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Smart Object Recognition in Wireless Surveillance

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Abstract: Multiple cameras feed their image analysis into this advanced security system which unites alarm activation with surveillance functionality and automated real-time security verification. The system functionally reacts to pre-setup scenarios including situations of break-ins and crimes as well as human supervision needs. The algorithm framework for visual content analysis (VCA) supports this concept. Our algorithms require changes with specific modifications to achieve requirements targets. A video processing framework detects foreground elements from background and performs localization while extracting objects and tracking them. Multiple cameras provide the foundation for the recognition process which relies on limited image sets and vector compositions. This system offers effective superiority over traditional surveillance methods while maintaining enhanced performance.

Keywords: *Smart Surveillance, Object Recongnition, Visual Content Analysis, Citywide Surveillance, Video Processing.*

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I. INTRODUCTION

A sophisticated smart surveillance system functions chiefly to provide security and to conduct surveillance operations[1]. This system boasts of multiple features such as Alarm system, Video Surveillance, Visual Content Analysis (VCA), Home, and Office automation. The system functions exclusively based on electronic components which function as chips similar to computers. Through its construction the smart Surveillance system integrates capabilities for wireless cameras together with alarm systems along with various sensors and other electronic control devices. This system delivers a complete package solution to handle multiple tasks including unauthorized entrance detection and criminal activity tracking and person and vehicle surveillance. [2] The developed system functions as an operational platform to handle numerous specific situations within varying environments. The system finds its primary applications throughout House, Hospitals, Offices, Backyards, Parking spaces, Entrance, and exits of buildings[3].

Various other security systems exist yet they do not contain VCA functionalities. Through VCA capabilities users can detect objects while simultaneously recognizing and tracking them [4]. Additional systems possess related functionality which includes dynamic saliency map used for object detection paired with Gaussian Mixture Model alongside boosting and Adaboosting for object classification[5]. The literature review demonstrates various intelligent security technologies based on concepts previously introduced. Liao and Su released a discussion on establishing communications and automation through various types of interfaces in their previous work[6]. A wireless sensor network-based system serves as the proposed framework toexecute surveillance operations without human supervision. This study describes the various components and functions of a smart surveillance platform that handles VCA procedures with sensor and gadget input channels. The report provides details about how service providers monitor individuals receiving care such as elderly or sick patients. The central focus of this report is to demonstrate a video processing mechanism which detects and categorizes moving objects effectively using wireless systems.

II. PROPOSED SOLUTION

The proposed solution incorporates a smart wireless surveillance system containing an object detection system. The current system operates correctly for standard security services together with monitoring operations. The system establishes dual capabilities for traditional security standard admirably alongside its processing abilities for video identification and object detection. The system demonstrates the capability to recognize between moving and stationary objects through its sensor arrangement while enabling alarm functions that standard sensor systems cannot perform[2].

The system includes personalized alerts which trigger specific responses based on object locations monitored by sensors and triggered events. The system includes dedicated sensors regularly employed to detect carbon monoxide since this chemical creates hazardous situations[7]. The system

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offers two options for alerts: one standalone response or multiple triggers including siren alerts together with SMS messages and phone call notifications in addition to other possible notification functions. The surveillance system operates through wireless cameras enabling users to control smart electronics and activate or deactivate surveillance functions and view live footage. A fundamental but effective system operates through a system which requires minimal computing power and demonstrates novel functionality. The classification system employs Harr-Like features together with Histogram of Orient Gradients. The surveillance system operates in diverse settings through cost-effective cameras because its low-resolution image requirements work well for such surveillance[8].

The surveillance system demonstrates intelligence through its operating capabilities together with environment adaptation and physical object recognition performances.

III. DESCRIPTION

The proposed system can be described in two parts: Logical and physical architectures. The system operates using multiple essential components which provide both functional capabilities and structural base. The major components are:

- Multi-interface module
- GUI
- Signal receivers
- Controllers
- Algorithms
- Object repository
- Pattern recording module
- Encryption.

