REAL-TIME BARCODE READER USING PERSONAL DIGITAL ASSISTANCE (PDA)

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In the name of Allah, Most Gracious, Most Merciful

All praise and thanks are due to Allah Almighty and peace and
blessings be upon His Messenger

The results of this effort are truly dedicated to my mother and father whose
example as devoted professionals, as well as, parents taught
me to be perseverant, responsible and loyal
to my belief.

To my brothers, and sisters, and my best friend my uncle for all their support,
encouragement, sacrifice, and especially for their love.

Thank you all and this work is for YOU.

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ABSTRACT

This project concerns the design and implementation of a system for real time barcode reader using personal digital assistant (PDA) with built-in camera. A system that reads and decodes (1D) linear barcodes based on images containing barcodes – independent of the barcodes' orientation or rotation. Problems associated with images taken by the PDA are limited depth of field, limited resolution, poor lighting sensitively and camera shake. To accomplish this project with the above constraints the following stages are undertaken; First the image from the camera is enhanced, the camera will send continuous frame of images from the environment. These images are converted to grayscale and some preprocesses are performed, image is filtered (such as sharpening and noise reduction) and converted to binary. The image is then scanned horizontally, vertically and diagonally for barcodes, thus enabling it to detect rotated barcodes to suit the subsequent processing. Then the barcode is located in the image using a method based on the evaluation of the correlation. To extract relevant information from the located image the barcode is then isolated from the image, after that it is used to gain a waveform that represents the information of the barcode. Finally, the waveform will be wavered into a string of digits representing the widths of each bars of the barcode. At this stage the processing has completely decoded the barcode symbology. This project only considers European Article Number 13, (EAN-13) barcodes. The system has been implemented in Windows Mobile (windows CE) based software in Embedded Visual Studio 2005 C++ on PDA, with a graphical user interface. Error correction and predictive decoding is implemented to improve the capability accuracy and performance of the system.

ABSTRAK

Projek ini berkenaan dengan reka-bentuk dan implementasi sistem kod-bar maya nyata menggunakan pembantu peribadi digit (PDA) yang dilengkapi dengan kamera terbina-dalam. Sistem ini mampu membaca dan menyahkod kod-bar satu dimensi tanpa mengambil kira orientasi dan pusingan kod-bar. Kedalaman medan yang terbatas, resolusi yang terhad, pencahayaan yang lemah dan goncangan kamera adalah beberapa masalah yang berkaitan dengan imej-imej yang dihasilkan oleh kamera PDA. Untuk melaksanakan projek yang mempunyai masalah diatas dengan jayanya, proses-proses berikut perlu dilakukan. Pertama, kualiti imej ditingkatkan. Imej-imej ini kemudiannya ditukar kepada imej aras kelabu dan beberapa peringkat pra-pemprosesan dilakukan seperti penajaman dan pengurangan hingar, dan imej ditukar ke nombor binary. Untuk mendapatkan kodbar, imej kemudiannya diimbas secara menegak, melintang, dan pepenjuru untuk menentukan proses yang selanjutnya. Dengan menggunakan kaedah penilaian korelasi, kodbar diletakkan didalam imej. Untuk mengekstrak maklumat darapida imej. Kodbar kemudiannya diasingkan daripada imej, dan digunakan untuk mendapat bentuk gelombang yang mewakili kodbar. Akhir sekali, bentuk gelombang diliang-liuk menjadi rangkaian digit yang mewakili lebar setiap buku kodbar. Pada peringkat ini, kodbar telah dinnyahkod sama-sekali. Projek ini hanya mengambil kira kodbar jenis nombor artikel Eropah (EAN-13). Sistem ini diatas diimplementasi di dalam persekitaran Windows Mobile (Windows CE) dengan menggunakan Embedded Visual Studio 2005 C++ untuk PDA dengan antara muka grafik. Pembetulan kesalahan dann penyahkid penjangkaan dilaksankan untuk meningkatkan ketepatan dan pencapaian sistem.

