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

Olayemi M. Olaniyi, Jibril A. Bala, Shefiu Olusegun Ganiyu and Praise Emmanuel. Wisdom

Federal University of Technology Minna, Niger State, Nigeria

*Corresponding Author's E-mail: mikail.olaniyi@futminna.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 algorithms showed a sensitivity of 80%, specificity of 92% and an accuracy of 95.56%. 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*

I. 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 means 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].
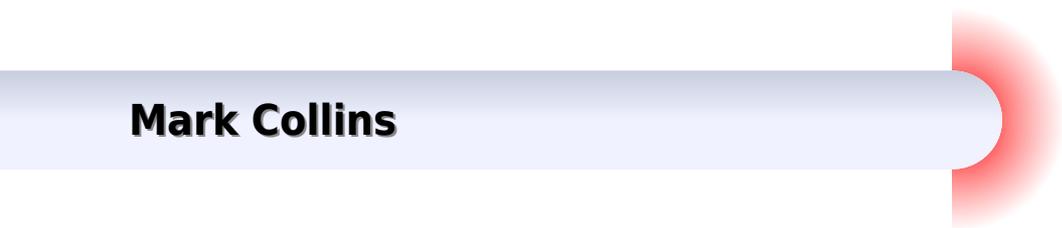
Moving object detection is a critical task for many computer vision applications; the objective is the classification of the pixels in the video sequence into either foreground or background [10]. A commonly used technique to achieve this in scenes captured by a static camera is Background Subtraction (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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Embedded Surveillance System Using Background Subtraction:

Proceedings of the 6th International Conference on Electrical, Control and Computer Engineering Zainah Md. Zain,Mohd. Herwan Sulaiman,Amir Izzani Mohamed,Mohd. Shafie Bakar,Mohd. Syakirin Ramli,2022-03-08 This book presents the proceedings of the 6th International Conference on Electrical Control and Computer Engineering InECCE 2021 held in Kuantan Pahang Malaysia on 23 August 2021 The topics covered are sustainable energy power electronics and drives and power engineering including distributed renewable generation power system optimization artificial computational intelligence smart grid power system protection and machine learning energy management and conservation The book showcases some of the latest technologies and applications developed to solve local energy and power problems in order to ensure continuity reliability and security of electricity for future generations It also links topics covered the sustainable developed goals SDGs areas outlined by the United Nation for global sustainability The book will appeal to professionals scientists and researchers with experience in industry *Smart Sensors and Systems* Yongpan Liu,Youn-Long Lin,Chong-Min Kyung,Hiroto Yasuura,2020-06-10 This book describes for readers technology used for effective sensing of our physical world and intelligent processing techniques for sensed information which are essential to the success of Internet of Things IoTs The authors provide a multidisciplinary view of sensor technology from materials process circuits and big data domains and showcase smart sensor systems in real applications including smart home transportation medical environmental agricultural etc Unlike earlier books on sensors this book will provide a global view on smart sensors covering abstraction levels from device circuit systems and algorithms Profiles active research on smart sensors based on CMOS microelectronics Describes applications of sensors and sensor systems in cyber physical systems the social information infrastructure in our modern world Includes coverage of a variety of related information technologies supporting the application of sensors Discusses the integration of computation networking actuation databases and various sensors in order to embed smart sensor systems into actual social systems **Computing Technologies for Sustainable Development** Prasanna Devi Sivakumar,Raj Ramachandran,Chitra Pasupathi,Prabha Balakrishnan,2025-02-14 This book constitutes the refereed proceedings of the First International Research Conference on Computing Technologies for Sustainable Development IRCCTSD 2024 held in Chennai India during May 9 10 2024 The 65 full papers and 14 short papers presented here were carefully selected and reviewed from 264 submissions These papers have been organized in the following topical sections Part I innovations in precision agriculture techniques and strategies for enhancing agriculture production classification and prediction analysis in healthcare animal welfare and innovations in diagnostics Part II video and image processing for security analysis innovations for smart cities sustainable practices in e commerce challenges and trends Part III environmental analysis and protection inclusive communication techniques AI for text audio image and video processing and application of AI for education **Background Modeling and Foreground Detection for Video Surveillance** Thierry

