Journal of Information System and Technology Management
EISSN: 0128-1666
JISTM
Volume 6 Issue 22 (September 2021) PP. 60-70
DOI: 10.35631/JISTM.622006

JOURNAL OF INFORMATION SYSTEM AND TECHNOLOGY MANAGEMENT (JISTM)
www.jistm.com

SUSPICIOUS ACTIVITY DETECTION USING CCTV SURVEILLANCE VIDEO

Bushra Yasmeen[1*], Haslina Arshad[2], Hameedur Rahman[3]

[1] Department of Computer Science and IT, Institute of Southern Punjab Multan, Pakistan
Email: bushramalik8600@gmail.com
[2] Institute of IR4.0, Universiti Kebangsaan Malaysia (UKM), Malaysia
Email: haslinarshad@ukm.edu.my
[3] Department of Creative Technology, Air University, Islamabad, Pakistan
Email: rhameedur@gmail.com
[*] Corresponding Author

Article Info:

Article history:
Received date: 10.06.2021
Revised date: 15.07.2021
Accepted date: 20.08.2021
Published date: 01.09.2021

To cite this document:

Yasmeen, B., Arshad, H., & Rahman. (2021). Suspicious Activity Detection Using CCTV Surveillance Video. *Journal of Information System and Technology Management, 6* (22), 60-70.

DOI: 10.35631/JISTM.622006.

Abstract:

Security has recently been given the highest priority with the rise in the number of antisocial activations taking place. To continuously track individuals and their interactions, CCTVs have been built in several ways. Every person is recorded on an image on average 30 times a day in a developed world with a community of 1.6 billion. The resolution of 710*570 captured at knitting will approximate 20 GB per day. Constant monitoring of human data makes it hard to judge whether the incident is an irregular one, and it is an almost uphill struggle when a population and its full support are needed. In this paper, we make a system for the detection of suspicious activity using CCTV surveillance video. There seems to be a need to demonstrate in which frame the behavior is located as well as which section of it allows the faster judgment of the suspicious activity is unusual. This is done by converting the video into frames and analyzing the persons and their activates from the processed frames. We have accepted wide support from Machine learning and Deep Learning Algorithms to make it possible. To automate that process, first, we need to build a training model using a large number of images (all possible images which describe features of suspicious activities) and a "Convolution Neural Network" using the Tensor Flow Python module. We can then upload any video into the application, and it will extract frames from the uploaded video and then that frame will be applied on a training model to predict its class such as suspicious or normal.

Keywords:

Suspicious Activity, Object Detection, Surveillance Videos, Human Activity Detection

Journal of Information System and Technology Management
JISTM
EISSN: 0128-1666
Volume 6 Issue 22 (September 2021) PP. 60-70
DOI: 10.35631/JISTM.622006

Introduction

The skin and the pattern of human behavior play a key role in identifying individuals. The main source for such recognition is visual knowledge. Images from surveillance provide visual information that can be used, as live videos can be played back for potential reference. Even in the field of image analytics, recent 'automation' trend has had its influence. Controlling systems could be used for a wide range of applications, such as motion sensors, analysis of people and their counts at crowded locations, and others. The two variables used for individual identification in this area are scientifically referred to as facial recognition and gait recognition, collectively. Among these two methods, automatic individual identification from surveillance images, face detection is more flexible. Face recognition can be used to predict a person's head orientation, which will in turn help to predict the actions of a person. In applications, such as individual verification, motion identification with face detection is very helpful. It helps in identifying an individual and identifying a person's presence or absence at a particular place and time. Additionally, human movements such as subtle communication between two people, identification of head, recognition of hand gestures, and estimation are used to devise a method that can effectively recognize suspicious activity between pupils in an exam hall. This paper offers a technique of face recognition of suspicious human motion detection. In two of the main fields, security or science, video editing is used. To track images, intelligent algorithms are used. Some of main considerations when designing a real time device are computational difficulties and time complications. For time critical applications such as bank robbery detection, patient tracking system, detection and reporting of suspicious activities at railway stations, the system using an algorithm with a relatively lower time complexity, using less hardware resources and delivering good results would be more useful. Manual surveillance of the examination hall by invigilators and manual surveillance of the examination hall by footage is carried out worldwide. In terms of manpower, monitoring of an examination hall is a difficult job. if done by people, manual analysis of exam halls can be vulnerable to error. When configured as a 'powered suspicious activity monitoring system, the system helps to detect nefarious behavior, and moreover helps to reduce such activities. In addition, there would be a much lower occurrence of error. For public universities, this device may act as a valuable surveillance component.

