processing.

Image Acquisition in Digital Image Processing. Digital Image Processing. In image processing, it is defined as the action of retrieving an image from some source, usually a hardware-based source for processing. It is the first step in the workflow sequence because, without an image, no processing is possible.

##### 4.2 CAMERA:

The camera used in this case will be overhead camera, it will take the snapshot of the object. The image captured by the camera will be processed by image processing using mat lab.

#### 4.3 IMAGE PROCESSING:

The objects are sorted on the basis of length and width. To identify the parameter, firstly the image is converted into grey format and then thresholding is done. After thresholding the image is converted into black and white format which is called as binary format. Find region properties & bounding box and the size of Nut or Bolt are identified.

In image processing, it is defined as the action of retrieving an image from some source, usually a hardware-based source for processing. It is the first step in the workflow sequence because, without an image, no processing is possible. The image that is acquired is completely unprocessed.

#### 4.4 SORTING MECHANISM:

The sorting mechanism consists of a linear actuator, servo motors and a conveyor assembly. After identifying the predetermined size, command will be sent to direct the linear actuator through COM port of the computer via the development board. Conveyor assembly is in OFF state for this period. According to the size the servo motors with help of linear actuator places the objects in their specified place.

#### 4.5 MATLAB:

It is a high-performance language for technical computing. It integrates computation, visualization, and programming environment. Furthermore, MATLAB is a modern programming language environment: it has sophisticated data structures, contains built-in editing and debugging tools, and supports object-oriented programming.

#### 4.6 MICROCONTROLLER:

The ATmega328 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the Atmega 328 achieves throughputs approaching 1 MIPS per MHz allowing the system designer to optimize power consumption versus processing speed.

#### 4.7 CONVEYOR BELT:

The conveyor motor receives power and signal from the central supply through rectifier and control circuit. The control circuit consisting of a potentiometer will allow the user to manually control the speed of conveyor belt by the regulatory knob. Polyester is used as a belt material. A conveyor belt consists of two or more pulleys, with a continuous loop of material - the conveyor belt - that rotates about them.

As shown in our block diagram our system proposes an image vision system for sorting Nuts and Bolts from conveyor line. Here we use hi speed cameras which captures continuous images of Nuts and Bolts and this images are been processed using matlab real time. As soon as the bolt is detected the controlling signals are send from Pc to controller to control the flapper in two different direction using predefined angle of rotation.

## V. HARDWARE IMPLEMENTATION

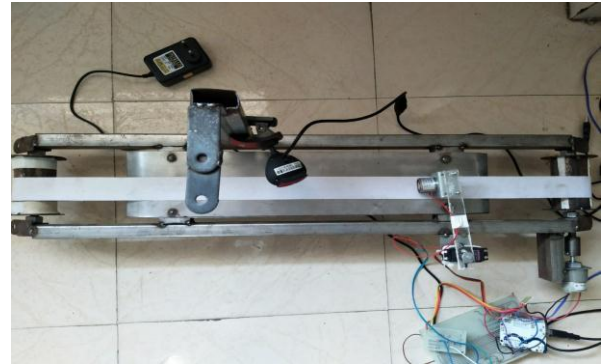


Fig 5.1 Robotic ARM

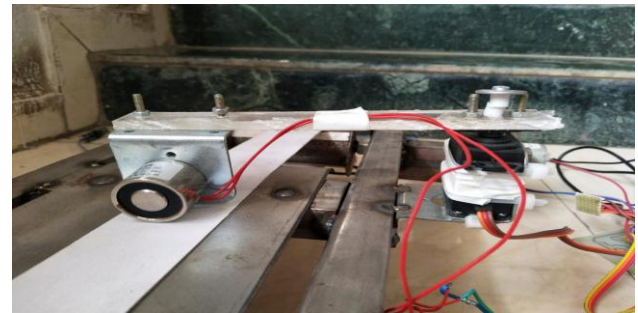


Fig 5.2 Conveyor Belt

## IV. CONCLUSION

The Code is generated using MATLAB image processing in conjunction with Arduino. The whole process is documented in the theory sections. There are no more limits but your imagination. One can begin to explore the more advanced functionality that the MATLAB-Arduino platform offers to understand as one progress further and further.

It was a valuable experience in making the project design, implementation, and testing of a system that involved digital components. More time was available for the circuit design and implementation, which was able to go through several designs before an acceptable one was reached. Ultimately the system accomplished its primary goal of motor speed control in a clear way.

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