A two-way communication module which integrates multiple peripherals functions as the multi-interface model. The delivery system provides reliable management of message sequences and peripheral control parameters to operate all connected peripherals. Through GUI users can view produced images. Using Web browsers runs on various operational platforms consisting of PC along with Mobile and Mac systems. Signal receivers take responsibility for both Wi-Fi and other analog signal receiver stream support functions. Controllers enable the functionality of those devices that connect physically to systems using wire transmission[9]. The encryption module maintains control of data encryption activities as data moves across transmission channels. The surveillance system depends mainly on its sophisticated algorithm which can recognize various objects whether they stay still or move throughout the area. The system analyzes multiple parameters together with event features including falls during the reporting process. This system processes several video streams simultaneously while requiring minimal computing power and demonstrating high reliability. The effectiveness of the system depends mainly on two interconnected components: the parameter repository and the object identification algorithm. Video stream recordings occur by using wireless cameras during operation. Ordinary wired cameras can also serve as surveillance tools[10]. The camera-recorded videos require dedicated storage to save them. Wireless communication services are available on the secure system interface.

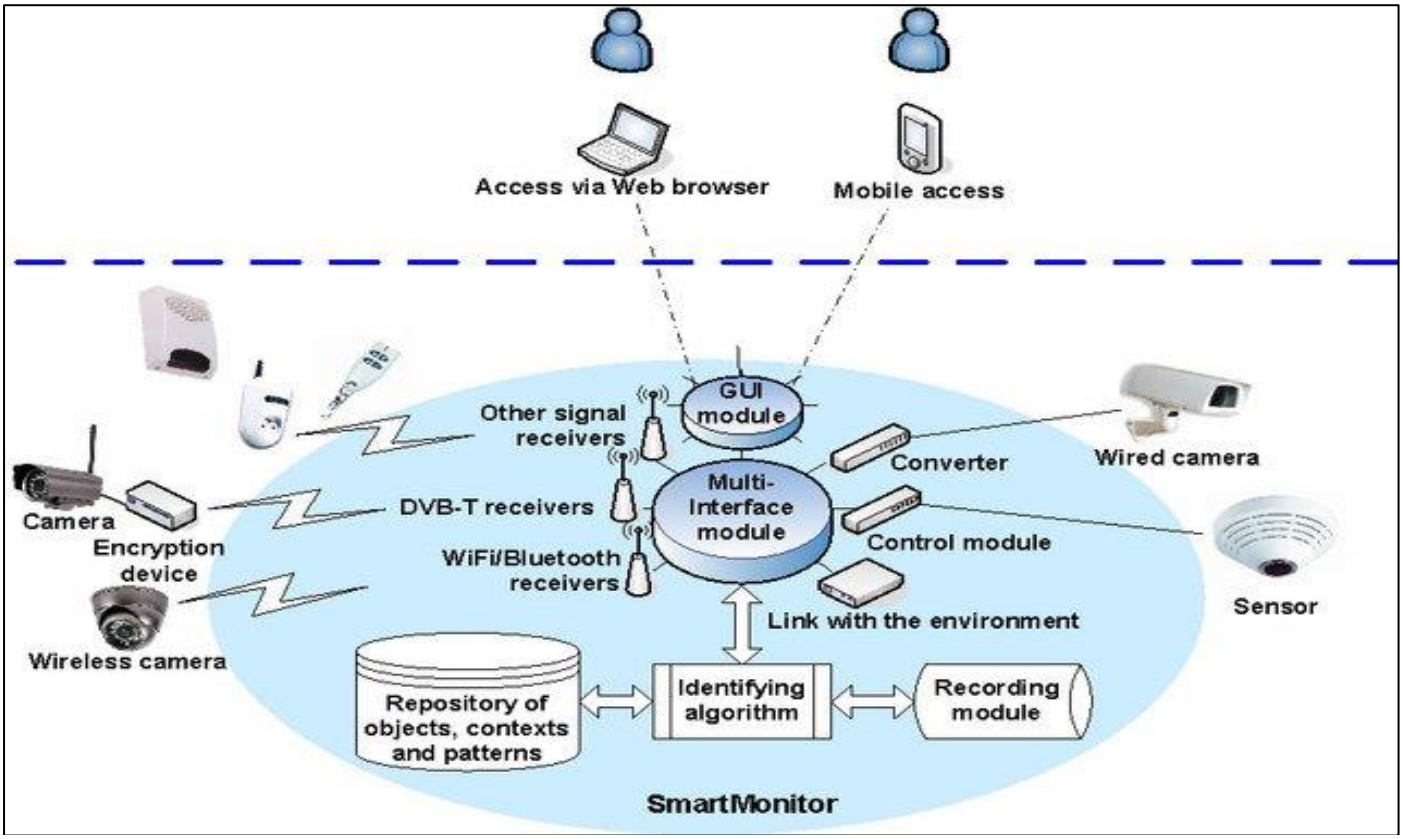

Fig 1 A Schematic for Smart Surveillance System

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In figure 1. The blue shaded portion shows components which match up to a CPU's functionality. How complex the system needs to be installed determines both its peripheral device quantity and variety. The devices preferred are wireless. The system comprises:

