ISSN2394-3777 (Print)
ISSN2394-3785 (Online)
Available online atwww.ijartet.com

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 5, Special Issue 11, April 2018

AUTOMATIC VISION SYSTEM OF A BEAD CHECKER MACHINE IMPLEMENTED USING PLC

Ashika Chockalingam
Department of Electronics and communication Engineering
Sri Venkateswara College of Engineering
Sriperumbudur, Tamil Nadu
ashika07chockalingam@gmail.com

Mrs. M.Anushya
Asst. professor
Department of Electronics and Communication Engineering
Sri Venkateswara College of Engineering
Sriperumbudur, Tamil Nadu
manushya@svce.ac.in

Indhuja Vinayagam
Department of Electronics and communication Engineering
Sri Venkateswara College of Engineering
Sriperumbudur, Tamil Nadu
indhuja.vinayagam115@gmail.com

Abstract— In this present era industries are rapidly adopting automation. Automation plays a major role in the development of innovative techniques that enhances the efficiency and production in industries. Industry 4.0 is a name for the current trend of automation and data exchange in manufacturing technologies. Automation of stupendous machineries are controlled by Programmable Logic Controllers (PLC). This project aims in delivering Machine Vision System (MVS), which acts as an eye to the machine, controlled using Siemens PLC which has been programmed in GX Developer. Omron ZFV vision sensor is interfaced with a controller that tells whether the object under test is error free by comparing it with a master image. The controller has in-built image processing comparison feature where images are compared in terms of electrical signal. This project is proposed as a bead checker machine where the welded part (Gear and Clutch) is captured as a 2D image and tested for hundred percent quality in no time. Object to be inspected is placed on the conveyor which is designed using SolidWorks 2015. A photo sensor notifies PLC when object arrives in front of the MVS. Then the image is captured and compared with the master image to verify the quality. If the controller says "OK" the job is passed else if it says "NOT GOOD (NG)" a pneumatic cylinder takes it to rectification stage. Finally, all the datum is stored in a server, which progenerates smart factory. This project has also been implemented using Matlab and Arduino.

Keywords—Automation; Accuracy; Inspection ; Vision system; Matlab

I. INTRODUCTION

In this present era Industries are rapidly adopting Automation. Automation plays a major role in the development of innovative techniques that enhances the efficiency and production in industries. Now a days Automobile Industries use automation to manufacture their products. Though Automobiles are mechanically driven, here electronics plays a vital role. Thus, automation gears up the present industrial technology world.

Automation can be defined as the technology by which a process or procedure is performed without human assistance. It has increased throughput or productivity and gives improved quality or increased predictability of quality. Thus provide improved robustness of processes or product. Automation also Increases consistency of output and Reduces direct human labor costs and errors.

- The advantages are the following methods that often employed to improve productivity, quality, or robustness.
- Install automation in operations to reduce cycle time.

ISSN2394-3777 (Print)
ISSN2394-3785 (Online)
Available online atwww.ijartet.com

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 5, Special Issue 11, April 2018

- Install automation where a high degree of quality is required.
- Replacing human operators in tasks that involve hard physical or monotonous work.
- Replacing humans in tasks done in dangerous environments such as fire, space, volcanoes, nuclear facilities, underwater.
- Performing tasks that are beyond human capabilities of size, weight, speed, endurance, etc.
- Reduces operation time and work handling time significantly.
- Frees up workers to take on other roles.
- Provides higher level jobs in the development, deployment, maintenance and running of the automated processes.

Automation is a great gift for the present fast growing technological world. It do shows some pitfalls as it may have a limited level of intelligence, and is therefore more susceptible to committing errors outside of its immediate scope of knowledge like, it is typically unable to apply the rules of simple logic to general propositions. The research and development cost of automating a process may exceed the cost saved by the automation itself. The automation of a new product or plant typically requires a very large initial investment in comparison with the unit cost of the product, although the cost of automation may be spread among many products and over time.

This paper talks on the increased accuracy which is beyond the actual outcome, where it is accomplished through Automation inspection. Automation inspection is a process to test the product completely. It can simulate tens, hundreds or thousands of virtual number of testing. This Testing Improves Accuracy and Saves Time and Money. The machine vision system is an application of such automatic inspection.

