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Cognex Vision System to Reduce the Rework and Process Cost for Raw Material Inspection

Dixit Patel[1], Kishan Gutta[2]

PG Student [Control], Dept. of Electrical Engineering, University of Bridgeport, CT, USA[1]

PG Student [Control], Dept. of Electrical Engineering, University of Bridgeport, CT, USA[2]

ABSTRACT: Rework and scraps are the major industrial problems in the United States. Due to high ratio of rework and scrap in any industrial sector which are involved in manufacturing processes and assemblinghas always deals with the losses in terms of money and time. The Shock & Struts manufacturing involves the use of around 100 machineries. If the raw materials used are not properly inspected before sending it to the manufacturing phase, the end product or final product will definitely have low quality problems. As a result of which probably the final product is dumped or if possible send for rework.This is a huge loss for the company, labor goes double, huge electricity usage goes in waste, material wasted and time consumed to manufacture that part goes in vain. This paper discuss about the raw material inspection method at different levels of manufacturing processes. This paper also provide the idea to illuminates this menace by using the Cognex Vision Camera which can be easily to be used in any industry.

KEYWORDS: Cognex Vision, PLC, Quality Control, Quality Inspection, Raw Material Inspection.

I.INTRODUCTION

Traditionally there is no specific method to inspect the raw materials in any industry when it arrives from the venders. Any defects or problems in the product are always identified when product reaches in its final stage of manufacturing. Even the identifications of these problems and defects in the final products are analysed by old methods. No new method is adopted yet to remove this menace which results in the creation of scrap materials, and it directly become great losses for any company[1].Rework and scraps are the major industrial problems in United States. Due to high ratio of rework and scrap in any industrial sector which are involved in manufacturing processes and assembling has always deals with the losses in terms of money and time, for example considering Toyota Car Industry[2].

Before the era of technology, the inspection of material was done by traditional method, i.e. by using naked eye[3]. This old method old product inspection and quality control is still being followed by the big companies in United States as result of which they face losses and ultimately companies shut down[4][5]. As the technology is very advance now days, the raw materials inspection should be done before sending it for further process using the highly advanced vision system which are currently being used in different sectors for several purposes.

In the fig. 1,it shows the chart of increase in losses due to defect in raw material in year 2009 and 2010. It is also observed that in many industries, the decision for material inspection has been left to human labor, which we believed to be bad practice[6]. The material inspection or the quality control is very critical and the decision to inspect material or product before any processing by many concern should be made by the top management cadre of the company in order to enhance the quality of the product[7].

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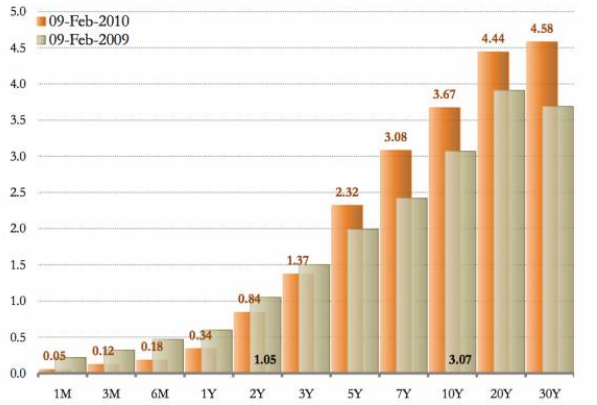

Figure 1 Losses Chart

In this paper, we will represent our research work by which manufacturing industries can eliminate the raw material inspection or quality control from their process cycle. In SectionII, vision system evolution is explained. Section IIIcontinues addressing the cognex vision system. The hardware setup is stated in SectionIV. The software result is described in SectionV. Lastly, in Section VI the main ideas of this survey are summarised.

