# SMART SURVEILLANCE USING PDA

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"*To my beloved Father, Mother, Brothers and Sisters*"

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# ABSTRACT

The aim of this research is to develop a fast and reliable surveillance system based on a personal digital assistant (PDA) device. This is to extend the capability of the device to detect moving objects which is already available in personal computers. Secondly, to compare the performance between Background subtraction (BS) and Temporal Frame Differencing (TFD) techniques for PDA platform as to which is more suitable. This project is designed for Pocket PC devices (windows Mobile 2003 SE or windows CE 4.2) meant for indoor use only. The system is capable to operate at 5 frames per second. The entire surveillance program has been developed and programmed using Embedded Visual C++ taking the advantage of the built-in camera. In order to reduce noise and to prepare frames for the moving object detection part, each frame is first converted to a gray-scale representation and then smoothed using a Gaussian low pass filter. Two moving object detection schemes i.e., BS and TFD have been analyzed. TFD is done by taking the difference between the current frame and the previous frame. On the other hand BS is accomplished by taking the difference between subsequence frame and the background frame. The background frame is updated by using Infinite Impulse Response (IIR) filter so that the background frame is adapted to the varying illuminate conditions and geometry settings. In order to reduce the effect of noise pixels resulting from frame differencing morphological filters erosion and dilation are applied. In this work, it has been found that TFD technique is more suitable for motion detection purpose than the BS in term of speed. On average TFD is approximately 170 ms faster than the BS technique.

# ABSTRAK

Tujuan utama penyelidikan ini adalah untuk membangunkan satu sistem pengawasan yang cepat dan boleh diharap serta beroperasi dengan penolong peribadi digital (PDA). Ini adalah untuk meningkatkan kebolehan peranti ini untuk mengesan objek bergerak, iaitu satu kebolehan yang sudah sedia ada pada komputer peribadi. Objektif kedua adalah untuk membandingkan pencapaian teknik penolakan latar belakang (BS) berbanding dengan teknik penolakan kerangka semasa (TFD) yang dilaksanakan di atas platform PDA dan menentukan teknik yang mana lebih sesuai. Projek ini direka untuk peranti Pocket PC (Windows Mobile 2003 SE atau Windows CE 4.2) dan hanya untuk kegunaan di dalam bangunan sahaja. Sistem in berkebolehan beroperasi pada kadar 5 kerangka per saat. Keseluruhan aturcara ini dibangunkan menggunakan Embedded Visual C++ dan memanfaatkan kamera digital dalaman. Bagi mengurangkan hingar dan menyediakan kerangka untuk pengesanan objek bergerak, setiap kerangka ditukarkan kepada skala kelabu dan ditapis dengan penapis lulus rendah Gaussian. Teknik TFD merupakan operasi penolakan antara kerangka semasa dengan kerangka terdahulu, manakala teknik BS pula mengambil hasil penolakan antara kerangka semasa dan kerangka latar belakang. Latar belakang dikemas-kini menggunakan penapis impuls terbatas (IIR) agar latar belakang boleh menyesuai terhadap perubahan pencahayaan dan keadaan geometri. Operasi morfologi penghakisan dan pengembangan digunakan untuk mengurangkan hingar hasil operasi penolakan kerangka. Di dalam penyelidikan ini, didapati apabila faktor masa diambil kira, teknik TFD adalah lebih berkesan untuk pengesanan objek bergerak berbanding teknik BS. Secara puratanya, TFD adalah 170ms lebih pantas berbanding dengan teknik BS.

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# GLOSSARY OF NOTATIONS

| | |
|---|---|
| $R$ | Value of Red color. |
| $G$ | Value of Green color. |
| $B$ | Value of Blue color. |
| $T$ | Threshold value (32) |
| $I_t$ | The current frame. |
| $I_{t-1}$ | The previous frame. |
| $\sigma^2$ | The variance of Gaussian distribution |
| $f(x, y)$ | Input image |
| $g(x, y)$ | Output image (binary image). |
| $P_v(y)$ | Projection of the vertical axis |
| $P_h(x)$ | Projection of the horizontal axis |

# LIST OF ABBREVIATIONS

| | |
|---|---|
| 1GSS | First Generation Surveillance Systems |
| 2GSS | Second Generation Surveillance Systems |
| 3GSS | Third generation surveillance systems |
| BS | Background subtraction |
| FPS | Frames Per Second |
| GUI | Graphical user interface |
| HTTP | Hypertext Transfer Protocol |
| IIR | Infinite Impulse Response |
| J2ME | Java2 Micro Edition |
| JMF | Java Media Framework |
| MO | Moving Object |
| PDA | Personal Digital Assistant |
| RMI | Remote Method Invocation |
| TFD | Temporal Frame Differencing |
| WTP | Watching Transmission Protocol |

# LIST OF APPENDICES

# CHAPTER 1

# INTRODUCTION

## 1.1 INRODUCTION

Video surveillance systems have long been in use to monitor security sensitive areas. The history of video surveillance consists of three generations of systems which are called 1GSS, 2GSS and 3GSS.

