

COMPUTER VISION FOR ENGINEERING STUDENTS

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Abstract:-

Machine Vision (MV), like different virtual technologies, is an essential element of Manufacturing engineering. MV can be used to quickly detect & flag faulty goods. This paper briefly discusses MV and how it can be taught in mechanical and Manufacturing engineering departments in Libya as a part of Mechatronic department for undergraduate students. The objective was to provide engineering students theoretical and practical experience with machine vision technologies that will be of the utmost importance in the near future. It also describes important concepts, hands-on equipment, and labs developed for this course, as well as provides some of real applications of Machine vision in Manufacturing and mechanical engineering. The course and laboratory materials were evaluated for learning effectiveness and technical content, which are included in this paper.

Keywords: Machine vision . Image processing . Image analysis . Quality inspection, Automation.

1. Introduction

Machine Vision which is the field that studies the automated analysis of images and video , started in the 1950s. Machine Vision in Manufacturing and mechanical engineering is the application of computer vision to industry and manufacturing. Whilst computer vision is mainly concerned with the application of image processing algorithms on a single computer or a computer network, machine vision in the other hand involves systems comprising additional components such as image acquisition systems, input/output cards and actuators (robot arms).

For many years machine vision was a research subject, generally within computer science. During the past decades, machine vision has changed dramatically, and it has become an essential technology with many industrial applications. These changes have occurred due to several factors such as the advanced in computing processor speed, increasing in memory capacity, reducing the cost of computer and machine vision technologies, and the development of powerful and easy-to-use machine vision software tools.

Machine vision is an engineering field that includes computer science, optics, mechanical engineering and industrial automation. It allows computers and machinery to 'see' the world through the extraction, processing, and analysis of visual knowledge. MV system facilitates automated inspection and review of systems by image processing [1]. Machine Vision techniques uses cameras, sensors and computing power to interpret pictures and enable machines to complete industrial tasks, such as production and verification of quality.

Manufacturing and Mechanical engineers need to be aware of machine vision technology, so they can use this technology into their engineering field where it is not currently used. Applying this

technology will help Manufacturing and Mechanical engineers to saving time; reducing production costs; improving productivity and product quality; reducing the number of unqualified products; improving machine utilization and so on.

The author believes that introducing machine vision technology in manufacturing and Mechanical Engineering at Libyan universities will open new research area and projects for undergraduate and post graduate studies.

2- IMPORTANT OF THIS COURSE

Machine vision technology has been applied in various industries, and it improves productivity and quality management and provides a competitive advantage to industries that use this technology. These include material analysis aerospace, aviation, intelligent transportation, text recognition, quality inspection, product classification, product packaging, robot positioning, automotive pharmaceutical, food and beverage, electronics, packages, and process control [2,3]. With the advent of low-cost computational hardware, computer vision systems have emerged as a financially viable device in automated manufacturing and measurement systems [4].

Machine Vision gives accuracy, consistency, and repeatability, compared to human examination, which is time-consuming, expensive, and exhausting. [5]. The advantages of using a machine vision system for assessment decreases the time required for measurement, also non-contact measures are more accurate and flexible than traditional approaches. [4].

3-FACTORS THAT AFFECT THE PERFORMANCE OF THE MACHINE VISION SYSTEM

As mentioned above the machine vision system has many advantages. However, it requires a lot of effort and cost to develop a high precision 3D measuring system [3]. The essential problem of using computer vision techniques consists in image quality, as image analysis requires the features of interest be well defined. The choice of the most suitable method to pre-processing and threshold the image, in its two main components (the object and the background), must be sufficient robust to obtain images without information loss [5].

Like the human eye, vision systems are affected by the level and quality of illumination. By adjustment of the lighting, the appearance of an object can be changed with the feature of interest clarified or blurred. Therefore the performance of the illumination system can affect the quality of the image and plays an important role in the overall efficiency and accuracy of the system [6].

Other source of errors result from electronic devices, for instance the camera analogue signal connected to the computer through the frame grabber, and during the sampling process mismatch between the pixels location in camera sensor and sampled image may occur (for more details see [7,8]. Moreover cameras often associated with geometric distortions caused by the optical system that can undermine the accuracy of the computer vision system [9].

4-COMPONENTS OF MACHINE VISION

The illumination, lens, image sensor, vision processing, and communications are the main parts of a machine vision system. The part being examined is illuminated, making its characteristics shine out so that the camera can see them clearly. The picture is captured by the lens and then presented as light to the sensor. This light is transformed into a digital image by the sensor in a machine vision camera, which is then delivered to the processor for processing.

Algorithms used in vision processing evaluate the image, extract the essential data, do the appropriate inspections, and make a decision. Finally, communication is generally performed by either discrete I/O signal or data sent over a serial connection to a device that is logging information or using it.

A computer vision system (Figure1) consists of all the elements necessary to obtain a digital representation of a visual image, to modify the data, and to present the data to the external world. The system may appear complicated in an industrial environment because of all the associated manufacturing process equipment used. However the computer vision system can be simplified three main parts [10] as following:

- Image acquisition
- Processing
- Output or display

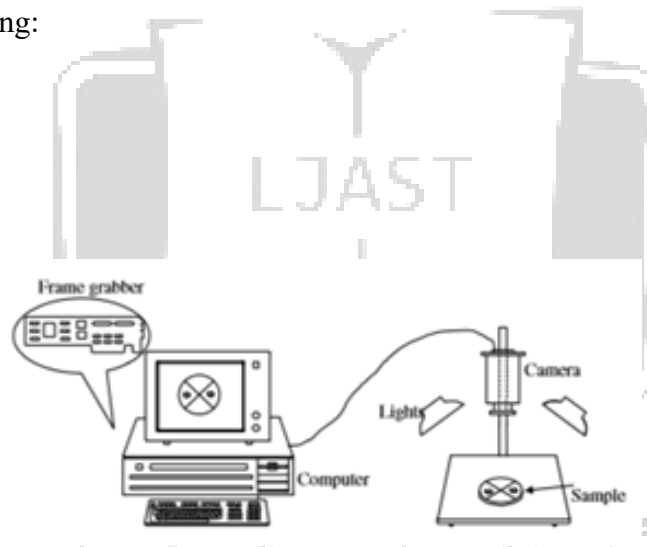


Fig. 1. Essential elements of a machine vision system

5- COURSE DETAILS:

By the end of the course, students should be familiar with the following points:

- 1-Knowing the components of a machine vision systems.
- 2- the purpose, and the construction of each component.
- 3-Be familiar with the most common image processing algorithms used in industrial and mechanical applications.
- 4- How to implement machine vision technology in mechanical and industrial applications.
- 5-Identify and select the machine vision components suitable for an intended application.

6-suggest a design of a machine vision system for a specific problem.

The lectures will include the following topics:

- Introduction to machine vision system.
- Cameras (sensors) and camera selection.
- Lenses and lens selection.
- Analog and digital signals.
- Digital image procession.
- type of lamination used in vision system.
- Image capture.
- Using image processing software such as Matlab Image processing tollbox.
- Different types of Image processing techniques.
- three dimensional machine vision methods.
- Real examples of Machine vision systems.

6- CONCLUSION

Machine vision technologies are low cost and high precision measurement system which have countless number of applications such as object recognition, pattern recognition, material inspection, item counting, Robot vision guidance, and more.

The aim of this course is to provide mechanical engineering and manufacturing students with theoretical and practical experience with automation technologies that will make a difference in the years to come. They will be able to design and integrate computer vision into the system to achieve specific goals. Additionally, this course provides students with the fundamentals of image generation and programming experience through the implementation of computer vision and object recognition applications.

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