II.EVOLUTION OF MACHINE VISION SYSTEM

In today's vigorously developing machine vision industry, there are number of standard systemare available for quality inspection and control. Machine vision being an engineering discipline, is interested in digital input/output devices and computer networks to control other manufacturing equipment such as robotic arms and equipment to eject defective products[8][9]. Machine Vision is a subfield of engineering that is related to computer science, optics, mechanical engineering, and industrial automation. One of the most common applications of Machine Vision is the inspection of manufactured goods such as semiconductor chips, automobiles, food and pharmaceuticals. Just as human inspectors working on assembly lines visually inspect parts to judge the quality of workmanship, so machine vision systems use digital cameras, smart cameras and image processing software to perform similar inspections

Vision Camera do not see in the same way that human beings are able to see with naked eyes. Cameras are not equivalent to human optics. While people can rely on inference systems and assumptions, computing devices must 'see' by examining individual pixels of images, processing them and attempting to develop conclusions with the assistance of knowledge bases and features such as pattern recognition engines[10]. Although some machine vision algorithms have been developed to mimic human visual perception, a number of unique processing methods have been developed to process images and identify relevant image features in an effective and consistent manner. Machine vision systems are capable of processing images consistently, but computer-based image processing systems are typically designed to perform single, repetitive tasks[11]. Despite significant improvements in the field, no machine vision or computer vision system can yet match some capabilities of human vision in terms of image comprehension, tolerance to lighting variations and image degradation, parts' variability etc.

III.COGNEX VISION SYSTEM

Vision systems play an important role in inspection ofproducts or objects, although in the market or in industriallots of inspection systems are available. Visual inspection ofproducts and parts or raw material by the naked eye ismore time consuming, tiring, inaccurate, and they aremore costly[3]. From last two decades machine vision hasbeen applied in manufacturing and production processesto improve the quality and productivity by using camerasand pc's which improves in precise, fast, efficient andobjective inspection [12]. However high speed, high quality and high resolution application requires innovative,customized solution is outside of the scope of standardpercentage of shelf system [13].

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These checker sensors help to reduce the production costs and optimize quality [14]. The new 3G Checker series of vision sensors from Cognex provides the easiest and most affordable way to verify the products you manufacture. Checker vision sensors offer extremely reliable part detection and inspection unattainable with photo electricsensors. Following are the major benefits that industries canown from this idea implementation.

The Checker® vision sensor is an award winning all-in-one vision sensor with built in camera, processor, lighting, optics and I/O capable of detecting and inspecting up to 6,000 parts per minute–all in an industrial IP67 enclosure small enough to fit into the tightest of spaces.Checker vision sensors help reduce production costs and optimize quality by:

- Reducing scrap.
- Reducing downtime and maintenance.
- Providing easy setup and maintenance by factory personnel.
- Simplifying the overall system design.
- Displaying and recording images.
- Eliminating the need for costly fixturing.
- Eliminating PLC programming.

Use Cognex patented technology to detect part by understanding what your part looks like which eliminates the need for an additional sensor to determine if the part is present. Inspect multiple part features simultaneously with a single Checker yielding simple pass/fail results. Overcome varying part positions which eliminate the need for costly fixturing by finding and inspecting your part. Empower the factory floor to solve problems through our simple four-step process. No Pc programming is required to use this device and friendly user software environment to operate by end user. Inspecting the raw material received from vendor through Cognex system will definitely help in eliminating the scrap rate menace which becomes heavy loss for any industry. Following are the major benefits that industries can own from this idea implementation.

- Reduced Re-Work on Product.
- Save Huge Electricity.
- Save Labor Cost.
- Save Material & Product Wastage.
- Reduce Scrap Material Rate.
- Improve Quality of Product.
- Production and delivery on Time.

IV.HARDWARE SETUP

In making of shock and struts, the assumption is that touse ideal raw material. The ideal raw material should be flawless from all points of view and should not have any defects.Most of the industries uses old traditional methods to inspect and they don't have any modern method to check these parts for error. As a result of this shock in the final stage of inspection is rejected for sending it out to put in different cars. This involves heavy loss for the company. Electricity loss take place, labor cost goes in vain and sometime defected product is sent back to rework which the double the loss cost.

All these problems ca be removed by Cognex Vision Camera, if it is implemented to inspect the raw material parts before they even goes into manufacturing zone. In this paper, we have demonstrate that how the Cognex Camera can do all the raw material inspection. The hardware setup designed and implemented also demonstrate that how efficient

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this vision sensor can be to reduce the above mentioned factors. In the Fig. 2, it shows the hardware setup for the inspection station.