Bouwmans,Fatih Porikli,Benjamin Höferlin,Antoine Vacavant,2014-07-25 Background modeling and foreground detection are important steps in video processing used to detect robustly moving objects in challenging environments This requires effective methods for dealing with dynamic backgrounds and illumination changes as well as algorithms that must meet real time and low memory requirements Incorporating both established and new ideas Background Modeling and Foreground Detection for Video Surveillance provides a complete overview of the concepts algorithms and applications related to background modeling and foreground detection Leaders in the field address a wide range of challenges including camera jitter and background subtraction The book presents the top methods and algorithms for detecting moving objects in video surveillance It covers statistical models clustering models neural networks and fuzzy models It also addresses sensors hardware and implementation issues and discusses the resources and datasets required for evaluating and comparing background subtraction algorithms The datasets and codes used in the text along with links to software demonstrations are available on the book s website A one stop resource on up to date models algorithms implementations and benchmarking techniques this book helps researchers and industry developers understand how to apply background models and foreground detection methods to video surveillance and related areas such as optical motion capture multimedia applications teleconferencing video editing and human computer interfaces It can also be used in graduate courses on computer vision image processing real time architecture machine learning or data mining   Computer Vision and Internet of Things Lavanya Sharma,Mukesh Carpenter,2022-05-19 Computer Vision and Internet of Things Technologies and Applications explores the utilization of Internet of Things IoT with computer vision and its underlying technologies in different applications areas Using a series of present and future applications including business insights indoor outdoor securities smart grids human detection and tracking intelligent traffic monitoring e health departments and medical imaging this book focuses on providing a detailed description of the utilization of IoT with computer vision and its underlying technologies in critical application areas such as smart grids emergency departments intelligent traffic cams insurance and the automotive industry Key Features Covers the challenging issues related to sensors detection and tracking of moving objects with solutions to handle relevant challenges Describes the latest technological advances in IoT and computer vision with their implementations Combines image processing and analysis into a unified framework to understand both IOT and computer vision applications Explores mining and tracking of motion based object data such as trajectory prediction and prediction of a particular location of object data and their critical applications Provides novel solutions for medical imaging skin lesion detection cancer detection enhancement techniques for MRI images and automated disease prediction This book is primarily aimed at graduates and researchers working in the areas of IoT computer vision big data cloud computing and remote sensing It is also an ideal resource for IT professionals and technology developers   **Distributed Video Sensor Networks** Bir Bhanu,Chinya V. Ravishankar,Amit K. Roy-Chowdhury,Hamid Aghajan,Demetri Terzopoulos,2011-01-04 Large scale video

