AUTOMATIC SORTING MACHINE USING USB CAMERA

WILLIAM TAM

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I have faced unlimited number of challenges in completing this project, from paper work to technical part. In each development that I have gone through, not only did I gain knowledge, but I also gained is that trust, believe and appreciation leads to success. My PSM project not only worth 3 credit hours in my syllabus, to me it is priceless.

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ABSTRAK

Jentera atau mesin yang bergantung pada penggunaan pengesan dalam pengoperasian mempunyai had dalam melakukan perubahan seperti aplikasi, penambahan baikan mesin dan juga perubahan bagi proses mesin tersebut. Disebabkan masalah ini, ia bukan hanya menghadkan usaha jurutera-jurutera bagi menghasilkan produk baru tetapi juga melibatkan pembaziran waktu bagi melakukan penilaian setelah kaedah baru dilaksanakan. “PC Based Controller & Camera Vision” akan menjadi revolusi pengesan pada masa hadapan, dimana akan mengantikan pengesan konvensional seperti pengesan warna, infra-merah dan suis had pengesan dalam membantu mengesan objek. Projek ini dapat diaplikasikan pada mana-mana komputer peribadi dengan hanya memuat turunkan perisian LabView dan memasang sebuah kamera. Perisian LabView, merupakan satu perisian yang mudah digunakan dalam mereka dan merubah tanpa perlu menggunakan peralatan tambahan, dimana jika dibandingkan dengan PLC yang memerlukan bantuan konsul bagi memasukan arahan. Selain dari itu, LabView yang mempunyai kelebihan GUI memudahkan lagi pengoperasian, aplikasi kawalan dan pemantauan. Diringkaskan, integarasi penglihatan kamera dan computer boleh menjana satu alat yang dapat berfungsi bagi apa jua jenis aplikasi dengan hanya melakukan pemprosesan imej atau analisis dan melibatkan bersama sedikit pengatucaraan. Dalam penghasilan “Automatic Sorting Machine”, keutamaan telah diberikan kepada kos, kualiti, kelajuan dan teramat penting adalah mudah dikawal dan pantau. Konsep sistem penglihatan yang digunakan dalam penghasilan produk kepada pengguna akan merupakan satu daripada kejayaan yang terbaik dan teknologi ini akan dapat membantu kita dalam menjalani kehidupan seharian dan lebih memudahkan hidup mereka.

ABSTRACT

Machines that rely on sensors to run operations have certain limitations; such as in terms of applications, machine upgrading, or when it comes to process change. This matter has not only limited engineers' development of new products, it is also time consuming for engineers to perform product evaluations after a new implementation has been done. PC Based Controller and Camera Vision are the next revolution of sensors, replacing conventional sensors such as color sensor, infra red, and limit switch for object detection, etc. Any normal PC with pre-installed LabVIEW software and a connected camera could perform any of the above-mentioned functions. LabVIEW programs could be created and modified easily without the requirement of any additional device. Compared to PLC, a special Handheld Console is needed to input commands. Besides that, GUI (Graphical User Interface) makes the operation user-friendly and enhances monitoring features. In short, the integration of Camera Vision and PC generates a powerful tool for applications that require image processing or analysis, with minimum programming. The priorities considered during the invention of this Automatic Sorting Machine are cost, reliability, speed and most importantly, ease of use and simplicity. Using this vision system concept to produce consumer gadgets would be another great achievement. This technology is supposed to make our lives simpler and easier.

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Fully Automatic Sorting Machine ***(ASM)*** using USB Camera Vision is a project that intends to help human work effectively. ASM sorts out items according to category continuously without the assistance or monitoring of human. USB camera is the main component in this whole project. The function of this camera is to capture images of objects delivered by loader and send them to PC via USB cable. LabVIEW is then used to analyze those images. A proper algorithm was designed to perform the operation / analysis and generate output control signals to the respective hardware. Finally, a rotary container was installed to collect items delivered by the conveyor. This project intends to convey the general idea of vision systems.

The contribution of the idea of vision systems can be widely accepted and can easily fit into any industry. This concept can be implemented in machine upgrading or to improvise a current process. Besides that, the concept can also be used to design a system that helps the disabled, mainly those with vision problems. The whole idea is to make the world more cheerful with the science and technology we have now.

