

# An Enhanced Background Subtraction Algorithm for Smart Surveillance System Using Adaptive Gaussian Mixture Technique

Olayemi M. Olaniyi, Ibrol A. Bala, Shefiu Oluasegun Ganiyu and Prince Emmanuel, Wisdom

Federal University of Technology Minna, Niger State, Nigeria

\*Corresponding Author's E-mail: [olaniyi01@futmminna.edu.ng](mailto:olaniyi01@futmminna.edu.ng)

**Abstract**— Surveillance is an important component of secure infrastructure. People need to ensure that their properties, homes, friends, families, and valuables are protected from intruders. In this article, we developed an enhanced background subtraction algorithm for smart surveillance of homes under changes in illumination. An adaptive Gaussian Mixture technique was applied to improve the conventional background subtraction technique for smart surveillance system by reducing false positives and improving the system performance in motion detection. The developed smart surveillance system has the ability to send notifications containing intruder's image to registered email account and short message system to registered phone number whenever motion is detected. The performance evaluation of developed algorithm showed a sensitivity of 89%, specificity of 92% and an accuracy of 93.56%. This system works in conditions of illumination changes and can be adopted in motion detection for home surveillance.

**Keywords**— Background Subtraction, Motion detection, Receiver Operating Characteristics, Short Message Service, Specificity, Sensitivity, Surveillance, Smart

## 1. INTRODUCTION

As an essential component of many security associations' priorities, video surveillance has demonstrated its importance and benefits many times by providing immediate supervision of possessions, people, the environment and property [1]. The demand for video surveillance systems is increasing rapidly nowadays. One of the first things important to people is about their monitoring system, whether or not they have the ability to connect to it via the Internet for remote viewing. In the past, security systems had to be monitored by a guard who was locked in a room all day to monitor the video feeds to make sure nothing happened [2]. The other option was to come back and view the video footages, but at that instance, damage might be caused to the stored images under monitoring. Therefore, researchers and scientists have had to find ways to overcome this problem and thereby improve overall safety.

Simply, Surveillance can be defined as the process of closely monitoring changing information like activities, conducts, behaviors for the purpose of protecting, managing, influencing and directing people [3]. The word surveillance is derived from two French words: "sur" which means "over" and "veiller" meaning "watch" which is in turn derived from the Latin word "vigilare" and is in contrast

to more recent developments such as sousveillance [4]. Surveillance could also mean watching over from a distance by means of electronic equipment such as Close Circuit Television (CCTV) cameras [5]. Surveillance is very helpful to law enforcement agents to investigate and prevent criminal activities, for recognizing and monitoring possible threats to an infrastructure. Basically, the design of a surveillance system consists of analyzing the needs of the people, reviewing the system costs based on existing hardware and software technologies, monitoring choices and then planning for the installation [6]. The design choices may vary from time to time due to advancement in technology. Surveillance system has always been playing a vital role in dealing with the burglary cases and protection of entire perimeter of an infrastructure [7].

Moving object detection is a critical task for many computer vision applications; the objective is the classification of the pixels in the video sequence into either foreground or background [10]. A commonly used technique to achieve this in scenes captured by a static camera is Background Subtraction (BGS) [11]. Background subtraction is the process of identifying moving objects from the portion of a video frame that differs significantly from a background scene [12]. An Adaptive Gaussian Mixture Technique (AGMT) can be used to detect motion or intruders by alerting the user of possible intrusion of infrastructure under surveillance.

In this contribution, we develop a smart surveillance system using AGMT to improve the basic BGS technique in motion detection. The problem of the BGS techniques are: inability to adapt to illumination changes, inability to mask areas where motion detection is not needed like rotation of fans in homes, surveillance being placed outdoors and the existence of trees moving under the wind which affect surveillance focus [8].

Also, this technique was implemented to avoid the use of motion detection sensors like the passive infrared sensors due to the following drawbacks: high sensitivity which leads to the detection of objects such as rats, improper function in hot areas due to faulty readings caused by an increase in temperature, high rate of maintenance in which a lack of could lead to sensor failure, and high cost of implementation [9]. This work makes use of camera for both video surveillance and motion detection simultaneously. In essence, this system improves on the basic background

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