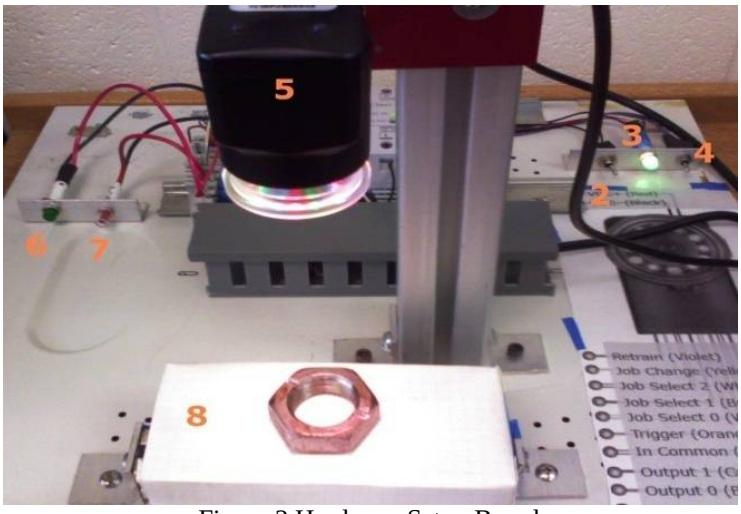

Figure 2 Hardware Setup Board

The inspection station is consist of the cognex vision camera mounted on the top of inspection area. Two LED's are used to display the output signal. Green light indicates good part, where red light indicates bad part. System is triggered when a part presence is detected. The part for inspection is placed on the top of the rail or conveyor system and the camera get triggered by part present sensor to capture the images. The power requirement for this project is 24V DC. There are four input wires on vision sensor, yellow wire is for job change signal, white/brownwire is for job select 2 signal, brown wire is for the job select 1 signal, and white/yellow wire is for the job select 0 signal. These job select pins providing 8bit binary input to the camera module to make the inspection decision. In the Fig 3, it shows the block diagram connection and fig 4 shows the detail wiring schematics diagram.

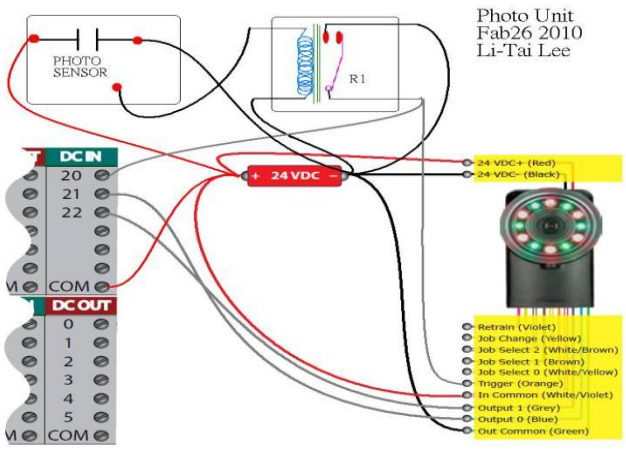

Figure 3 Connection Block Diagram

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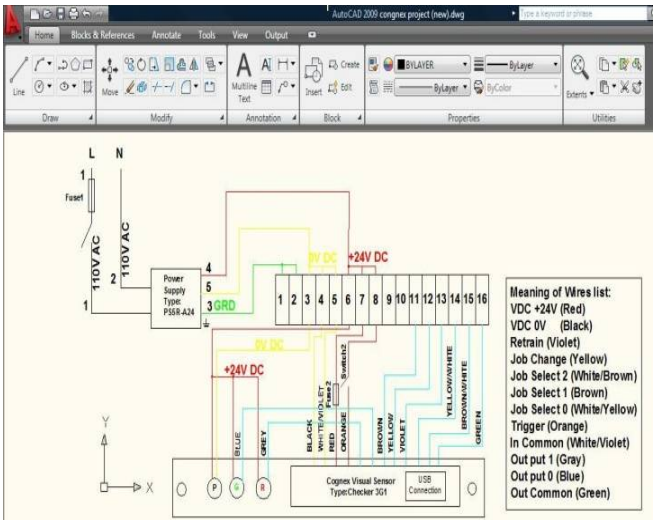

Figure 4 Wiring Schematics Diagram

V. SOFTWARE RESULT

The vision sensor will do the auto-handshaking with PC tthrough the USB port. A user can find the sensor on the connection list and create a new job. It can change the brightness and direction of parts travel.It also can change the speed and trigger input delay.There are two personalities in the option, persence and meansurement. The basic idea is setup a image and decides it as a part at first. The sensor recives a part then compare the shape or length with preset image or scale. The vision sensor need installation with angle to get better result.Users can set up output by different result, delay and duration and test output pin. HS0 is blue, and HS1 is gray. Users can set up image respond and record deciding on PC. It also can change statistics report on PC. The "Run My Job" option can save the job into the vision sensor and run without PC conntecting. User can change their jobs during Running-mode without Connecting PC.

