AUTOMATED QA INSPECTIONS USING VISION SENSOR

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Date : 09-MAY-2008
Dedicated to my beloved family especially my parents, lecturers, and also to all my friends
ACKNOWLEDGEMENT

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ABSTRAK

ABSTRACT

This project is an upgraded version of the current system in the QA department in a company. The QA team usually inspects their product dimension by taking some sample or hourly sample from production. Since budget is a big factor most of the companies inspect the sample manually by using QA tools. When it’s done manually there are chances to have human made errors. Beside that, not all the produced product will be inspect. Using this automated QA inspection, we can overcome all the mistakes and have a greater inspection of the entire produced product dimension. With the help of this system we can inspect both in specification and out of specification product dimension. Also, this system will record the quantity of inspected product in the control unit (PC). The inspected product quantity record can be dividing to 2 main types, in specification and out of specification means accept and reject. The status of inspected product will show in display unit (PC Monitor). This system can be used in any kind of industries to improve the inspection process and the product quality.
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<td>CCD</td>
<td>Charge Coupled Device</td>
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<tr>
<td>CMOS</td>
<td>Complementary Metal-Oxide Semiconductor</td>
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<td>DSP</td>
<td>Digital Signal Processor</td>
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<td>RS232</td>
<td>Recommended Standard 232</td>
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<td>LED</td>
<td>Light Emitting Diode</td>
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<td>VGA</td>
<td>Video Graphic Array</td>
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<tr>
<td>SVGA</td>
<td>Super Video Graphic Array</td>
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<tr>
<td>MV</td>
<td>Machine Array</td>
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<tr>
<td>AGV</td>
<td>Automated Guided Vehicles</td>
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<td>UAV</td>
<td>Unmanned Aerial Vehicles</td>
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<tr>
<td>SLAM</td>
<td>Simultaneous Localization and Mapping</td>
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<tr>
<td>dpi</td>
<td>Dot per Inch</td>
</tr>
<tr>
<td>ppi</td>
<td>Pixel per Inch</td>
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<tr>
<td>JPEG</td>
<td>Joint Photographic Expert Group</td>
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<td>CRT</td>
<td>Cathode Ray Tube</td>
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<tr>
<td>RGB</td>
<td>Red, Green, Blue</td>
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<tr>
<td>RGBA</td>
<td>Red, Green, Blue, Alpha</td>
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<tr>
<td>LCD</td>
<td>Liquid Crystal Display</td>
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<tr>
<td>HSL</td>
<td>Hue, Saturation, Lightness</td>
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<tr>
<td>HSV</td>
<td>Hue, Saturation, Value</td>
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<tr>
<td>GIF</td>
<td>Graphic Interchange Format</td>
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<td>TIFF</td>
<td>Tagged Image File Format</td>
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<td>Quarter VGA</td>
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<td>Extended Graphic Array</td>
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<td>WXGA</td>
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<td>WUQSXGA</td>
<td>Wide Ultra Quad Super</td>
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<tr>
<td>DCS</td>
<td>Distributed Control System</td>
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<tr>
<td>PLC</td>
<td>Programmable Logic Controller</td>
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<td>PID</td>
<td>Proportional Integral Derivative</td>
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<tr>
<td>HMI</td>
<td>Human Machine Interface</td>
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<td>RAM</td>
<td>Random Access Memory</td>
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<td>SCADA</td>
<td>Supervisory Control and Data Acquisition</td>
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<td>QA</td>
<td>Quality Assurance</td>
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<td>I/O</td>
<td>Input/ Output</td>
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<tr>
<td>PC</td>
<td>Personal Computer</td>
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CHAPTER I

INTRODUCTION

1.1 Project Introduction

This project is about inspecting final output of a product in a production line for example FMS 200 product as in Figure 1.1.2. This system will inspect product either satisfying its specification or not, means the final output is in specification or out of specification. The main focus is the screw on top of the product. This system will inspect the tightness of screw regarding the gap between the head of screw and the body base. Vision sensor or smart camera will sense the product and calculate dimension of the product according given data. There is a control unit (PC) to control and command vision sensor by using a software. Otherwise, the vision system will help by the PLC system to control the display unit and conveyor system. The system basic block diagram was shown in Figure 1.1.1. Unlike other QA tools, this vision sensor will fixed in final test department and can be control from other place by using the control unit (PC). Figure 1.1.3 shows the real design of the system which consist of vision system and the PLC system.
Figure 1.1.1: System block diagram