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LIST OF ABREVIATIONS

PDA	-	Personal Digital Assistants
GPS	-	Global Positioning System
PC	-	Personal computer
MS	-	Microsoft
RAM	-	Random access memory
CPU	-	Central processing unit
GSM	-	Gold Standard Multimedia
GPRS	-	General Packet Radio Service
CDMA	-	Code division multiple access
WCDMA	-	Wideband Code Division Multiple Access
3G	-	3-Generation
SD	-	Secure Digital
MP	-	Micro Pixel
D	-	One- or Two- Dimensional
BMP	-	Windows Bitmap
EAN	-	European Article Number
UPC	-	Universal Product Code
CCD	-	Charge-Coupled Devices
PSA	-	Personal Shopping Assistant
PIM	-	personal information manager
JPEG	-	Joint Photographic Experts Group
RGB	-	Red, Green and Blue
SD	-	Secure Digital
SDIO	-	Secure Digital Input/Output
SDK	-	Software Development Kit

PCB	-	Printed Circuit Boards
CD	-	Compact Disc; conjugate directions
GSM	-	Groups :Special Mobile or Global System for Mobile
SMS	-	Simplex Minimization Search

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CHAPTER 1

INTRODUCTION

1.1 Overview

Today barcodes are present all around us not only for use on groceries in the super-market, but also in industries for example in a car assembly plant most the car parts are marked with barcodes for identification purposes. Similarly, and for the same reasons, most electronic circuits and microchips have barcodes on them.

Why is that? Why are barcodes used?

The main reason is the convenience and effectiveness barcodes provide since they are designed for automated reading and interpretation. Leading to a rationalization when a machine does the job instead of a human operator. Further, a product can be given a fix barcode, only linking the barcode's number to a database containing attributes such as price, manufacturing date, adjacent bars and spaces etcetera. Hence, attributes can easily be changed in the database, without actually re-labeling the product.

Barcodes are standardized, as shown in figure 1.1, which leads to that they are consistently shaped and used, and that they have a well defined structure wherever they are found.

They provide unambiguous, and secure, identification. Some barcode symbologies also offer a feature for tracing for example the origin of a product. As

barcodes are wide-spread over the world there has naturally evolved many different ways to read them – using for example laser scanners, so called wands, CCD-scanners, or digital cameras. If it could be possible to use personal digital assistant (PDA) build in camera to read barcodes image much could be gained. Naturally, the first advantage compared to, for example, a laser scanner is that the object with the barcode is visible in the image, and thus that the operator can see whether the object is for example intact or damaged, which means that the system easily could be expanded with additional cameras. This is due to the fact that the PDA using a camera downloads the images with ease could be connected to the network via the internet such as the World Wide Web.

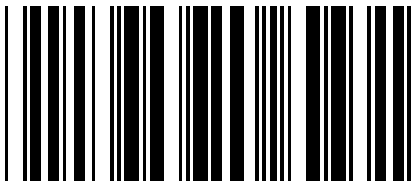

Figure 1.1: symbol barcode

1.2 Personal Digital Assistants (PDA)

A personal digital assistant (PDA) is a handheld device technology that can implements various new kinds of applications such as telephone/fax, internet, GPS, movie and network features. A typical PDA can function as a cellular phone, fax sender, Web browser and personal organizer. Unlike portable computers, most PDA's began as pen-based, using a stylus rather than a keyboard for input. This means that they are also integrated with handwriting recognition features. Some PDA's can also react to voice input by using voice recognition technologies. PDA's of today are available in either a stylus or keyboard version.