1.2 OBJECTIVES

Sorting items or objects manually is a hassle - it consumes a lot of time and the attention of the sorter. This translates to unnecessary high labor cost. Sometimes, as the quantity of items increases, inconsistency in sorting happens due to worker fatigue. These problems can be solved in an instant when machines are used for the sorting process, replacing the manual work done by human.

The idea of *A*utomatic *S*orting *M*achine using USB Webcam *(ASM)* - my PSM topic – can be used to handle the situation above. Processes such as transferring, image processing and storage are part of ASM. human operation could be replaced with higher reliability. The result clearly shows that it could reduce the time consumed (tact time), cost, increase the safety and cleanliness.

Besides that, a simple modification on the current system could be used to help the disabled especially those who are color blind. ASM can recognize the color of an object and send the information to the blind in a pre-loaded sound. This is an alternative way for them to get to know the color of an object.

Consumers are currently looking for user friendly and multipurpose products. This project has a high demand value if it is implemented and marketed effectively. In future, this machine could be resized to a handy device. Thus the blind could easily bring it along just like the mobile phone that we carry everyday.

1.3 PROBLEM STATEMENT

1.3.1 The Conventional Method

Conventional machines rely on a variety of sensors to perform a single operation and have very limited application. Such designs are expensive and appear to be time consuming when modifications are needed on a particular process. Besides that, only qualified and experienced engineers manage to perform the modifications smoothly. Other people who may need to follow up on the project in future require an in-depth analysis and understanding of the process.

1.3.2 Conventional Sensor VS Vision System

Vision System is the revolution of sensors, replacing conventional color sensor, motion sensor, vibration sensor, mechanical sensor and etc. Image analysis is the most powerful tool to perform all of the above work. NI Vision Module is used to perform image analysis in this project. This would thus reduce the cost of sensors that could only perform certain functions, for example: color sensor has maximum color determination up to 3 types. However, any colors could be detected without limitations using vision system as long as the reference colors are well pre-set into the database.

1.4 PARALLEL PORT

The main reason why I have selected Parallel Port as my interfacing port is because Parallel Port can be found in any PC. Parallel Port is very common and can easily interface with any hardware without additional devices or special drivers. Besides that, the cost of parallel port is cheap compared to other DAQ (Digital Acquisition) Input / Output offer in the market. The cheapest USB DAQ offered by NI costs around RM500. In terms of cost, I probably can save up that sum for other purposes. It is undeniable that Parallel Port has slower sampling rate, but it is more than enough for my PSM. USB Camera would be more of a concern for me in this project. This camera plays an important role to capture clean images. .

1.5 SCOPES OF WORK

ASM requires a USB webcam, LabVIEW 8.5, NI Vision Module 8.5, Parallel Port as I/O interfacing, and a PC. Each of the element mentioned above are essential components to build the system. ASM costs below RM1000.00 with the student version's software, meaning to say that, the software is free for use under student license and could not be used for commercial or profitable purpose. The costing and budget allocation is focused to hardware parts. Any additional cost has been absorbed into the sum above. However, any obligations of using National Instruments software or designed program by student for commercial purposes require permission from the appropriate authorities.

Parallel port interfacing with LabVIEW requires a special driver and also knowledge on programming. I am required to understand the principle of writing a program with arithmetic feature.

In order to use USB camera as the capturing device, NI vision module software is used to work with LabVIEW 8.5. The license for this software is very expensive, and the budget allocated by the faculty needs to be taken into consideration. As a result, I will use the evaluation software to complete my task.

Besides that, I had concerns about the hardware part; to make it work effectively with my program. Some of the parts were sent for manufacturing such as the bearing holder, driveshaft and other assembled mechanical parts.

CHAPTER II

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter covers the background, advantages and disadvantages of the software – LabVIEW used in my PSM. Parallel Port and Vision System interfacing will be further discussed in this chapter as well.

2.2 LABVIEW AS PROGRAMMING PLATFORM

LabVIEW (short for Laboratory Virtual Instrumentation Engineering Workbench) is a platform and development environment for a visual programming language from National Instruments. The graphical language is named "G". Originally released for the Apple Macintosh in 1986, LabVIEW is commonly used for data acquisition, instrument control, and industrial automation on a variety of platforms including Microsoft Windows, various flavors of UNIX, Linux, and Mac OS.