Table 1 The below table shows the Component and Specification of Wireless Surveillance Component and Specification of Wireless Surveillance

Components	Specification
Processor	Intel Core i5
Memory	16 GB
SDD	256 GB
Ports	2USB 3.0, 6USB 2.0, 2 RJ45; 2 audio outputs, Bluetooth 3.0, 2 Wi-Fi antennas, 2 Antennas for control devices
OS	Windows 7 64-bit
Power consumption	95 W
Additional	IP Camera (1–4 pcs, Day and Night option required), Power over Ethernet (PoE) switch, UPS, remotely controlled sockets and remote controllers

IV. SOFTWARE

Video Content Analysis stands as the crucial component of the system because it performs recognition and identification of objects and events from recorded video surveillance footage. A variety of modules operates simultaneously to execute VCA along with its interpretation process. The first process involves video transmission and subsequent analytic procedures. The system requires analysis to happen within microsecond timescales. The steps involved in the object detection module are:

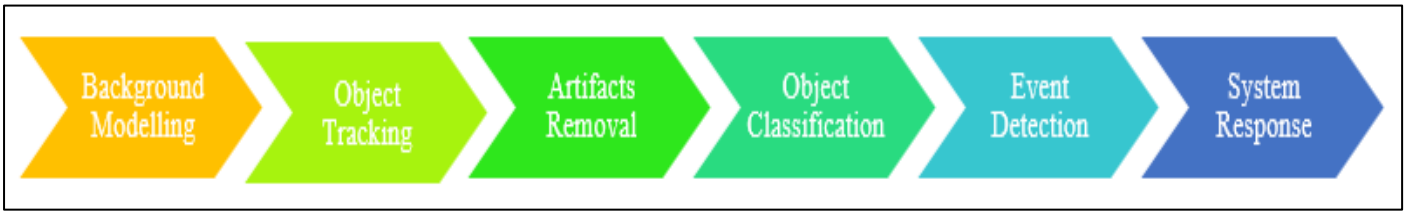

Fig 2 Visual Content Analysis

The method uses motion detection by subtracting background information to enable background modeling. A foreground binary mask emerges from this step followed by consideration of objects exceeding minimum dimension requirements for interest analysis. Additional tracking occurs after background modeling completes its execution. The object tracking procedure uses position information that comes from earlier background modeling calculations. The object trajectory emerges from this process for critical use in deciphering movement patterns. The system enables tracking of multiple objects at the same time. Trajectory mapping functions to identify dangerous movements while enabling automated alarm activation. The artifact removal function conducts a process which eliminates redundant information from binary foreground product masks. The process will eliminate wrong regions which appear within the foreground image. A fundamental method exists for classifying objects through their defined characteristics. Event detection functions by identifying transformations in the shapes and movements of tracked objects together with their spatial position changes. The system establishes warnings based on these parameters[11].

Sırasly the algorithm with particular capabilities for specified tasks demonstrates real-time functioning in surveillance contexts. The newly developed field of Visual Computing Application represents a modern approach to machine vision methods. Several algorithms exist while users have the freedom to select any algorithm they prefer.

Table 2 The below table shows the Parameter and Value of Wireless Surveillance Parameter and Value of Wireless Surveillance

Parameter	Value
Frame resolution	640 X 360 pixels
Scaling factor	0.5 - 320 X180-pixel frames are processed
Background mode	40 frames without any movements are used for learning (the model calibrates within 2–3 s)
Operations	A median filter and double erosion using foreground binary mask
Ares for classification	Minimum 60 pixels
Human object classification	2:1 (height to width)
Harr Classifier specifications	24 X 12 pixels
HOG classifier object size	96 X 48 pixels

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The system effectively performs analysis on the delicate motion of someone who falls.The system performs autonomous wireless task execution.Each system component performs event identification along with automatic pattern detection capabilities.The system both sends alerts and triggers warning alarms when threat situations occur.The system reaches peak efficiency without requiring high computing capabilities.After setup the system operates without human intervention during detection and assessment tasks.l motion of a falling human. The process of the same is:

- Initial parameters setup
- Open video sequence
- Building a background model
- Getting current video feed.
- Detect foreground
- Haar and HOG classification

V. ADVANTAGES

➢ *The System Provides Certain Advantages over the Conventional Surveillance System:*

- The system can do the task automatically and wirelessly.
- The system provides pattern recognition and event classification.
- The system can notify in case of threat along with the triggering alarms.
- The system is also efficient despite the low computing resources.
- The system does not rely on humans once calibrated.

