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Safe Campus: An Intelligent Campus Video Surveillance System for Crowd Analysis

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Abstract

Nigerian campuses comprises of diverse culture, ethnicity and religion. Controlling these campuses is a very big deal. Cameras are installed to help security personnel in carrying out these enormous tasks. However, the installed closed circuit television [CCTV] cameras are only used for evidence sourcing rather than prevention of campus vices. With the use of appropriate technique, campus vices can be prevented thus securing the campus. In this research, an Artificial Intelligent (AI) video surveillance system was developed. The system captures, analyses video for any abnormal behaviour and alerts relevant personnel for appropriate required action. The scheme uses crowd surge a crowd analyzer for videos with vulnerability and threats. The result shows that when deployed at strategic flagged locations early campus vices are detected and reported to relevant personnel whom take appropriate actions and measures to curb escalation of the vices.

Keywords: Surveillance systems, Surveillance video, Crowd analysis, Videos analysis, campus Artificial intelligence.

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INTRODUCTION

Surveillance videos are becoming part of every aspect of life activities, from court of law to entertainment as well as monitoring of traffic, organizations and schools Anas *et al.,* (2022). Surveillance systems are employed in school to prevent examination malpractice and immoral activities. So, surveillance cameras are mainly deployed in the exam halls, laboratories and libraries. The capability of surveillance system is far beyond how it is currently used in the school campuses. Campuses have diverse set of individuals which makes it hard to monitor and control. Nigerian campuses are multilingual comprising of different ethnicity as well as different religions. Riots and protests frequently arise in Nigerian campuses due to the difference in religion and culture. Example is Deborah's case (13-may-2022) in Shehu Shagari Collage of Education, Sokoto State of Nigeria as a result of blasphemy. And also Lukman (23-nov-2022) in Sultan Abdulrahman Collage of Health Technology, Gwadabawa, Sokoto State of Nigeria as a result of theft accusation. These cases usually reach the authorities very late when things are already out of control. Surveillance system can be used to trace and penalize the perpetrators of such events. Researchers have proposed video surveillance systems. These include the works of Wang *et al.,* (2012); Hao *et al.,* (2014); Lan *et al.,* (2014) and Jingnan *et al.,* (2017). All these proposed scheme provides monitoring and control system which increases the safety of the campuses. However, the schemes require high human intervention as a personnel is required to view and make decisions. To minimize human intervention and optimize the overall performance of campus surveillance system, a situation analysis and decision making capability can be incorporated to increase the performance of campus surveillance systems. With the use of appropriate surveillance analysis techniques, situation analysis and decision making capability can be incorporated into campus surveillance system. Crowd analysis is surveillance analysis technique which can be used to understand the behaviour/situation of area of interest. Crowd is the number of people sharing the same physical location at the same time Mary *et al.,* (2022). The types of crowd solely depend on the situation in which the gathering occurs. Markets have different crowd as compared to mosque, churches, campaign rallies, clubs, stadium, schools etc. the proximity, cohesion motivation as well as size and duration indicates the context of the crowd. Crowd analysis is an analytical technique which aids deep understanding of crowd dynamics in relation to the behavior of the people. Crowd analysis involves tracking, density estimation, motion detection and behaviour detection. Crowd behaviour can be normal or abnormal. Normal crowd behaviour in the campus content is smooth execution of daily student routine. On the other hand abnormal crowd behaviour in the campus content is any event or activity that will affect peace, harmony and smooth execution of the school activities. Safe campus is a campus in which peace and harmony reigns, given a room for smooth and peaceful running of school activities. This greatly depends on the behaviour of the students. Abnormal student behaviour hinders the activity of the campus which later leads to riots or protests. Thus the student behaviour needs to be examined and monitored. Securities are employed to control and monitor student behaviors on campus. Surveillance videos are used mainly to gather evidences. This limits the possibilities of surveillance videos in this field. To enhance the use of surveillance videos, reduce high dependence on human intervention and to prevent the occurrence of some school vices, an intelligent monitoring surveillance system is required. Intelligent monitoring surveillance system are systems that capture, report and analyses information on areas of interests such as weapon detection, intruder detection object tracking etc. Researchers have proposed schemes that will aid the operation of the surveillance systems. Dasic *et al.,* (2017) Explores the services of video surveillance as a services in improving the patient safety in hospitals. The services are e-loud based services. However, there is high amount of data traffic and it is affected by network latency.