2.2.1 Graphical Programming

LabVIEW ties the creation of user interfaces (called front panels) into the development cycle. LabVIEW programs/subroutines are called virtual instruments (VIs). Each VI has three components: a block diagram, a front panel, and a connector pane. The last component is used to represent the VI in the block diagrams of other, called VIs. Controls and indicators on the front panel allow an operator to input data into or extract data from a running virtual instrument. However, the front panel can also serve as a programmatic interface. Thus a virtual instrument can either be run as a program, with the front panel serving as a user interface, or, when dropped as a node onto the block diagram, the front panel defines the inputs and outputs for the given node through the connector pane. This implies each VI can be easily tested before being embedded as a subroutine into a larger program.

The graphical approach also allows non-programmers to build programs simply by dragging and dropping virtual representations of lab equipment with which they are already familiar. The LabVIEW programming environment, with the included examples and the documentation, makes it simple to create small applications. This has a benefit on one side, but there is also a certain danger of underestimating the expertise needed for good quality "G" programming. For complex algorithms or large-scale code, it is important that the programmer possess an extensive knowledge of the special LabVIEW syntax and the topology of its memory management. The most advanced LabVIEW development systems offer the possibility of building stand-alone applications. Furthermore, it is possible to create distributed applications, which communicate with a client/server scheme, and are therefore easier to implement due to the inherently parallel nature of *G*-code.

To maintain clean and legible VI user interfaces, these tips need to be kept in mind: keep panels simple and clean, maintain a consistent style, clean up wires wherever possible, and use proper terminology when labeling controls and indicators.

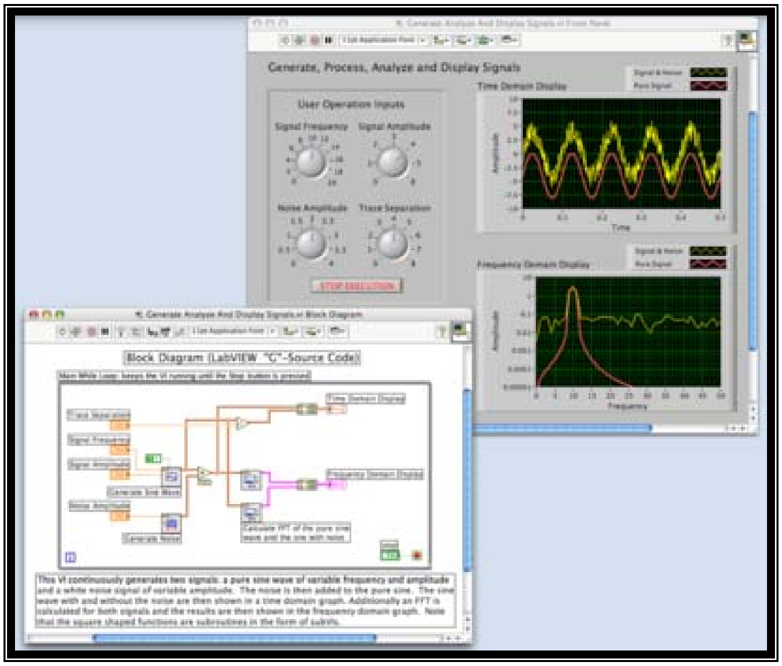

Figure 2.1 LabVIEW

2.2.2 Connectivity and Instrument Control

Virtual instrumentation software productivity comes about because the software includes built-in knowledge of hardware integration. Designed to create, test, measurement, and control systems, virtual instrument software includes extensive functionality for I/O of almost any kind.

2.2.3 Reduces Cost and Preserves Investment

With LabVIEW, user can use single computer equipment for countless applications and purposes. It is definitely a versatile and cost effective product. Virtual Instrumentation with LabVIEW proves to be economical, not only in the reduced development costs but also in its preservation of capital investment over a long period time. When a user needs change, he / she can modify systems easily without the need to buy new equipment of a single traditional, commercial instrument.