This paper describes a technique wherein the real time videos are assessed or used in an examination to detect human motion. It is used to classify whether the activity of the individual is suspicious. It is used to recognize abnormal head movements as defined by the established system, thus prohibiting copying. A student moving out of his place or swapping spot with another is also described. Finally, the device senses contact between students and prevents incriminating information from being passed on between students. We have contributed to a framework in our research that intellectually processes live videos of student examination halls and classifies their operations as suspicious or not. This study proposed a smart algorithm which can track and evaluate student behavior in exam halls and can warn the administration of the academic institution of any fraud/ suspicious behavior.

The Suspected Human Activity Detection system aims to assess students who, during the course of their examination, participate in suspicious behaviors. This system detects suspicious behavior immediately and also alerts management. Image context subtraction is used as the initial VPI process. Image classifiers will take all extracted images from the image extraction unit to detect the moving object and motion. These image classifiers have to perform operations such as static extraction of the background, separation of the foreground, elimination of noise

Journal of Information System and Technology Management
JISTM
EISSN: 0128-1666
Volume 6 Issue 22 (September 2021) PP. 60-70
DOI: 10.35631/JISTM.622006

from the foreground of objects, human body tracking, modeling of poses, and identification of the detection of movements. We need to distinguish the static context of the picture foreground from the static extraction of the background. Separation of the foreground, and elimination of noise from the provided image is done to explain the dynamic events that are happening at that moment. Several studies have achieved the detection of movements. We need to distinguish the static context of the picture. From easy approaches to potentially complex ones, this technique can be used for efficient and reliable results in any condition. The background is separated from the true noise by analyzing the existing images (foreground) with image sequences. The surveillance video system is made of video, digital and electronic modules to ensure continuous or intermittent videorecording for the monitoring of various important public places. Many organizations install video surveillance systems at their sites with CCTV cameras because of the increased crime rate and unstable events occurring in the world. We can see these cameras at different crowded locations, such as bus stations, office buildings, holy sites, the streets, academic institutions, and community hearings. The video data collected is helpful for stopping the danger before it happens, and also gives access to the correct proof to identify suspects after crimes. In this project we need to detect whether a person's behavior is suspicions or not. Nowadays, there are CCTV cameras installed almost everywhere, which capture videos and store them at centralized servers and manually scan those videos to detect suspicious activity from the recorded humans, which requires lots of human effort and time. To overcome this issue, the author proposes to automate this process using Machine Learning algorithms. This involves translating a user oriented definition of the information into some kind of software design. In order to minimize errors in input files and processes, this design is critical and shows the correct way to the administrationto get appropriate facts from the computerized systems. It is done by designing user-friendly screens to accommodate vast amounts of data for data entry. The purpose of designing inputs is to make it easier to enter data and for it to be free of errors. The data entry screen is built in such a way that it is possible to manipulate all the data. It offers record viewing facilities as well. It will also verify data identity when the data is entered. Data is entered with the assistance of displays. Reasonable messages are given so that the consumer is not instantly confused. The main purpose to have an input program is to develop an easy-to-follow design.

The number of witnesses and the path of the movements is not limited. We limit the images though to enclosed color images in which a static camera captures the footage. Moving items that belong to individuals in the picture are identified by the formula of context multiplying. As the two primary characteristics for operation designation, we recognize the movement's level of cluster centers of differentiated backdrop areas whose level of increase is in the number of the structure of data (Jonson D, Kumar AS, 2012). Recognition of human behavior is a major field of study in machine learning. Its implementations include communications networks, patient tracking systems, and a number of other processes and equipment. A device consisting of two wireless cameras or a laptop, which manages images from the lenses and remotely regulates a garden hose, was proposed and built to prevent the onset of fires. The system seems to be a very good replacement for traditional fire protection systems in a confined area (Airs B, Gray A, 2017).

Based on the average shift of adjacent pixels, the suggested technique of context model updating enables the speed of such updating activities to be dynamically modified. The application of the modified quad tree development algorithm enables the output to be

Journal of Information System and Technology Management
EISSN: 0128-1666
Volume 6 Issue 22 (September 2021) PP. 60-70
DOI: 10.35631/JISTM.622006

accelerated by contrast; not by using all pixels, but just the arbitrary ones, and also using the framework of the quad tree.