Figure 1.1.2: FMS 200 product
1.2 Problem Statements

This system is designed to overcome certain problems that faced by most of factory especially in QA department. For example most of QA department done their inspection process by manually using the QA tools. There are high possibilities to have errors in measuring products dimension like human made errors. This kind of unwanted problems can be overcome by using this system. Usually, inspection on products done by taking some sample product, hourly inspection, or first sample product and last sample product. This kind of system is less effective and the probabilities for rejected products to miss the inspection are high. By using automated QA inspection system, every produced product will go through the inspection process and out of specification product will be noticed. This system will improve the inspection process and output products qualities are ensured. Beside that, the inspection process will take time if done manually by quality assurance inspectors. This automated QA inspection system will overcome this kind of problem as a timesaving system.

1.3 Objective

The objectives of this project are:

a) To have a higher quality assurance where this system will go for higher accuracy.

b) To reduce the errors or reject product in the outgoing product.

c) To ease the QA department in inspection techniques where the inspection will done by automatically.

d) To save manpower and as timesaving system.

e) To reduce the cost in product inspection since budget is a big factor for most of company.
1.4 Scopes of work

1.4.1 Vision sensor

The vision sensor functions as an inspector. This unit use to view or sense the present product. The sensed product data will transfer to control unit (PC) using connector. The field of view or sense can be adjusted. Field of view (FOV) is proportional to value of accuracy.

1.4.2 Control unit (PC)

The control unit (PC) is the heart of the system. It is use to command the vision sensor by using software. The product specification will upload here and as an input for display board.

1.4.3 PLC system

PLC system use to control the inspection process. Output from PLC system is use as an input for conveyor or display board. This system is easy to control and portable to communicate with other device. Using software CX-Programmer.

1.4.4 Display board

The display board functions to show us the status of the present product in the view of vision sensor. There are two statuses that show by the display board. First, system ready for inspection, green lamp will ‘ON’. Second, stage show the product is under inspection, red lamp ‘ON’.
1.4.5 Conveyor

The conveyor system was designed to move the product. In this project, rotational conveyor used to rotate the product. Hereby, the four screws in every angle of the product will pass the vision sensor field of view.

Figure 1.1.3: Automated QA Inspection using Vision Sensor System
CHAPTER II

LITERATURE REVIEW

2.1 Previous Study and Research

2.1.1 Machine Vision

Machine vision (MV) is the application of computer vision to industry and manufacturing. Whereas computer vision is mainly focused on machine-based image processing, machine vision most often requires also digital input/output devices and computer networks to control other manufacturing equipment such as robotic arms. Machine Vision is a subfield of engineering that encompasses 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.

Machine vision systems are programmed to perform narrowly defined tasks such as counting objects on a conveyor, reading serial numbers, and searching for surface defects. Manufacturers favour machine vision systems for visual inspections that require
high-speed, high-magnification, 24-hour operation, and/or repeatability of measurements. Frequently these tasks extend roles traditionally occupied by human beings whose degree of failure is classically high through distraction, illness and circumstance. However, humans may display finer perception over the short period and greater flexibility in classification and adaptation to new defects and quality assurance policies.

Computers do not 'see' in the same way that human beings are able to. Cameras are not equivalent to human optics and 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. 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 and computer vision systems are capable of processing images consistently, but computer-based image processing systems are typically designed to perform single, repetitive tasks, and 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.

2.1.1.1 Components of a Machine Vision System

A typical machine vision system will consist of several among the following components:

1. One or more digital or analog camera (black-and-white or color) with suitable optics for acquiring images
2. Camera interface for digitizing images (widely known as a "frame grabber")
3. A processor (often a PC or embedded processor, such as a DSP)