The first generation surveillance systems (1GSS, 1960-1980) were based on analog sub systems for image acquisition, transmission and processing. They extended human eye in spatial sense by transmitting the outputs of several cameras monitoring a set of sites to the displays in a central control room. They had the major drawbacks like requiring high bandwidth, difficult archiving and retrieval of events due to large number of video tape requirements and difficult online event detection which only depended on human operators with limited attention span.

The next generation surveillance systems (2GSS, 1980-2000) were hybrids in the sense that they used both analog and digital sub systems to resolve some drawbacks of its predecessors. They made use of the early advances in digital video

processing methods that provide assistance to the human operators by filtering out spurious events. Most of the work during 2GSS is focused on real-time event detection.

Third generation surveillance systems (3GSS, 2000- ) provide end-to-end digital systems. Image acquisition and processing at the sensor level, communication through mobile and fixed heterogeneous broadband networks and image storage at the central servers benefit from low cost digital infrastructure.

Unlike previous generations, in 3GSS some part of the image processing is distributed towards the sensor level by the use of intelligent cameras that are able to digitize and compress acquired analog image signals and perform image analysis algorithms like motion and face detection with the help of their attached digital computing components.

The ultimate goal of 3GSS is to allow video data to be used for online alarm generation to assist human operators and for offline inspection effectively. In order to achieve this goal, 3GSS will provide smart systems that are able to generate real-time alarms defined on complex events and handle distributed storage and content-based retrieval of video data.

The making of video surveillance systems “smart” requires fast, reliable and robust algorithms for moving object detection, classification, tracking and activity analysis. Starting from the 2GSS, a considerable amount of research has been devoted for the development of these intelligent algorithms.

## 1.2 PDA

PDA is an abbreviation for Personal Digital Assistant, a handheld device that combines computing, telephone/fax, Internet and networking features. A typical PDA can function as a cellular phone, fax sender, Web browser and personal organizer. Unlike portable computers, most PDAs began as pen-based, using a stylus rather than a keyboard for input. This means that they also integrated handwriting recognition features. Some PDAs can also react to voice input by using voice recognition technologies. PDAs of today are available in either a stylus or keyboard version. The most of PDAs can be categorized as shown in Figure 1.1 in three types:

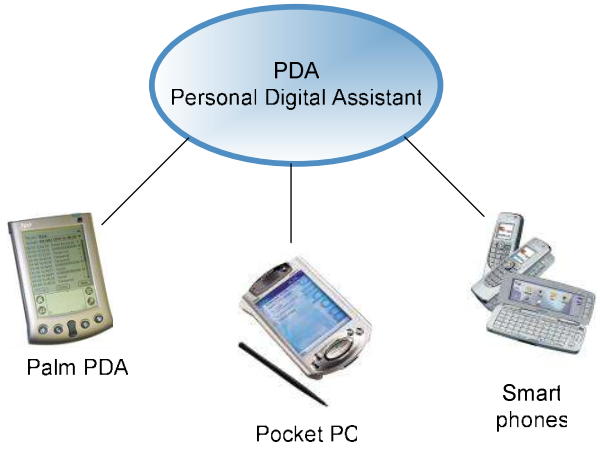


**Figure 1.1:** Types of PDA

### 1.2.1 Palm PDAs:

Palm PDAs originally developed by the Palm Company but now available from other companies such as Acer, Sony and Handspring.

### 1.2.2 Pocket PC

These PDAs run a version of Windows specifically designed for handhelds. As such, it is initially more familiar to a PC user. HP, Fujitsu-Siemens, DELL are popular manufacturers.

### 1.2.3 Smartphones

Mobile phones use Windows Mobile or Symbian as operating system developed by the Palm Company but now available from other companies such as Acer, Sony and Handspring.

## 1.3 The comparison between Pocket PC and Palm PDA

Differences between Pocket PC (Windows CE or Windows Mobile OS) and Palm PDA (Palm OS) are shown in Table 1.1:

**Table 1.1**: Comparsion between PocketPC and Palm

| Feature | PocketPC (Windows CE) | Palm PDA (Palm OS) |
|---|---|---|
| User Interface Action Clicks (clicks required to perform a function) | 1 | 1 |
| User Interface Application Launching | Menu, submenu is icons after drilling down | icons only |
| User Interface Application Menus | Always visible | Requires user to click on menu button |
| Fonts | Regular and Bold | 3 different font sizes per application |
| Handwriting Recognition Shortcuts | No | Yes |
| E-Mail - Attachments | Yes, and HTML | No |
| Pocket apps (Word and Excel) w/desktop file format support | Yes | No |
| Sound levels | variable | 3 |
| Sound level options | System | System, Alarm, Game |
| IrDA Auto Receive | no | yes |
| Sync log on device | no | yes |
| Security | password | password, private items, forgotten password |
| Find | by column, word, or application | General - searches all apps and data |
| Storage Model | Directory, flattened My Documents | invisible to user |
| Multitasking | Yes | No Multitasking |

## 1.4 Windows Mobile for Pocket PC

Microsoft recently announced Windows Mobile, a new global brand for Microsoft software for mobile devices such as Pocket PCs and Smartphones. The launch of Windows Mobile software extends the Windows brand to the Pocket PC and Smartphone mobile device categories. The new Windows Mobile brand also helps customers more readily understand the consistent user experience they can expect from the software inside Pocket PCs and Smartphones. The new branding also reflects Microsoft's commitment to the mobile space in bringing its mobile device software into the Windows brand family.