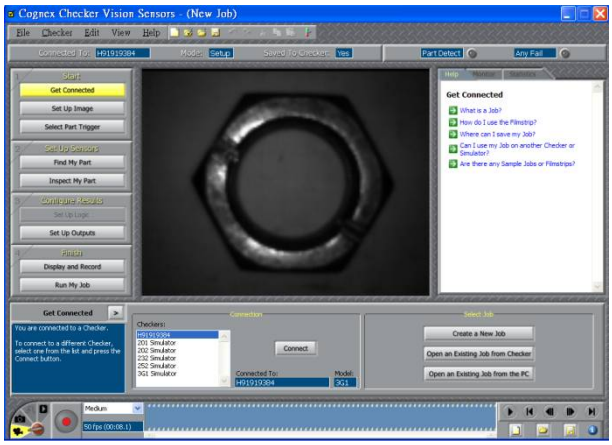

Figure 5 Checker Software for Cognex Cameraf receiving packets

- Three things are checked by detect zone.
- If there is anything triggers the photo-eye sensor, the relay 1 will send a signal to the sensor, than delay for 2 seconds to take a snap-shot.
- If the mark of detect zone is passed, it will check the inspect zone.

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- After the detecting, the sensor will go to the inspect process immediately

PRESENCE INSPECTION:

Sensor will first look for the detect zone and then go for the inspect zone. In fig 6, it shows the presence of object or part inspection bases analysis.

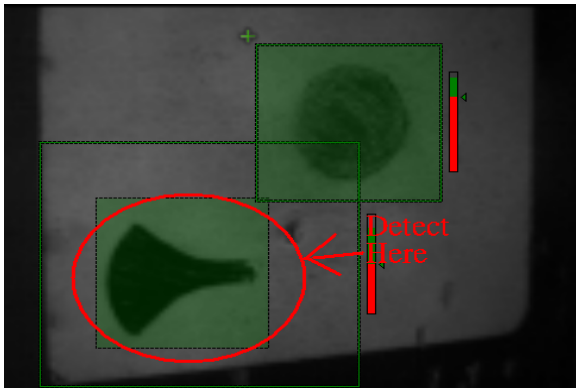

Figure 6 Presence Inspection Analysis

The old tradition system didn't have these features to verify the object is correct and then inspect it for further more levels to make sure that it is not defected. But now Cognex has all these features to take care.

DIMENSION BASED ANALYSIS:

In dimension base analysis Cognex sensor will look for 3 factors height, length and diameter, as shown in fig 7. If any of these parameters are out of range or not up to basic requirement of the final product, sensor will reject it off by indicating red LED. If it has no defects in all these parameters it will be indicated by green LED. All final results of product can be seen in software chart that how many parts passed through inspection and how many didn't passed it.

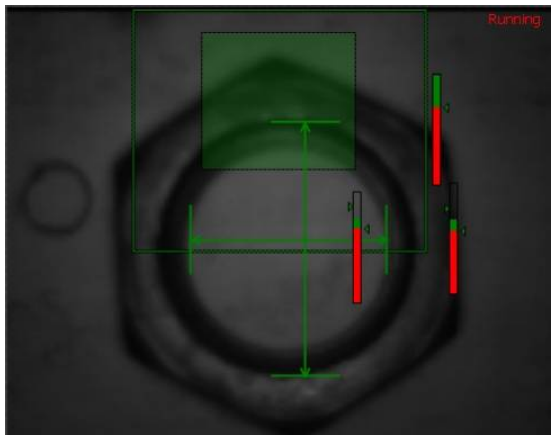

Figure 7 Dimension Based Analysis

VI.CONCLUSION

Checker's part finding sensor identifies a reference feature on each struts rod. The reference feature is used to locate the point on the product to identify and then inspect it. Checker uses an intelligent sensor to inspect that point for defect in

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rod as define by the user side. Quality is improved by reliable identification of defected rod prior to product manufacturing. Rework costs were reduced via tighter control of the lens application process.

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