Generated, instead of building from nothing on the given image. Experimental findings show that the approach introduced is up to 10% faster than simple distinction, and up to 40% quicker than the typical sprint (Y. Kurylyak, 2012).

We address the concepts of qualitative assessment and include some examples of current conceptual frameworks and how they are being strengthened. They quantified demonstrate effectiveness and relevance of my approaches to banking and airline tarmac security system in spite of classification tasks (Academic, global prices P 2008 yet to at phenomenology have also been exploratory in nature in image recognition for environmental factors. We propose a more structured approach. By observing the shape shift of humanoid profile through characteristics derived from four parts, falls are observed. The findings from the experiments demonstrate that the suggested 3 point based techniques improve fall recognition accuracy in comparison to traditional ellipse based image techniques despite increasing computational complexity (Ching JL, Ming Gls, Thurs, 2013). Depending on the given mission, humans assign their attention to following the aspects of objects and scenes. In the model, for the identification of items that have become stagnant, a particular process contributing to visual search is being used. The continuous stationary art cars or empty bags. Cluniac S, goodman J, Pushee Kao, al, 2016).

We integrate awareness of the specific problem into planned activity structural models. Automatic acts are defined as minimal concentration and feeding to handcrafted syntax to detect interesting behavior patterns (Rodriguez JC, Rohanchez JM, 2018). For the description of latest video event shots detection or indexing parameters, an event manager is used. Relevant events apply to potentially hazardous situations; the paper discusses lost items and pre-defined human events for online/offline content-based recovery of the system (Foresti Il, Marcenaro , Regazzoni Cells, 2014).When an item reaches the scene, crime is announced and it induces an illegal alteration in a predefined vandalized location such as a public phone or a sign inside of the scene. The framework developed was checked online as well as offline, and our findings indicate that it is robust in detecting damage or graffiti in surveillance footage sequences (Nawab M, Amaar A, 2017).

The processing system of image processing in complex scenes typically involves the following phases: environment modeling, motion sensors, moving face detection, monitoring, activity, both processes, and an analysis of recent trends and general strategies (Cu W, Pan T and Amanah S, 2015). Trajectory characteristics of distant vehicles have been extracted or interpreted as a feature dataset. To detect suspicious activities in real-time, a blurry self-organized graph-based sensor, and an unattended detector, was constructed. To demonstrate the efficiency and efficacy of the proposed solution and the experimental results, eventually, some assumptions are made (Moha N, Hasan RM and Imran A, 2012).

There is a suggestion for a hierarchical data analysis strategy. Frequency-based research is carried out at each stage to quickly discover the normal rules of huge events. Things that deviate from all these laws are known as deviations. The current algorithm is highly efficient, but can infer strict tasks (Ghai F, Ren J, 2011). Given the complexity of techniques including such real-

Journal of Information System and Technology Management
EISSN: 0128-1666
Volume 6 Issue 22 (September 2021) PP. 60-70
DOI: 10.35631/JISTM.622006

time processing or analysis/knowledge of image information, another well-developed product in this field is expected but is not available so far.

In this work, by extracting skin region (if known), human presence is identified from the surveillance films. Since human flesh can indeed be found in a range of colors, it is used to obtain fuzzy approaches (S.S. and Goswami, 2014). In order to illustrate the abilities of this strategy, a range of forms of conduct that are used in protection in transportation areas have also been chosen. Demolished and stolen items, combat, and loitering are examples of these. Experimental findings presented below, using normal public data sets, illustrate the good computation time of this research (M. Dalai Lama and Elhamod Curtis, 2019).

Methodology

In this system we have made a suspicious activity detection method using CCTV surveillance video. We use some modules and datasets that are given for this system.

Image Classifiers

Image context subtraction is the initial VPU process. Image classifiers will take all extracted images from the image extraction unit to detect the moving object and motion. These image classifiers have to perform various operations such as static extraction of the background, separation of the foreground, elimination of noise from the foreground, and recognition of objects, modeling of poses and identification of poses, detection of movements. We need to differentiate the static context of the picture from the provided image to explain dynamic events that are happening at that moment. Several studies have implemented different methods for background detection, but in this system, image classifiers have been used for scalable dynamic backdrops, which is further recognized and is used for activity recognition by removing it from the true picture. We can monitor the usual areas of emphasis and remove the noise by analyzing the existing images (foreground) with image sequences.