Elharrouss *et al.,* (2019) proposed surveillance video summarization based on motion detection. The scheme mitigates the effect of sensor noise and changes in scene illumination through the combination of background subtraction and structure-texture noise decomposition. However, the scheme only enhanced motion detection system. Eldrandaly *et al.,* (2019) proposed a scheme that enhances the performance of the surveillance system by increasing the field of view (FOV) coverage of PTZ-surveillance camera using artificial intelligence. Based on artificial intelligence video retrieval technology, Dong *et al.,* (2020) proposed an enhanced security monitoring scheme with face detection using cascaded deep learning detection network. Xu *et al.,* (2020) proposed AI-based surveillance system that detects and recognizes weapons. The scheme is low cost and efficient which is developed based on open source tensor flow machine learning platform. Dsouza *et al.,* (2022) proposed an artificial intelligence surveillance system which minimizes manual human monitoring of CCTV footage. The scheme passes the footage to a machine learning (ML) engine. The engine detects intruders and alert relevant personnel. However, the scheme is limited to intruder detection.

Monitoring and controlling school campuses is far beyond object detection, face recognition and intruder detection. Crowd and human behaviour is a key factor in understanding a situation. In this research, video surveillance system that understands scene crowd and behaviour is proposed. The proposed scheme will incorporates a crowd density analyzer and monitoring solution by Mary *et al.,* (2022), the scheme provides solutions to vulnerabilities assessment.

RESEARCH METHODOLOGY

Research Design

To achieve the objective of this study, efficient design and methods are used. Crowd analysis is behaviour within a given video. An intelligent program which uses the input of crowd analyzer to monitor and control the overall behavior of a campus using artificial intelligence (AI) driven decision maker is designed.

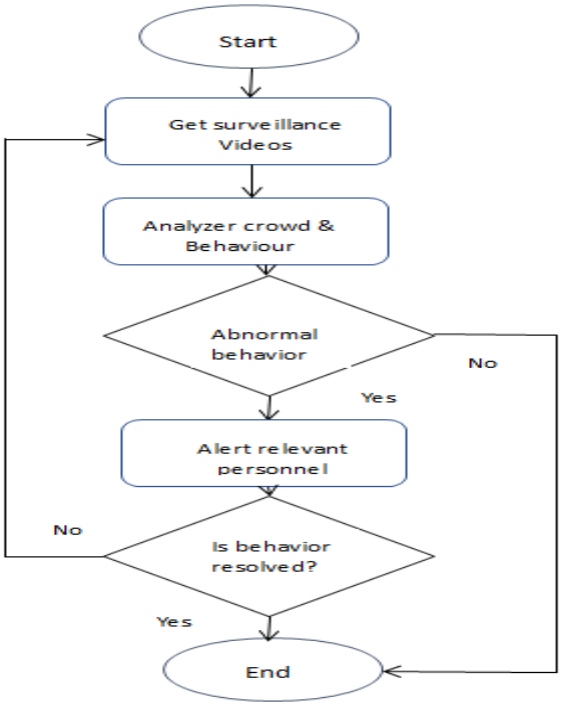

Figure 1: Proposed research Flow Chart

Requirement Analysis

Functional:
Analyze video: - this examine the video to find crowd and analyses the crowd behaviour of any abnormality.
Deceiver: - select the appropriate decision that will resolve the detected abnormal behaviour.
Send signal: - send the decision made by the decider and location to the appropriate stakeholder.

Nonfunctional:
***Security*:** - only the appropriate stakeholder receives the signal.
***Record*:** - record of all events is to be kept.

System Requirements
***Hardware*:** - Intel core 2, 4GB Ram, 320 HDD.
***Software*:** - window 7/Linux 14 LTS, Phython 3.6, Phycharm 1.0.7.

SYSTEM IMPLEMENTATION

Prototyping system analysis and design model is used in the design and implementation of the campus surveillance system. This model is chosen because model quickly presents a simplified version of the system with primary functional requirement. The system is implemented using Python programming language. Reusability and availability of related programming blocks and libraries aided the selection of Python as the programming language of choice. The system is divided into two parts acquisition and analysis part. The acquisition part of the system is the hardware dependent section in which surveillance cameras captures the physical environment around the campus. And send the information to the campus analyzer for analysis and decision making. The campus analyzer is the second part of the system which upon receiving the information analyzes the environment for any abnormal behaviour. A Crowd Density Monitoring Solution Using Smart Video Surveillance with Security Vulnerability Assessment is used to analyze the environment. The analysis result is fed into the decider which draws conclusions based on the outcomes of the analysis and predefined data.