The objective of the project is that by using a vision system and capturing the objects in real time which is compared with the preloaded perfect image. The comparison process is done by matlab through image processing. Every parameter of the image is checked for perfect match thus to acquire higher degree of accuracy. Thus products with even small deviation is recognized to provide the best of accuracy.

II. BACKGROUND STUDY

A. *Existing system*

In automobile industry the mechanical defects are due to the faults in the manufacturing of products. Considering the gear parts for example, it has to be checked for proper welding and if we consider the accuracy rate in checking the welded parts in the gear is very less near perfection. All these years the welding done in gear are been tested using Linear variable differential transformer (LVDT).

B. *LVDT*

An LVDT (linear variable differential transformer) is an electromechanical sensor used to convert mechanical motion or vibrations, specifically rectilinear motion, into a variable electrical current, voltage or electric signals, and the reverse. Actuating mechanisms used primarily for automatic control systems or as mechanical motion sensors in measurement technologies.

Linear transducer provides voltage output quantity, related to the parameters being measured, for example, force, for simple signal conditioning. LVDT Sensor devices are sensitive to electromagnetic interference. Reduction of electrical resistance can be improved with shorter connection cables to eliminate significant errors.

Physically, the LVDT construction is a hollow metallic cylinder in which a shaft of smaller diameter moves freely back and forth along the cylinder's long axis. The shaft, or pushrod, ends in a magnetically conductive core which must be within the cylinder, or coil assembly, when the device is operating.

A typical LVDT sensor has three solenoid coils lined end-to-end, surrounding the tube. Primary coil is in the center and secondary coils are top and bottom. The object of position measurement is attached to the cylindrical ferromatic core, and slides along the axis of the tube. Alternating current drives the primary coil causing voltage induced in the two secondary coils proportionate to the length of the linking core. Range of frequency is usually from 1 to 10 kHz.

Movement of the core triggers the linkage from primary to both the secondary coils, which changes the induced voltages. Top and bottom secondary output voltage differential is the movement from calibrated zero phase. Using a synchronous detector reads a signed output voltage that relates to the displacement. LVDT linear transducers can be up to several inches long, working as an absolute position sensor which is repeatable and reproducible. Other actions or movements will not alter measurement accuracy. The LVDT is also highly

ISSN2394-3777 (Print)
ISSN2394-3785 (Online)
Available online atwww.ijartet.com

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 5, Special Issue 11, April 2018

reliable because the sliding core does not touch the inside of the tube, and allows the sensor to be in a completely sealed environment.

The LVDT is an ac device which means there is a need for electronics to translate its output into a useful dc signal. There are two hybrid modules that are the foundation for LVDT Signal Processing; an Oscillator and a Demodulator.

The Oscillator is designed to provide a stable sine wave for driving the transducer, and a square wave reference for the Demodulator. The Demodulator is designed to amplify the output from the transducer, and convert it into a highly accurate dc voltage which is directly proportional to displacement.

To operate the linear transducer, it is necessary to drive the primary with a sine wave and the output from the secondaries consist of a sine wave with the position information contained in the amplitude and phase. The output at the centre of the stroke is zero, rising to maximum amplitude at either end of the stroke. The output is in phase with the primary drive at one end of the stroke and out of phase at the other end.

In a high quality linear displacement transducer, the relationship between position and phase/amplitude is linear. The Oscillator and Demodulator are what makes the transition between position and phase/amplitude easy.

In common practice, the pushrod is physically attached to the moveable object whose position is to be determined (the measurand), while the coil assembly is attached to a fixed reference point. Movement of the measured moves the core within the coil assembly; this motion is measured electrically.

III. PROBLEM STATEMENT

Accuracy in LVDT is very low since only few points can be checked; it cannot be assured that job is completely error free. Hundred percent qualities cannot be achieved.

Thus this LVDT usage does not provide the accuracy rate that is required while testing the welded objects on the moving conveyor