1.2.1 Pocket PC

This project will use Pocket PC (HP iPAQ hx4700 series as shown in Figure 1.3). The main reason for choosing Pocket PC rather than Palm is that Pocket PC is a handheld computer with a subset of the capabilities of a PC and provides the basic functionality those users need when they are traveling. Pocket PC also has a longer battery life than a notebook PC, therefore, offers 320 x 240 color display or more, moreover it can use touch screen for data entry. The pocket PC uses a cable serial & USB sync port to connect with PC or other devices. It is an available compact flash and/or Secure Digital (SD) Card for secondary storage. The pocket PC is better than palm because the palm is just an organizer but the Pocket PC is a small computer that uses a windows interface which is already user-friendly. The Pocket PCs are more popular and used by many people because it can use Microsoft Word, Excel, and Outlook. The Pocket PC uses high resolution color screens.

Pocket PCs come with mobile versions of office applications in addition to Microsoft Outlook Mobile. Though there are different Pocket PCs, all of them can compose e-mail messages and send them by synchronizing with desktop computer or wirelessly.

Figure 1.2: HP iPAQ hx4700 Pocket PC

1.3 Palm

The palm has some applications with an easy to use interface, as shown in figure 1.3

Figure 1.3: Palm

1.4 Smartphones

Mobile phones use Windows Mobile or Symbian as operating system developed by the Palm Company. The smartphone is different with PDA's, as shown in figure 1.4.

Figure 1.4: Smartphone

Therefore, the smartphone has something like a PDA (storage on flash, multimedia features, pocket outlook, pocket internet explorer, GSM/GPRS, CDMA, WCDMA, 3G Radio, SD Card.

1.5 Camera used with PDA

There are many kinds of camera for PDA. They include; built–in camera, wireless camera and digital card camera. The recent models of smartphone's and PDA's have built-in camera, as shown in figure 1.5, which is digital camera card that can be used in a PDA's and other dives.

Figure 1.5: Digital camera card (HP Photosmart mobile camera)

1.6 Windows Mobile

Microsoft recently announced Windows Mobile operating system, which is a handheld device powered by the Windows Mobile platform. It allows the user to make phone calls, retrieve e-mails, browse the Internet, send and receive text messages, read and compose Microsoft Word Mobile files, make Microsoft Excel Mobile charts, and view Microsoft PowerPoint presentations. Windows Mobile powered devices come in three types and includes: Pocket PC, Pocket PC Phone Edition, and Smartphone, as Shown Figure 1.6

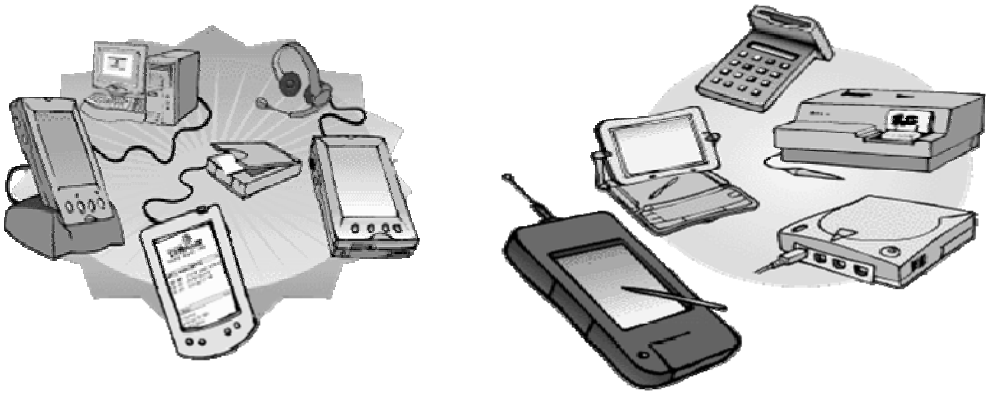

Figure 1.6: Different devices that use windows CE

Windows CE (WCE) is a Windows like operating system for various handheld devices, including Personal Digital Assistants (PDA's) and Mobile Phones. While at the API level, many of the function calls and interfaces are the same as the standard version of Windows as shown in figure 1.7, much of the internals have been altered to accommodate many different types of CPUs and architectures.