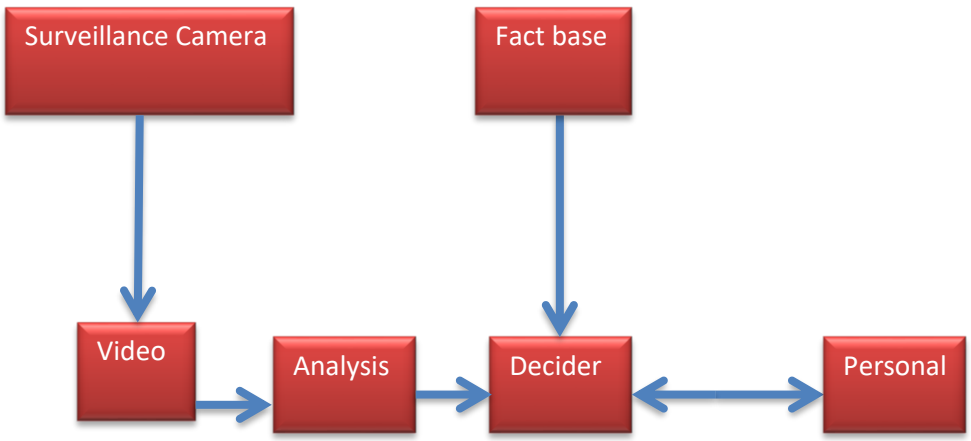

Figure 2: Activity Diagram

System Implementation

Figure 3 shows the home screen of the Safe campus software, in this box, there are four (4) navigable tabs, the home, Surveillance, personnel and help tab. The first three (3) tabs are basic function of the software which includes adding a camera, adding/registering personal and the homepage where messages and current states of the surveyed area are shown.

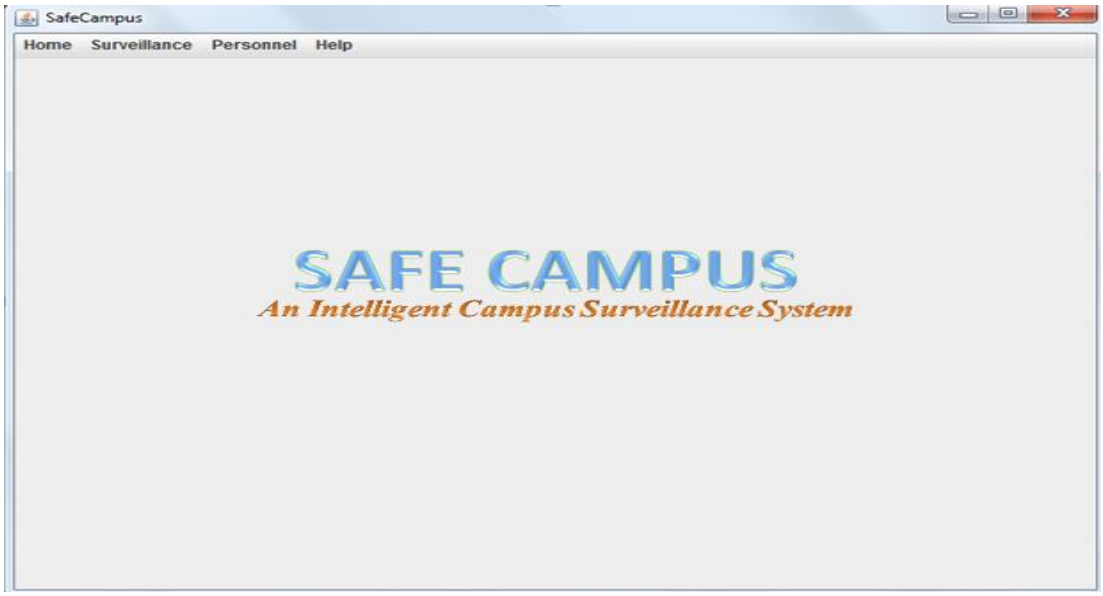

Figure 3: Home Screen from SafeCampus software

Figure 4 shows the camera tab where cameras are added for intelligent surveillance, this is where the cameras are connected to the software. The online/green color and offline/grey color under each camera depicts the status of the camera. Add and delete buttons are used for connecting and disconnecting cameras respectively.

