

ELIMINATION OF RAINDROPS EFFECTS IN INFRARED SENSITIVE  
CAMERA

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To my beloved mother and father

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## **ABSTRACT**

Surveillance systems are important part of the security systems nowadays. The traditional methods of surveillance systems involving human now have improved to automated systems. The effects of rain brought some drawback to the automated surveillance systems especially during rainy night time which degrade the performance of the tracking system. This project has proposed a method to eliminate those raindrops effects in order to improve the performance of the tracking system in the automated surveillance systems. An algorithm has been developed using MATLAB® Image Processing Toolbox. Unique visual properties of raindrops are observed and analyzed which then has been manipulated into the algorithm as a mechanism for raindrops effects removal. The result produced as a comparison to its original input shows a significant raindrops effects elimination.

## **ABSTRAK**

Pemantauan atau pemerhatian merupakan suatu perkara yang penting dalam sistem keselamatan. Kaedah tradisional dalam sistem pemantauan yang melibatkan pegawai keselamatan untuk berjaga, meronda dan memerhati telah digantikan dengan sistem pemantauan automatik yang menggunakan kamera pemantau dan unit pemprosesan digital. Namun, kesan hujan telah membawa beberapa kesan buruk kepada sistem pemantauan automatik terutamanya hujan ketika waktu malam yang mana menyebabkan prestasi sistem pengesanan menurun. Projek ini telah mencadangkan suatu kaedah untuk menghilangkan kesan hujan tersebut dalam usaha untuk memperbaiki prestasi sistem pengesanan dalam sistem pemantauan automatik. Suatu algoritma telah dibangunkan menggunakan MATLAB® Image Processing Toolbox. Ciri-ciri visual hujan yang unik diperhatikan dan dianalisis, kemudiannya dimanipulasikan ke dalam algoritma tersebut sebagai suatu mekanisme untuk menghilangkan kesan hujan. Keputusannya, imej yang telah diproses, sebagai perbandingan kepada imej yang asal menunjukkan kesan hujan telah berjaya dihilangkan dengan baik.

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**LIST OF SYMBOLS**

$a$	-	Radius
$b_c$	-	Diameter of defocus kernel (blue circle)
$c$	-	Threshold value
$E$	-	Irradiance
$f$	-	Focal length
$I$	-	Intensity
$k$	-	Camera gain
$L$	-	Luminance
$N$	-	F-number
$n$	-	Frame number
$r$	-	Spatial coordinate
$R$	-	Temporal correlation
$T$	-	Camera exposure time
$t$	-	Time
$v$	-	Velocity
$w$	-	Width
$z$	-	Distance
$\beta$	-	Slope
$\Delta$	-	Different
$\tau$	-	Time

**LIST OF ABBREVIATIONS**

AVI	-	Audio Video Interleave
NVD/NVDs	-	Night Vision Device/s
RGB	-	Red blue green

## **CHAPTER 1**

### **INTRODUCTION**

Automatic surveillance system is an important system since it involves the security and safety of the surrounding automatically. One of the important features in an automatic surveillance system is the ability of the system to automatically tracking the objects of interest in the scene. This system involves the used of surveillance camera and digital image processing unit instead of human to monitor the surrounding area of interest and it is proven to perform better than the human to some extent.

The surveillance camera used is the infrared sensitive camera that has night vision built right in. Night vision or sometimes called night vision devices (NVDs) rely on a special tube, called an image-intensifier tube, to collect and amplify infrared and visible light. A projection unit, called an IR Illuminator, is attached to the NVD. The unit projects a beam of near-infrared light, similar to the beam of a normal flashlight. Invisible to the naked eye, this beam reflects off objects and bounces back to the lens of the NVD and eventually make the camera to “see” at night.

## **1.1 Problem Statement**

The ability of infrared sensitive camera to “see” at night does bring some problems to the tracking system. One of the major problems encountered in detecting moving objects at night time using infrared sensitive camera is the presence of raindrops. Due to its reflective surface, raindrops, especially those near the camera lens, will appear as very bright moving objects. As a consequence, these raindrops will be detected as valid moving objects which in return increasing the false detection rate of the tracking system.

## **1.2 Objective of Project**

The objectives of this project are to develop, simulate and analyze an algorithm that will remove raindrops effects using MATLAB® Image Processing Toolbox and to discriminate the raindrops effects from the scene captured by the infrared sensitive camera so that effective detection and tracking of moving objects can be undertaken.

## **1.3 Scope of Project**

This project will make use of the MATLAB® Image Processing Toolbox as the algorithm development platform. Images sequence captured by an infrared sensitive camera is used as the input material for the development process. This images sequence is a night scene of moving objects with the interference of moderate rain condition. The processing will be done offline where the input material is first

captured before being processed. The process will involve the frame level processing where frame by frame is observed and analyzed in order to develop an algorithm for raindrops effects elimination.