INDUSTRIAL AUTOMATION USING IOT WITH IMAGE PROCESSING

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Abstract:

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. 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.

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 colour identification of an object which is done by a webcam acting as colour sensor which identifies the object's colour 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 color detected, the linear actuator pushes the object to the specified location. It aims in classifying and sorting the colored 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 colors and predefined 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.

Methodology

Block Diagram

![Block Diagram](image)

**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.

**Camera**

The camera used in this case will be overhead camera, it will take the snapshot of the object for colour sensing purpose. The image captured by the camera will be processed by image processing using MATLAB.
IMAGE PROCESSING

The objects are sorted on the basis of color and predetermined shape. To identify the color, firstly the image is converted into gray format and then thresholding is done. After thresholding color components are extracted and the image is converted into black and white format which is called as binary format. Find region properties & bounding box and the color are identified.

SORTING MECHANISM

The sorting mechanism consists of a linear actuator, servo motors and a conveyor assembly. After identifying the colour with 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 and colour the servo motors with help of linear actuator places the objects in their specified place.

MATLAB

MATLAB 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.

3.3.6 Microcontroller

The 8051 is a low-power CMOS 8-bit microcontroller based on the enhanced RISC architecture. By executing powerful instructions in a single clock cycle, micro controller achieves throughputs approaching 1 MIPS per MHz allowing the system designed to optimize power consumption versus processing speed.

3.3.7 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 a hi-tech vision system for sorting bottles without cap or labels from conveyor line. Here we use hi speed cameras which captures continuous images of bottles and this images are been processed using matlab real time. As soon as the bottle without cap or label is detected the controlling signals are sent from Pc to controller to control the flapper in two different direction using predefined angle of rotation.

Hardware Implementation

Circuit Diagram:

![Figure: Power supply (on-board)](image)

The Atmega 16 can be powered via the USB connection or with an external power supply. The power source is selected automatically.

External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm
center-positive plug into the board's power jack. Leads from a battery can be inserted in the Gnd and Vin pin headers of the POWER connector. The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board.

**Testing & trouble shooting**

**Results**

The conveyor system designed will only be efficient when it achieves higher degree of accuracy and its output is very close to the expected result. The initialization delay of the microcontroller in the beginning is expected and can be tolerated up to 4 seconds. The Conveyor system is designed in an efficient way and expecting to work normally with provided power supply. The Matlab code has the option to modify the industrial and product parameters and can be recalibrated.

Fig: results using matlab

First we recognize the object through webcam, then we convert that object or that taken picture into grayscale image, and that grayscale image is represented in fig.6.3.1. For filtering purpose we are using the median filter, after converting the captured image into the gray scale image we are filtering that image through median filter for removal of noise present in the captured image. Fig: shows the filtered image of gray scale image. After filtering the gray scale image, we are converting filtered image into the binary image for the red object recognition. In binary image it only recognize the edges of the red object. fig: shows the binary image of object captured.
After filtering, converting the image into binary image we got the original filtered image with noise removal using median filter. The detected image is as shown in fig.7.3.4. in this image we are detecting the boundary region of the object. If the object having x axes greater than 20 and y axes is greater than 30 then the object showing to camera is recognizing it as object to be captured.

Conclusion

The Code is generated using MATLAB image processing in conjunction with Atmel. The whole process is documented in the theory sections. One can begin to explore the more advanced functionality that the MATLAB-Atmel 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.

Future Applications

- Conveyor belts are designed for a systematic organization of workers, machines, and products. Mass production & distribution via conveyor belts is widely considered to be the reason which is responsible for the modern consumer culture leading to low unit cost for manufactured goods.
  - The conveyor belt designed today can be upgraded to automatically sort more number of products on a single conveyor belt and delivered at convenient distances with faster speeds. More precisely coded algorithm will be developed using image processing techniques and optimally planned logistics for creating a finished product much faster than with present methods.
  - The constant research & development has enabled to improve other aspects of industry, so that the motion of the workers will be minimized to the extent possible in the future. Instead of manual trucking all parts or assemblies will be handled by motorized vehicles such as fork lifts. Heavy lifting will be done by machines such as overhead cranes or lifts. Every worker typically performs one simple operation. The future of conveyor belt will be large-scale development, expand the scope of use, automatic sorting, reduce energy consumption, and reduce pollution.
    - Systematic organization.
    - Mass production and distribution.
    - faster speed.
    - large-scale development.
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