Human Identification Through Activity

It is quite crucial and necessary to distinguish human behavior from the identified human objects and extracted actions. Basic human behaviors involve walking, sleeping, driving, and other similar behaviors. The strategies of scene understanding have failed, and these methods are independent methods, meaning that one domain's boundary conditions and object tracking rules may not be useful for other domains. By using human body motions (dynamics) either at the level of body or at level of body parts, cognitive theories have been used to classify human beings. Many models of research are used for this system. Although for the ISADF frame function, we chose professionals and implemented a holistic approach. This method concerns polygonal shaped structures on distant vehicles in the plane, and also derives object motions from some very low quality images.

Training Of Data From Suspicious Activity Detection

Only object models (human actions) are detected by the above behavior detection methods, not suspicious behaviors, because they are unintelligent. Whether something is suspicious or not should be explained after noticing an object's dynamic behavior. Intelligence in the form of training data is needed by the system for this purpose. Training information is categorized into online and offline data. Offline data for training is static, and from current understanding can never be changed. Professional development data, however, has some startup experience and

Journal of Information System and Technology Management
EISSN: 0128-1666
Volume 6 Issue 22 (September 2021) PP. 60-70
DOI: 10.35631/JISTM.622006
can be expanded by current information. We use online updateable training data in this framework that initially also has suspicious activity detection information.

Detection of Suspicious Activity Mechanism
A classification method linked to training data for operations is used in this mechanism. The training methods linked to training data for operations are used by human observers. A person can recognize suspicious behaviors because of environmental knowledge and signs of suspicious video data activity.

Python
Python is an interactive and high-level programming language that is interpreted for general purposes. Python, an interpreted language, has a design direction that emphasizes readability of code (notably using semi colons and indentation to \delimit code blocks instead of curly brackets or key phrases) and a syntax that engineering students o commissars in fewer code lines thanlarge scales to be clearly configured. Python interpreters are available for many operating systems. CPython, Python's reference version, is an open-source software, and almost all of the software's foundation operates on CPython. The non-profit Python management is featured in Python. It supports numerous programming paradigms and has a wide and extensive standard library, including imperative, functional, and procedural elements.

Django
Django is truly a high-level web applications project that encourages fast growth with a simple and functional architecture. It takes care of much of the digital marketing headache, and is designed by experienced developers, so that one can start writing your app without trying to reinvent a machine. It is an open- source software. The primary objective of Django is to ease the processes of complex, database driven websites. Django emphasizes part scalability and "wide band gap", rapid growth, and the concept of not repeating oneself. Python is also commonly used for configuration data and information templates**.** Django offers optional government agreed that created dynamically via self and designed through administrator models to create, read, update and delete.

Feasibility Type Study
In this process, the cost of the project is evaluated, and the marketing plan is put forward with a very general project plan and some cost estimates. The feasibility research of the suggested scheme is to be conducted out during the device review. This is to make sure that the framework proposed is not a liability to the organization. The feasibility study includes some knowledge of the main requirements of the essential system.

Economical Type Feasibility
This analysis is conducted to verify the economic effect on enterprises that the device would have. Amount analysis is conducted to verify that the economic effect on enterprises that the device would have by the organization is reduced. It is necessary to justify expenses. Thus, the technology used is readily accessible. It was only appropriate to establish and buy the personalized items.

Technical Type Feasibility
Refers to the technical specifications of the system. Any framework may not have a strong demand for the technological funds allocated. This would contribute to high demands on the

Journal of Information System and Technology Management
EISSN: 0128-1666
Volume 6 Issue 22 (September 2021) PP. 60-70
DOI: 10.35631/JISTM.622006

technology funds allocated, which in turn would contribute to high demands on the technological resources that are available and high expectations being imposed on the customer. Modestcriterion made established method, as only limited implementation of this method, zero and null adjustments are needed.

Social Type Of Feasibility

The study aspect is to verify the user's level of understanding of the method. This requires the process of teaching the user to successfully use the device. The consumer should not feel burdened by the device but should consider it as a requirement. The level of user acceptance depends on the approaches used to inform the users more about the system by making them acquainted with it. The level of trust will be elevated so that, as final consumers of the system, they can also offer some objective criticism that can be factored in and appreciated.