IV. COMPONENTS

A. PLC

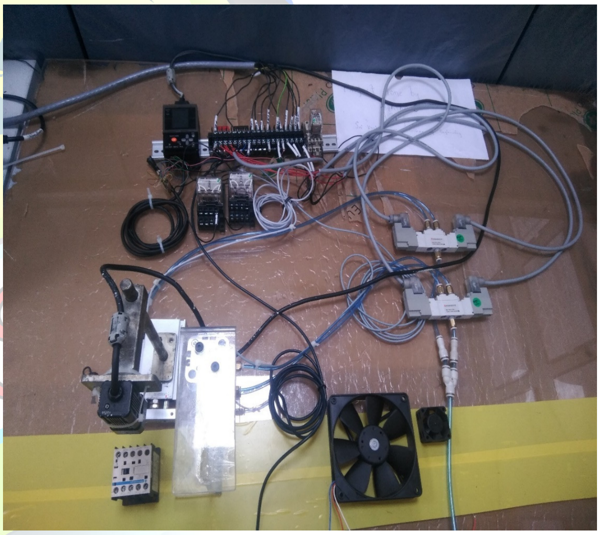
A programmable logic controller (PLC), or programmable controller is an industrial digital computer which has been ruggedized and adapted for the control of manufacturing processes, such as assembly lines, or robotic devices, or any activity that requires high reliability control and ease of programming and process fault diagnosis.

B. CONVEYOR

A conveyor system is a common piece of mechanical handling equipment that moves materials from one location to another. Conveyors are especially useful in applications involving the transportation of heavy or bulky materials.

C. PNEUMATIC SYSTEM

Pneumatic cylinder(s) also known as air cylinders are mechanical devices which use the power of compressed gas to produce a force in a reciprocating linear motion.



V. METHODOLOGY

A. Working process

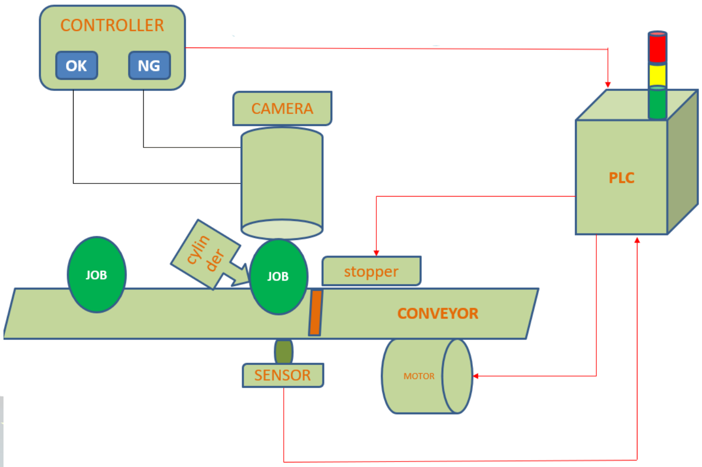
There will be number of jobs (in our case “welded gear and clutch”) running on a conveyor, whenever the sensor senses the job, conveyor stops and stopper holds the job via pneumatic mechanism. Pneumatic system consists of a compressor that is given to the direction driver that moves the stopper up and down. For the hands of a stopper we have used acrylic.

ISSN2394-3777 (Print)
ISSN2394-3785 (Online)
Available online atwww.ijartet.com

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 5, Special Issue 11, April 2018

PLC triggers the camera to capture the job underneath and sends the captured image to the controller. Controller will compare the current job under test and master job (already taught to the system). This control processes has been already programmed in the controller. Camera controller sends a feedback to PLC saying whether the job under test is OK or NOT GOOD (NG). If the feedback is OK, PLC turns ON the conveyor and the process continues. If in the case of NG , pneumatic cylinder pushes the job outside the conveyor

The set up for the automatic vision system is as the below figure



.

1) Sensor:

A photoelectric sensor, or photo eye, is equipment used to discover the distance, absence, or presence of an object by using a light transmitter, often infrared, and a photoelectric receiver

2) Camera:

Vision systems are primary consideration for any manufacturer who is looking to improve quality or automate production.

Vision systems can be thought of as computers with eyes that can identify, inspect and communicate critical information to eliminate costly errors, improve productivity and enhance customer satisfaction through the consistent delivery of quality products.

A machine vision system (MVS) is a type of technology that enables a computing device to inspect, evaluate and identify still or moving images.

It is a field in computer vision and is quite similar to surveillance cameras, but provides automatic image capturing, evaluation and processing capabilities.

VI. Result

The PLC program gives the ultimate solution for achieving high accuracy.

The image after all the processing is OK. OK means the accuracy rate is high enough for a defect free component.