networks are of increasing importance in a wide range of applications However the development of automated techniques for aggregating and interpreting information from multiple video streams in real life scenarios is a challenging area of research Collecting the work of leading researchers from a broad range of disciplines this timely text reference offers an in depth survey of the state of the art in distributed camera networks The book addresses a broad spectrum of critical issues in this highly interdisciplinary field current challenges and future directions video processing and video understanding simulation graphics cognition and video networks wireless video sensor networks communications and control embedded cameras and real time video analysis applications of distributed video networks and educational opportunities and curriculum development Topics and features presents an overview of research in areas of motion analysis invariants multiple cameras for detection object tracking and recognition and activities in video networks provides real world applications of distributed video networks including force protection wide area activities port security and recognition in night time environments describes the challenges in graphics and simulation covering virtual vision network security human activities cognitive architecture and displays examines issues of multimedia networks registration control of cameras in simulations and real networks localization and bounds on tracking discusses system aspects of video networks with chapters on providing testbed environments data collection on activities new integrated sensors for airborne sensors face recognition and building sentient spaces investigates educational opportunities and curriculum development from the perspective of computer science and electrical engineering This unique text will be of great interest to researchers and graduate students of computer vision and pattern recognition computer graphics and simulation image processing and embedded systems and communications networks and controls The large number of example applications will also appeal to application engineers *Advanced Hybrid Information Processing* Weina Fu,Lin Yun,2023-03-21 This two volume set constitutes the post conference proceedings of the 6th EAI International Conference on Advanced Hybrid Information Processing ADHIP 2022 held in Changsha China in September 29 30 2022 The 109 full papers presented were selected from 276 submissions and focus on theory and application of hybrid information processing technology for smarter and more effective research and application The theme of ADHIP 2022 was Hybrid Information Processing in Meta World The papers are named in topical sections as follows Information Extracting and Processing in Digital World Education Based methods in Learning and Teaching Various Systems for Digital World MEMS, NANO and Smart Systems Li Yuan,2011-11-29 Selected peer reviewed papers from the 2011 7th International Conference on MEMS NANO and Smart Systems ICMENS 2011 November 4 6 2011 Kuala Lumpur Malaysia **Employment of low-cost low-power ARM machines as tracking device for real time vehicle movement** Mark Collins,2014-06-26 Bachelor Thesis from the year 2013 in the subject Computer Science Technical Computer Science grade 69 University of Lincoln School of Computer Science course Computer Science language English abstract This undergraduate Bachelor Thesis examines the use of a raspberry pi towards a real time computer vision system Advances in

technology in recent years have steadily increased computational performance ushering in the availability of affordable powerful single board micro systems This project attempts to showcase an application of low cost hardware for performing modern computer vision algorithms paired with imaging sensors to emulate an embedded system In order to achieve this goal the project must demonstrate background learning object detection and establish methods for monitoring the real time movement of pedestrians and vehicles on a road The implementation will make use of a Raspberry Pi type Model B as the main piece of computational hardware to be employed to an IP camera   *Journal of VLSI Signal Processing Systems for Signal, Image, and Video Technology* ,2005   *Multimedia Content Access* A. Hanjalic,Raimondo Schettini,Nicu Sebe,2007 Proceedings of SPIE present the original research papers presented at SPIE conferences and other high quality conferences in the broad ranging fields of optics and photonics These books provide prompt access to the latest innovations in research and technology in their respective fields Proceedings of SPIE are among the most cited references in patent literature   *Pattern Recognition and Image Analysis* ,2005   **Proceedings** ,2003   **New Trends and Applications of Computer-aided Material and Engineering** Wen Ya Tian,Lin Li Xu,2011-01-11 Selected peer reviewed papers from the 2011 International Conference on Computer aided Material and Engineering ICCME 2011 March 9 11 2011 Hangzhou China   **Unattended Ground Sensor Technologies and Applications** ,2002   *Optical Instrumentation for Gas Emissions Monitoring and Atmospheric Measurements* Joseph Leonelli,1995   *Environmental Monitoring and Remediation Technologies II* Tuan Vo-Dinh,Robert L. Spellicy,1999 This work brings together a selection of papers dealing with various aspects of environmental monitoring and remediation technologies   Optical Methods in Cell Physiology Paul De Weer,1986 A book for physiologists biologists and biochemists studying cell physiology Included are major optical techniques and bases for designing experiments and choosing appropriate instrumentation along with discussions on methods and results of optical techniques applied to research through image enhancement probes for membrane potential intracellular indicators for Ca and pH and photobleaching and photoactivation techniques Also included are schematic drawings and numerous references   Optomechatronic Machine Vision Kazuhiko Sumi,2005 Proceedings of SPIE present the original research papers presented at SPIE conferences and other high quality conferences in the broad ranging fields of optics and photonics These books provide prompt access to the latest innovations in research and technology in their respective fields Proceedings of SPIE are among the most cited references in patent literature   **Acquisition, Tracking, and Pointing** ,1998

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