Data Analysis and Results

We run our system for getting the results and then analyzing them.

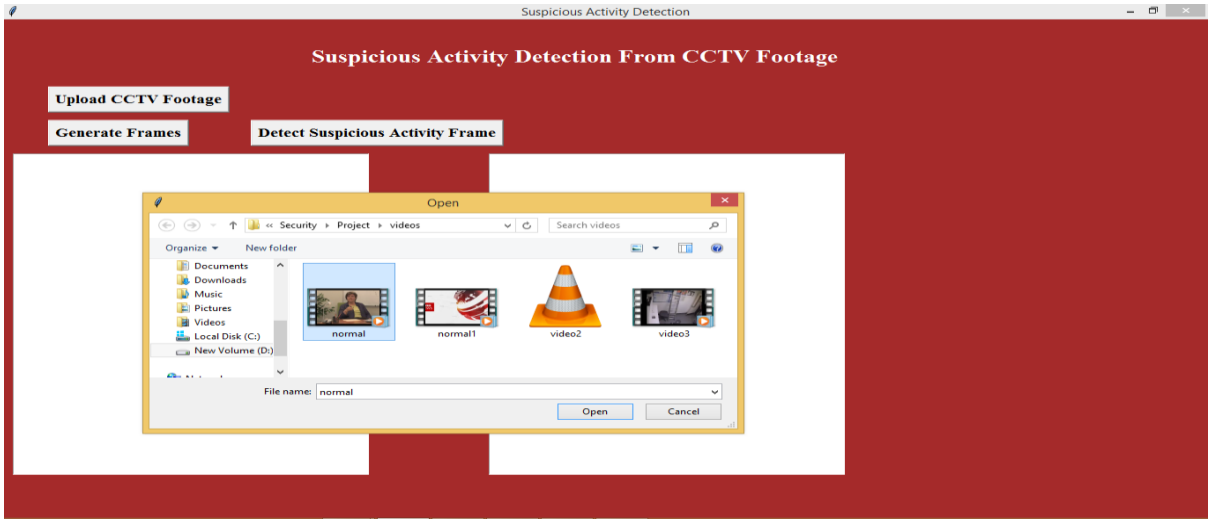

Figure 1: Upload Normal Video

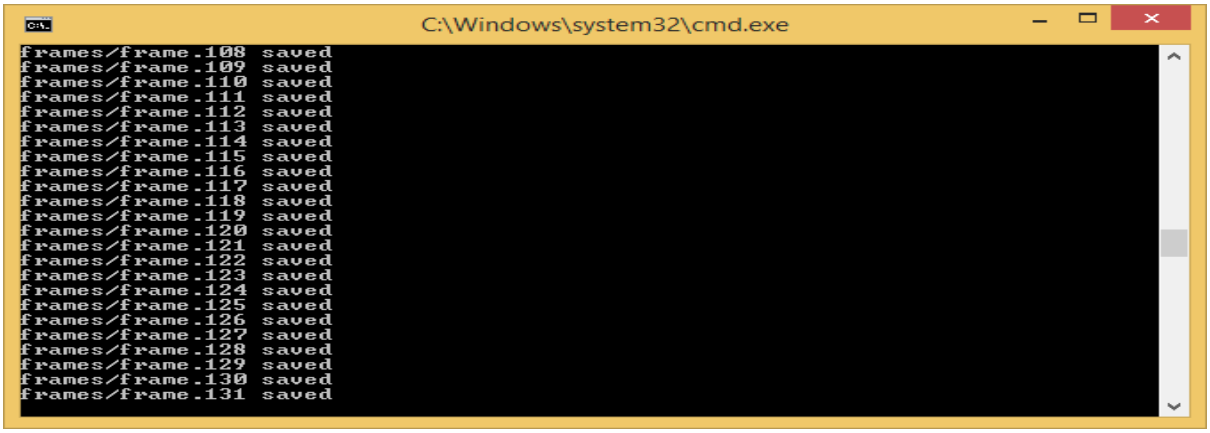

Figure 2: Generated Framework

Journal of Information System and Technology Management
EISSN: 0128-1666
Volume 6 Issue 22 (September 2021) PP. 60-70
DOI: 10.35631/JISTM.622006

In the generated framework, we can see that the extracted frames are saved inside a 'frames' folder, named with a frame number. Below we see a frames folder which has images from video.