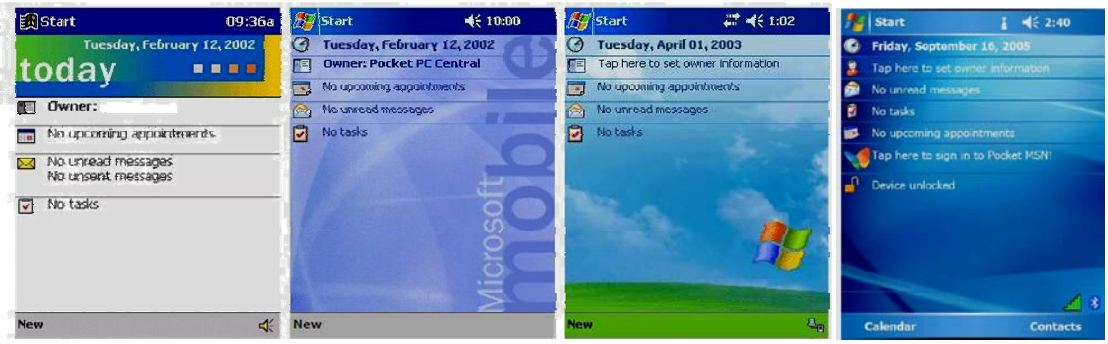

Figure 1.7: Interfaces for windows CE

1.7 PDA using a camera

The system architecture of PDA using a camera is a recent generation of PDA devices, as shown in figure 1.8

Figure 1.8: PDA build-in camera

This project can perform either in real-time (online) or load from a file (offline). The application revolution has been made possible by the added extra processor called an application processor into the newer PDA's. The software used is Embedded Visual Studio 2005 C++ and the hardware system processing will be done in real-time by PDA using camera. See figure 1.8, PDA with camera.

1.8 Limitations of Conventional Barcode Readers

In real time (online) phase, the capturing of barcodes image depends on the following:

a) Resolution of the camera, for build-in camera in real time, the resolution of the camera must be more than 3.0 MP.
b) Light intensity is very important to camera.
c) Camera stationary using a camera that is shaking will could the barcode image to be blurred (that mean the bars are not clear.).

1.9 Objective of Project

The main objective of this project is to develop a system comprising of a PDA using camera and software for the purpose of capturing 1-D barcodes and decoding them in real-time (online) as well as offline (reading from a file). Suitable image processing techniques must be implemented in the software to accommodate inaccuracies or environmental changes during the acquiring process.

1.10 Scope of Project

The project is mainly to develop a Windows Mobile (windows CE) based software in Embedded Visual Studio 2005 C++, which is to be run on HP Ipaq hx 4700 series PDA.

a. The program obtains images barcode from offline windows bitmap (BMP) files or in real-time from a camera that is either attached or built in the PDA.
b. The image barcode is obtained from a camera that is either attached or built in the PDA.
c. Barcode symbologies that will be considered in the project will be mainly the **EAN -13** (Very common in consumer products).

1.11 Project Outline

This project is organized into five chapters. The outline is as follows;

Chapter 1-Introduction

This chapter discusses the objectives and scope of the project and gives a general introduction to barcode technology.

Chapter 2-Review of Literature Studies

This chapter reviews the relevant literature and previous work regarding PDA using camera barcode readers. In addition to that, explain of EAN-13 symbologies are given.

Chapter 3- Methodology

This chapter elaborates on the principles behind good quality image acquisition and the factors that must be taken into consideration to obtain readable barcodes. This includes camera selection, determination of field of view, resolution, light intensity and shake. The algorithms to initiate barcode detection and decoding are also described and justified in this chapter.

Chapter 4-Result

The final results of this project are shown in this chapter.

Chapter 5-Conclusion

This chapter consists of the conclusion and future improvement.