VI. FUTURE SCOPE

Future advancements to the proposed system will focus on extending its traffic monitoring capabilities. Traffic monitoring requires numerous resources because it demands fast processing and heavy workload. A smaller-scale system implementation success determines further growth possibilities. The system shows potential for military applications by enabling real-time detection of high-speed bullets alongside other ammunition during battles. The major obstacle emerges fromRequirements for distant targeting with exceptional precision alongside high-definition cameras[12].

VII. RESEARCH CONCLUSIONS

The findings in this paper verify that the designed system functions as an intelligent video surveillance platform. The system features detection capabilities for objects while operating according to custom user configurations. The surveillance technology extends its use to automated controls for residences and commercial facilities. The system uses its functionality to transmit alerts through telephone numbers and emails to specific recipients. The system provides diverse use cases for applications throughout hospitals and essential entrances and exists in homes and schools and offices. The system demands human intervention only during the initial phase of calibration; afterward, it becomes automatic. The proposed surveillance model can appropriately detect, tracks and classifies moving objects.

REFERENCES

[1]. A. Rahimpour, A. Taalimi, J. Luo, and H. Qi, "Distributed object recognition in smart camera networks," pp. 669-673: IEEE.
[2]. K. Abas, C. Porto, and K. J. C. Obraczka, "Wireless smart camera networks for the surveillance of public spaces," vol. 47, no. 5, pp. 37-44, 2014.
[3]. W.-T. Chen, P.-Y. Chen, W.-S. Lee, and C.-F. Huang, "Design and implementation of a real time video surveillance system with wireless sensor networks," in VTC Spring 2008-IEEE Vehicular Technology Conference, 2008, pp. 218-222: IEEE.
[4]. T. Zhang, A. Chowdhery, P. V. Bahl, K. Jamieson, and S. Banerjee, "The design and implementation of a wireless video surveillance system," in Proceedings of the 21st Annual International Conference on Mobile Computing and Networking, 2015, pp. 426-438: ACM.
[5]. F. Bashir and F. Porikli, "Performance evaluation of object detection and tracking systems," in Proceedings 9th IEEE International Workshop on PETS, 2006, pp. 7-14.
[6]. K.-L. Su, S.-H. Chia, S.-V. Shiau, J.-H. J. A. L. Guo, and Robotics, "Developing a module-based security system for an intelligent home," vol. 14, no. 2, p. 242, 2009.
[7]. X. Wang, "Intelligent multi-camera video surveillance: A review," Pattern recognition letters, vol. 34, no. 1, pp. 3-19, 2013.
[8]. L.-Q. Xu, "Issues in video analytics and surveillance systems: Research/prototyping vs. applications/user requirements," in 2007 IEEE Conference on Advanced Video and Signal Based Surveillance, 2007, pp. 10-14: IEEE.
[9]. R. Wijnhoven and E. Jaspers, "Flexible surveillance system architecture for prototyping video content analysis algorithms," in Multimedia Content Analysis, Management, and Retrieval 2006, 2006, vol. 6073, p. 60730R: International Society for Optics and Photonics.
[10]. E. G. Jaspers et al., "Candela-Storage, Analysis and Retrieval of Video Content in Distributed Systems: Real-Time Video Surveillance and Retrieval," in 2005 IEEE International Conference on Multimedia and Expo, 2005, pp. 1553-1556: IEEE.
[11]. D. Frejlichowski, K. Gościewska, P. Forczmański, and R. Hofman, "“SmartMonitor”—An Intelligent Security System for the Protection of Individuals and Small Properties with the Possibility of Home Automation," Sensors, vol. 14, no. 6, pp. 9922-9948, 2014.
[12]. V. Casola, M. Esposito, F. Flammini, N. Mazzocca, and C. Pragliola, "Performance evaluation of video analytics for surveillance on-board trains," in International Conference on Advanced Concepts for Intelligent Vision Systems, 2013, pp. 414-425: Springer.