International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 06 Issue: 07 | July - 2022 Impact Factor: 7.185 ISSN: 2582-3930

Highly Secure CCTV System Using Computer Vision

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***Abstract*— As crime and theft increase rapidly, CCTV cameras have become quite commonplace. Smart CCTV camera surveillance system is to develop CCTV camera-based security systems, which are now available in various locations. Conventional CCTV cameras do not offer high security. An improved system is required where notification can be sent whenever theft or other items occur**.

Keywords—smart cctv, face recognition, LBPH algorithm, convolution kernels, structural similarity index, haar cascade.

I. INTRODUCTION

As crime and theft increase rapidly, CCTV cameras have become quite commonplace. Conventional CCTV cameras do not offer high security. An improved system is required where notification can be sent whenever theft or other items occur.

Video Surveillance started with analogue CCTV systems, data collection and monitoring of people, events and activities. Existing digital video surveillance programs provide only video capture, video storage and distribution, while leaving the task of detecting threats to only human users. Monitoring a video surveillance is a very difficult task. Finding multiple jobs in real-time video is hard to analyze in person. So, a smart video surveillance system emerges. Mathematical software processes video streaming to automatically identify objects (people, equipment, vehicles) and the event you are interested in for security purposes. In real time, video surveillance systems detect video streaming conditions that represent a security threat and trigger an alarm. Smart CCTV camera monitoring system to improve CCTV camera-based security systems, which are now available in various locations. Project Protection Plan using CCTV Camera is designed using wireless technology. The use of a surveillance system for image detection is very important. Focused surveillance system is often used at home, office or factory to process images of surveillance system and traffic monitoring.

II. RELATED WORK

A. Face recognition in CCTV systems

As technology grows at a higher rate, people are becoming more and more dependent on their use. Closed-Circuit Television (CCTV) is one of the technological inventions that ensures the safety of firms and offices on a large scale. Although CCTV systems are very useful for visual purposes, they also have specific requirements. In a case similar to bank robberies that take place within the bank, official analysis can be done with images from the CCTV system itself. The parameters that affect the detection process are many such as camera quality, distance from object to camera, camera angle etc. Here the two categories include facial recognition. In the first phase we gather the different faces of the subjects to build a database. In the second phase we remove the targeted face from the CCTV evidence images and deal with the image enhancement process in order to create better outgoing images of the comparison process with the site images.

B. A study on location information aided re-identification in CCTV environment .

Video details captured by CCTV cameras are becoming more and more common as CCTV is widely distributed in the surveillance area. As video analysis technology advances, the acquisition and distribution of video data can be done with devices such as CCTV cameras and computers. Automatic object detection and editing can be used to identify one person in multiple video clips taken at a different time or with different cameras. The accuracy of the video item segmentation can be improved by using additional information. In this paper, a method is introduced, which improves the accuracy of personal

identification using local CCTV and smart phone location information.

C. Concept of cost efficient Smart CCTV network for cities in developing countries .

Many cities around the world use a system to monitor their roads. The program is usually a Closed-Circuit Television (CCTV) network spread across the city. The number of CCTV installed varies, with 150 "Bandung Command Center" cameras going to hundreds of thousands of cameras "the famous London City Police". This huge camera gap as a whole is very reasonable considering the difference in budget allocation given to each city, with Bandung being a city in a developing country while London is the capital of a developed country. In addition, CCTV network is not a cheap technology. In 2014, the mayor of Bandung allocated IDR 3.2 billion (approximately USD 222 000) just to install 80 cameras on the streets. The cost structure alone can be a great wall that prevents the city from becoming a smart city in the area of surveillance. In this paper, we propose the concept of intelligent and cost-effective CCTV designed, used the Wireless Sensor Network (WSN) concept and developed with artificial intelligence (AI). With the implementation of the proposed concept, the same budget for Bandung Municipality in 2014 could be implemented for 300 cameras, an increase of 375% compared to the original.