Figure 3: Image of A Person

Figure 3 shows one image of a person with face covering. Similarly, we can see all frame details in the screen which has such activities in these videos.

In data analysis and results, we use some types of testing, which are:

Unit Testing

Unit testing requires the creation of tests that verify the proper internal issues with programming logic, and also that correct outputs are generated by the programmed inputs. It is necessary to verify all decision branches and internal code flow. It is the validation of the app's individual program units. It is performed prior to integration, following completion of an additional device. Unit tests carry out simple tests and validate a particular business method, programmer and/or device configuration. Testing phases ensure how each particular direction of the business operation follows the recorded requirements.

Integration Testing

Implementation tests are based on the modules of embedded systems to assess if they are currently running as one application. The research is event driven but is much more associated with displays or the areas' specific outcomes. Integration checks demonstrate that, while components are satisfactory individually, the arrangement of parameters is right and reliable, as demonstrated bygood unit testing. Implementation phase is primarily designed to expose the issues resulting from the mixing of components.

Functional Test

Functional checks offer systematic proof of the availability of tested functionality as defined by organizational and functional specifications, device documentation or user guides. Functional research organization and planning is based on criteria, main features, or specific unit test. Furthermore, for systemic coverage related to research, attention must be given to required fields, predefined procedures, and back to how things. One should confirm that the test results defined before the testing process are full and the successful amount of c tests is calculated.

Journal of Information System and Technology Management
EISSN: 0128-1666
Volume 6 Issue 22 (September 2021) PP. 60-70
DOI: 10.35631/JISTM.622006

System Test

Test plan ensures that the specifications are met by the integrated control software application. To guarantee known and predictable outcomes, it measures a setup. The configuration centered process control test is an illustration of the testing process. The testing process focuses on definitions or flows of systems, emphasized before the driven process relations or points of configuration Haslina Binti Arshad.

White Box Testing

Cardboard sleeve Testing is a test where the computer programmer has experience of, or at least the intent of, the workings, layout, and terminology of the program. It is about intent. It is used to confirm the studies and investigations from the black box stage that cannot be approached.

Black Box Testing

Unit testing tests the programmer with little knowledge of both the device and the verifier's internal dynamics, layout, or language. Like most other types of tests, black box testing tests are written from a comprehensive data source, such as a manual for specifications orcriteria, or a memorandum for specifications. It really is test is a type programme is viewed as a data recorder in where you can never "see" it. Without taking into consideration how the software operates, the test offers inputs and needs to respond to outputs.

Discussion

On the other hand, it could be suggested that the relatively higher attitudes of the pre-service teachers. The relation between the knowledge user and the system is the data design. It requires the creation of data pre-processing requirements and procedures, and certain steps require placing the transaction data in a usable form for processing, which can be done by the reviewing machine to read information from a verbal or written file or by making people insert the raw data into the system. The input is built in such a way that maintaining privacy provides protection and ease of use. The following points have been considered by the input design: How can information be organized or coded? A dialogue to direct the working staff to provide feedback. Methods for planning validation of inputs and steps to take when there is a mistake.

A performance output is one that meets the needs of end users and specifically presents the data. In any system, processing outcomes are transmitted by outputs to the users and to other systems. It is decided in the production design on how to displace the data for immediate need and for the production of physical copies. It is the user's most significant direct data source. In order to assist user decision making, effective and intelligent performance design strengthens the relationship of the device. Computer developed systems should proceed in a structured way; the correct output must be generated while ensuring that each output component is configured so that the device can be easily and efficiently used by individuals. When designing results of data for analysis, the precise output that is also considered necessary to fulfill the criteria should be identified. Methods should be picked for knowledge presentation, building a text, an article, or any other format that contains system generated information.