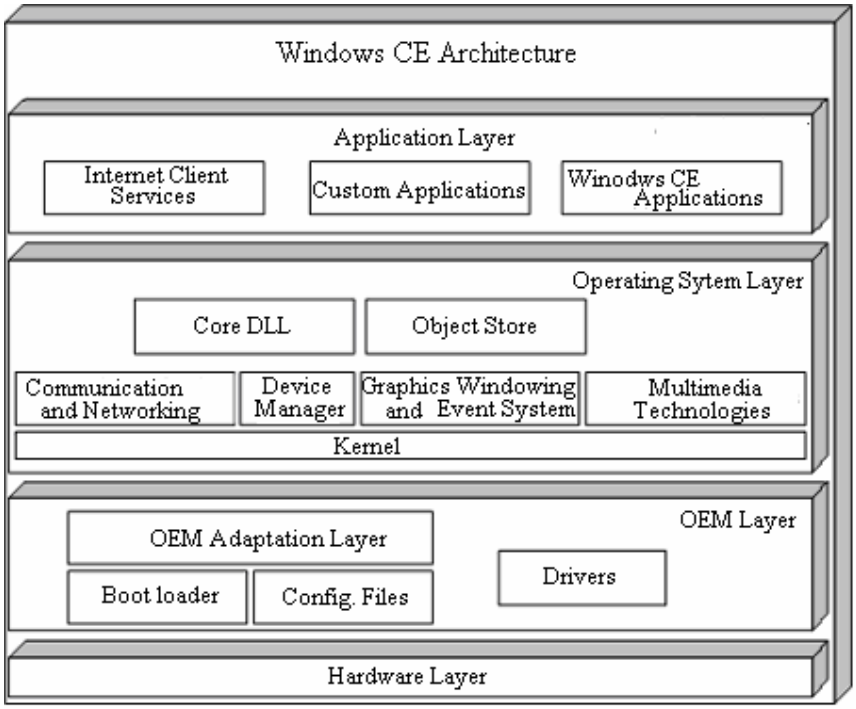


**Figure 1.2**: Pocket PC platform.

## 1.5 Surveillance using PDA

PDAs have become devices many of us use on a daily basis. They are relatively inexpensive; offer a many of applications while also being small, portable, and easy to use. Many standard PDA interfaces have been developed for a wide range of applications. In addition to standard applications such as word processing, calendar management, and calculators, some more specialized systems have been developed. For example, character recognition [1, 2, 3], educational tools [4, 5], and face recognition [6].

Therefore, it seems relatively obvious that PDAs may represent a good base for supervision. Their small size, processing capability, and portability make them suitable platform for surveillance.

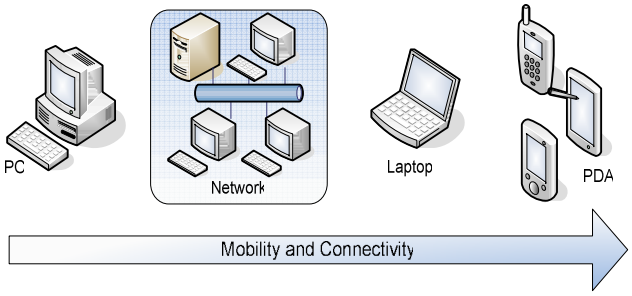


**Figure 1.3**: Evolution of Mobility & connectivity

## 1.6 Objectives

The main objective of the project to design and develop a fast and reliable surveillance system based on PDA. This is to extend the capability of the device to detect the moving of objects which is already available in personal computers. The second objective is to compare the performance between BS and TFD techniques for PDA platform

## 1.7 Scope of the work

In developing a system for smart surveillance for PDA platform, the scope of the current research has been defined as follows:

- The system is designed for Pocket PC only
  (Windows Mobile 2003 SE, Windows CE 4.2 or higher)
- Indoor use only with stationary PDA.
- The system operates at 5 FPS.
- The entire surveillance program has been developed and programmed using Embedded Visual C++.

## 1.8 Project Outline

The project is organized into chapters. The outline is as following:

**Chapter 1-Introduction**

The first chapter provides readers a first glimpse at the basic aspects of the research undertaken such as objectives, copes, problem statement.

**Chapter 2-Literature Review**

The second chapter gives an insight to the previous work regarding to the surveillance based on PDA platform.

**Chapter 3- Methodology**

This chapter presents an overall system methodology and steps must be taken in consideration for moving object detection.

**Chapter 4-Results**

This chapter shows the final results for Moving Object detection based on PDA platform.

**Chapter 5- Conclusion**

This chapter deals with summary and conclusion of the research. Last of all some realistic extensions as well as possible enhancement for the research are provided.

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