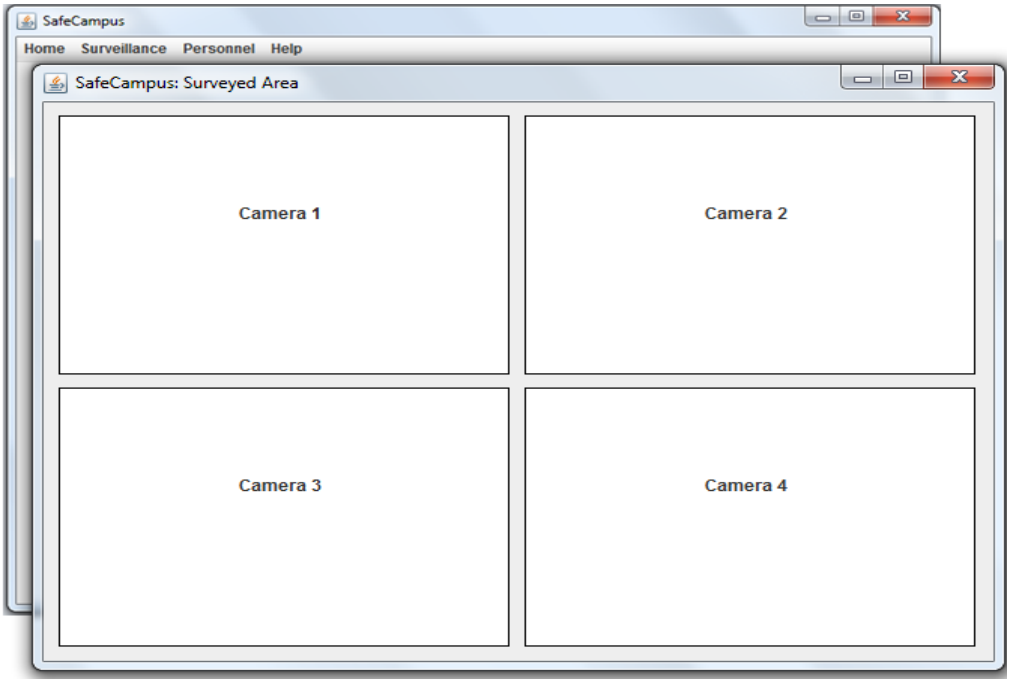

Figure 4: Camera Tab from SafeCampus software

For quick response and action taking, appropriate personnel are contacted when abnormal behaviour is detected. The personnel information and proximity are capture on the personal tab. The details are shown below

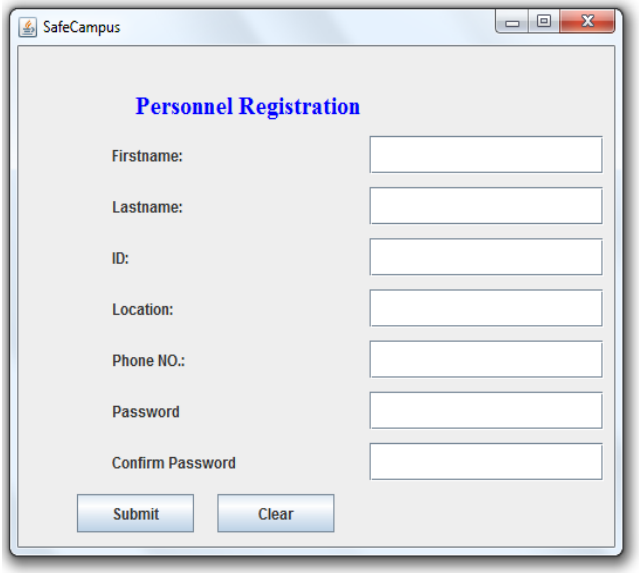

Figure 5: Personnel Information from SafeCampus software

Figure 6 shows messages on the screen when abnormal behaviour is detected and when resolved respectively.

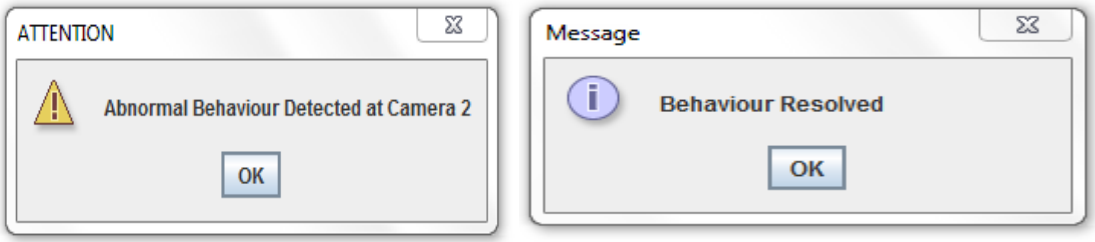

Figure 6: Abnormal Behaviour and Resolution notification from SafeCampus software

CONCLUSION

Video surveillance system is design to report videos of surveyed area. In Nigerian campuses these system are mainly designed for evidence gathering. Safe campus is a novel video surveillance system which incorporates intelligence in surveillance. The scheme/software makes use of crowd analysis technique to detect abnormal behaviour within the content of the fed video. The detected abnormality is intelligently communicated to the appropriate channel for action to be taken. A Crowd Density Monitoring Solution Using Smart Video Surveillance with Security Vulnerability Assessment algorithm called crowd surge is improved and employed for the development of the software. This study changes the overall approach on which the campuses are monitored when adopted by providing an early detection and reporting mechanism for quick response and prevention of campus vices.

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