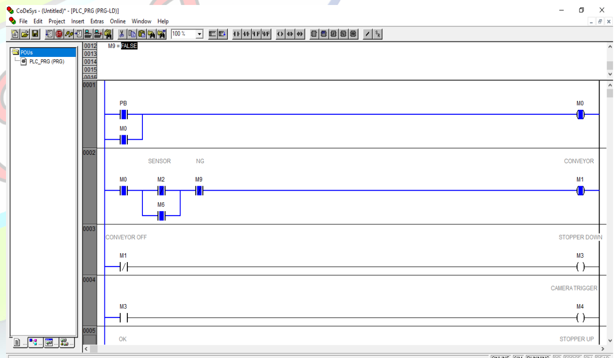


Fig.1. OK image

The image if the accuracy rate after processing is Not Good (NG).

ISSN2394-3777 (Print)
ISSN2394-3785 (Online)
Available online atwww.ijartet.com

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 5, Special Issue 11, April 2018

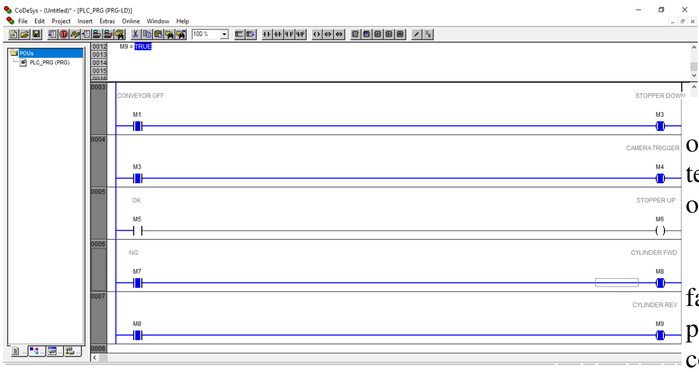


Fig. 2. NG image.

.

VII. CONCLLUSION AND FUTURE SCOPE

This project delivers intelligent machine vision solutions custom designed to optimize and automate quality control. Utilizing smart cameras and image capture technology, we build complete automation systems that perform label inspection, early defect detection, assembly verification, as well as many other quality assurance operations, and seamlessly integrate them into your existing manufacturing lines. The goal to improve your products and provide you with greater efficiency and manufacturing consistency is been achieved.

With experience in many industries, including medical device manufacturing, packaging, automotive, and plastics, we engineers have found the best combination of cameras, light sources, part handling equipment, and software to meet the needs of your application and its manufacturing environment. We have particular expertise building inspection systems that handle high volumes of discrete components, and we deliver all vision components, machine controls, HMIs, and part handling equipment as a single system. The project is also capable of retrofitting and upgrading existing systems.

Within 20 years, computer vision will be a commodity component within the fabric of the worldwide analytics infrastructure, similar to the telecommunications infrastructure of today, containing distributed analytics and databases services. Application-specific analytics and intelligence will be added to all devices by default within the Internet of All Things (IoAT)

Industry 4.0 is a name for the current trend of automation and data exchange in manufacturing technologies. It includes cyber-physical systems, the Internet of things, cloud computing and cognitive computing.

Industry 4.0 creates what has been called a "smart factory". Within the modular structured smart factories, cyber-physical systems monitor physical processes, create a virtual copy of the physical world and make decentralized decisions.

Over the Internet of Things, cyber-physical systems communicate and cooperate with each other and with humans in real time, and via cloud computing, and the value chain both internal and cross-organizational services are offered and used by participants.

Acknowledgment

The Authors would like to thank the Educational Iinstitute "Sri Venkateswara college of Engineering" for their support.

We are also really grateful to "Hyundai Motor India limited" for providing their samples for testing purpose and the Employee of the company for the information that they have provided about the vision system and its processes.

References

[1] Edward W. Kamen Industrial Controls and Manufacturing, (Academic Press, 1999) ISBN 0123948509, Chapter 8 Ladder Logic Diagrams and PLC Implementations

[2] Heeresh Mistry, Fundamentals of Pneumatic Engineering, Create Space e-Publication, 2013, ISBN 1-49-372758-3

[3] Maher, Michael J. Real-Time Control and Communications. 18th Annual ESD/SMI International Programmable Controllers Conference Proceedings

[4] Petruzella,, Frank D. (2005). "Programmable logic controllers". Tata McGraw-Hill Education

[5] Yotter, R.A.; Wilson, D.M. (June 2003). "A review of photodetectors for sensing light-emitting reporters in biological systems". IEEE Sensors Journal. 3 (3): 288–303. .

.