2.2.4 Multiple Platforms

The majority of computer systems use some variation of Microsoft Windows operating system. Nevertheless, options offer clear advantages for certain types of applications. Real-time and embedded development continues to grow rapidly in most industries, as computing power is packaged into smaller and more specialized packages. Minimizing losses resulting from changing to new platforms is important and choosing the right software for this purpose is a key factor. LabVIEW minimizes this concern, because it runs on Windows 2000, NT, XP, ME, 98, 95, and NT embedded, as well as Mac OS, Sun Solaris, and Linux. LabVIEW complies code to run on the VenturCom ETS real-time operating system through the LabVIEW Real-Time Module. Given the important of legacy systems, National Instruments continues to make available older versions of LabVIEW for Windows, Mac OS, and Sun operating systems.

LabVIEW is platform independent; virtual instruments that have been written in one platform can transparently be ported to any other LabVIEW platform by simply opening the virtual instrument. Because LabVIEW applications are portable across platforms; users can be assured that what works today will be applicable in the future. As new computer technologies emerge, user can easily migrate the applications to new platforms and operating systems. In addition, user can create platform-independent virtual instruments by porting applications between platforms. This can save development time and other inconveniences related to platform portability.

2.2.5 Analysis Capabilities

Virtual instrumentation software requires comprehensive analysis and signal processing tools; it is because the application does not just stop when the data is collected. High speed measurement applications in machine monitoring and control systems usually require order analysis for accurate vibration data. Closed-loop, embedded control systems might need point-by-point averaging for control algorithms to maintain stability. In addition to the advanced analysis libraries already included in Lab VIEW, National Toolset, the LabVIEW Sound and Vibration Toolkit, and the Lab VIEW Order Analysis Toolkit to complement offerings.

2.2.6 Visualization Capabilities

LabVIEW includes a wide array of built-in visualization tools to present data on the user interface of the Virtual Instrument for charting and graphing as well as 2D and 3D visualization. User can instantly reconfigure attributes of the data presentation, such as colors, font size, graph types, and more, as well as dynamically rotate, zoom, and pan these graphs with the mouse. Rather than programming graphics and all custom attributes from scratch, user can simply drag-and-drop these objects onto the instrument front panel.

2.2.7 Flexibility and Scalability

Engineers and scientists have the need and requirement that a system can be used for a long time. By creating Virtual Instruments based on powerful development software such as LabVIEW, user can design an open framework that seamlessly integrates software and hardware.

This ensures that the applications not only work well today but the user can easily integrate new technologies in the future as they become available, or extend their solutions beyond the original scope, as new requirements are identified. Moreover, every application has its own unique requirements that require a broad range of solutions. Virtual Instruments provide significant advantages in every stage of the engineering process, from research and design to manufacturing test.

2.2.8 Research and Design

In research and design, engineers and scientists demand rapid development and prototyping capabilities, with virtual instruments, user can quickly develop a program, take measurements from an instrument to test a prototype, and analyze results, all in a fraction of the time required to build tests with traditional instruments.

When user needs flexibility, a scalable open platform is essential, from desktop, to embedded systems, to distributed networks. The demanding requirements of research and development (R&D) applications require seamless software and hardware integration. Whether the need is to interface stand-alone instruments using GPIB, or directly acquire signals into the computer with a data acquisition board and signal conditioning hardware, LabVIEW makes integration simple. With virtual instruments, user also can automate a testing procedure, eliminating the possibility of human error and ensuring the consistency of the results by not introducing unknown or unexpected variables.

2.2.9 Development Test and Validation

With the flexibility and power of virtual instruments, user can easily build complex test procedures. For automated design verification testing, you can create test routines in LabVIEW and integrate software such as National Instruments Test Stand, which offers powerful test management capabilities. One of the many advantages these tools offer across the organization is reusable code. User can develop code in the design process, and then plug these same programs into functional tools for validation, test, or manufacturing.

2.2.10 Manufacturing Test

Decreasing test time and simplifying development of test procedures are the primary goals in manufacturing test. Virtual instruments based on LabVIEW combined with powerful test management software such as Test Stand deliver high performance to meet those needs. These tools meet rigorous throughput requirements with a high speed, multithreaded engine for running multiple test sequences in parallel. Test Stand easily manages test sequencing, execution, and reporting based on routines written in LabVIEW. Test Stand can also reuse code created in R&D or