Conclusion

Designing an automated solution for the identification of suspicious behavior from video streams to video cameras is an essential necessity in present conditions. Sadly, most current methods rely mainly on social observation, and so there is no cohesive structure to meet such

Journal of Information System and Technology Management
JISTM
EISSN: 0128-1666
Volume 6 Issue 22 (September 2021) PP. 60-70
DOI: 10.35631/JISTM.622006

needs. For video cameras, we create a new trainable human activity and behaviour like an observable intellectual, called Suspicious Activity Monitoring Framework (ISADF), in this paper. The video and extraction unit included in this system collects the video images as needed and sends them for suspected fraud analysis to both the video processing units. The behavior perception algorithm contrasts the recent work with previous experience in order to understand. In this paper, we find accurate results by running a system on python opencv. We take a suspicious activity of humans and then detect it using CCTV surveillance videos.

Acknowledgement
This work has been funded by UKM GRANT: GPK-2020-018.

References

Albukhary N, Mustafah YM (2017) Real time human activity recognition. In: 6thInternational conference on mechatronics, pp. 35-43

Arroyo R, Yebes JJ, Bergasa LM (2015) Expert video-surveillance system for real-time detection of suspicious behaviors in shopping malls. Expert Syst Appl 42(21). ElsevierGoogle Scholar

Farooq J, Ali MB (2014) Real time hand gesture recognition for computer interaction. In: 2014 International conference on robotics and emerging allied technologies in engineering (iCREATE), IEEE Conf Publications, pp 73–77

Gowsikhaa D, Abirami S (2012) Suspicious human activity detection from surveillance videos. Int J Internet Distrib Comput Syst 2(2)

Hariyono J, Jo KH (2016) Centroid based pose ratio for pedestrian action recognition. In: IEEE 25th International symposium industrial electronics (ISIE), pp 895–900Google Scholar

Javare, Amirush, Tushar Ghayal, Jayant Dabhade, Ankur Shelar, and Ankita Gupta, IEEE, 2017,"Access control and intrusion detection in door lock system using Bluetooth technology." In 2017 International Conference on Energy, Communication, Data Analytics and Soft Computing (ICECDS), pp. 2246-2251.

Jonson D, kumar AS, (2012) „Identification of suspicious person activity from security cameras‟ Proceedings of the 4th ACM/IEEE Symposium on Edge Computing, Pages 101–112

Kodali, Ravi Kishore, and SreeRamya Soratkal, IEEE, 2016,"MQTT based home automation system using ESP8266." In 2016 IEEE Region 10 Humanitarian Technology Conference (R10-HTC), pp. 1- 5.

Kumar, R. Praveen, and S. Smys. IEEE, 2018, "A novel report on architecture, protocols and applications in Internet of Things (IoT)." In 2018 2nd International Conference on Inventive Systems and Control (ICISC), pp. 1156-1161.

Nguyen V-T, Le T-L, Tran T-H, Mullot R, Courboulay V (2014) Hand posture recognition using Kernel descriptor. In: 6th International conference on intelligent human computer interaction, IHCI 2014. Procedia Comput Sci 39:54–157.

Nguyen, Huu-Quoc, Ton Thi Kim Loan, Bui Dinh Mao, and Eui-Nam Huh, IEEE, 2015."Low cost realtime system monitoring using Raspberry Pi." In 2015 Seventh International Conference on Ubiquitous and Future Networks, pp. 857-859.

Pandian, A. P. (2019). Artificial Intelligence Application in Smart WarehousingEnvironment for Automated Logistics. Journal of Artificial Intelligence, 1(02), 63-72.

Pavithradevi K, Aruljothi S (2014) Detection of suspicious activities in public areasusing staged matching technique. Int J Adv Inf Comm Tech (IJAICT) 1(1):140–144

Journal of Information System and Technology Management
EISSN: 0128-1666
JISTM
Volume 6 Issue 22 (September 2021) PP. 60-70
DOI: 10.35631/JISTM.622006
Raj, J. S. (2019). Qos Optimization of Energy Efficient Routing In Iot Wireless Sensor Networks. Journal of ISMAC, 1(01), 12-23.

Sakaino H (2013) Video based tracking, learning and recognition method for multiple moving objects. IEEE Trans Circ Syst Video Technol 23(10):1661–1674

Shvachko, Konstantin, Hairong Kuang, Sanjay Radia, and Robert Chansler, Ieee, 2010 "The hadoop distributed file system." In 2010 IEEE 26th symposium on mass storage systems and technologies (MSST), pp. 1-10.

Suganthy, M., and P. Ramamoorthy. 9 (2012), "Principal component analysis based feature extraction morphological edge detection and localization for fast iris recognition." Journal of Computer science 8, no. 1428.