D. Analyzing the Influence of Micro-Level Factors on CCTV Camera Effect

Despite the popularity of closed-circuit television (CCTV), the evidence for its crime-prevention power is limited. Studies have largely reported the effect of CCTV as "mixed" without explaining these differences. Current research contributes to the literature by examining the impact of small-scale interventions on crime rates within CCTV locations in Newark, NJ. The viewing areas, which define the CCTV camera line of sight, were analytical units (N = 117). Area measurements, control of observed size and crime incidents in the control area, measuring changes in six levels of crime, from pre-inclusion period to inclusion. Ordinary square-back models have examined the impact of certain low-level objects — natural features, camera vision, compulsory function, and camera design — in each crime category. First, the impact of environmental factors varies across all categories of crime, the surrounding environment is related to the reduction of certain crimes and the increase of others. Second, law enforcement produced by CCTVs was related to the reduction of overall crime, violent crime and car theft. Third, the blocking of the CCTV line of sight caused by immovable objects was linked to increased levels of car theft and declining rates of violent crime, car theft and robbery.

The findings suggest that CCTV operations should be designed in a way that will maximize its preventative effect. In particular, the police should be held accountable for the presence of generators / criminologists and low-level barriers when selecting camera sites, and devising a strategy to work in a way that creates high levels of enforcement.

Describe the abbreviations and acronyms where they first appear in the text, even after they have been described in invisible text. Abbreviations such as IEEE, SI, MKS, CGS, sc, dc, and rms should not be defined. Do not use abbreviations in the title or in the head unless it is unavoidable.

E. Color-based Structural Similarity Image Quality Assessment

Quality assurance is a challenge to problems in the field of image and video processing, such as signal acquisition, integration, development, watermarking, compression, transmission, retention, retrieval, reconstruction, authentication, display and printing. There are two types of quality assessment methods: subjective and objective. Image quality testing methods are accurate in measuring image viewing quality because they are man-made but involve an expensive process that requires a large number of viewers and takes valuable time. On the other hand, targeted image quality monitoring methods are computer-based methods that can automatically predict imagined image quality. Targeted image quality testing methods have therefore gained more popularity although they do not correlate well with quality as seen by humans. Targeted image quality testing methods can also be divided into full reference, reduced reference, and non-reference methods based on the availability of the reference image. Full image reference quality assessment requires complete information about the reference image; and partial information about the reference image is required in the evaluation of the reduced image quality; while no reference information for the reference image is required for the quality of the reference image. This paper focuses on ways to assess the full image quality of colour images where both original and experimental images are available.

III. METHODOLOGY

This is a python GUI application that can work on any operating system, uses a webcam and has many features that are not in normal cctv. This is a Project built using the latest Software Languages and the highly developed Computer Science component “Computer Vision”. This means that the project allows the computer to be viewed or in other words provides visual effects on computers. The GUI is easy to use, and all buttons are backed up using a nice icon. We have used Python language as it is very new and comes with many features as we can easily make a GUI application.

Reasons for choosing this language:

1. Short, concise language.
2. Easy to read and use
3. Good Online Technical Support
4. Many packages for different functions.
5. Run in any arena.
6. Modern language and OOP

Python

Python is a widely used, high-performance, high-performance language. Developed by Guido van Rossum in 1991 and developed by the Python Software Foundation. It is built with emphasis on code readability, and its syntax allows programmers to express their ideas in a few lines of code. Python is a programming language that allows you to work faster and integrate systems more efficiently. There are two major versions of Python: Python 2 and Python 3.

Some specific features of Python are as follows:

- Translated language. Unlike eg, C or Fortran, one does not compose a Python code before making one. In addition, Python can be used collaboratively: many Python translators are available, where commands and texts can be created.
- Free software licensed under open source license: Python can be used and distributed free of charge, even for commercial software development.
- Multi-platform: Python is available for all major operating systems, Windows, Linux / Unix,
- MacOS X, which is most likely your OS, etc.
- Highly readable language with clear non-verbose syntax
- The language in which a wide variety of high-quality packages are available for a variety of purposes, from web frameworks to computer science.
- easy-to-use language with other languages, especially C and C ++.

Some other features of the language are illustrated just below. For example, Python is an object-oriented language, with dynamic typing (the same variable can contain objects of different types during the course of a program).

Below are the different features which can performed by using this minor project:

1. Monitor
2. Identify family members
3. Detect for Noises
4. Visitors in room detection
5. Normal recording
6. Focusing a particular area

A. Monitor

This feature is used to detect what is being stolen from a frame that appears on a webcam. Which means it always monitors frames and looks for any object in the frame taken by a thief.

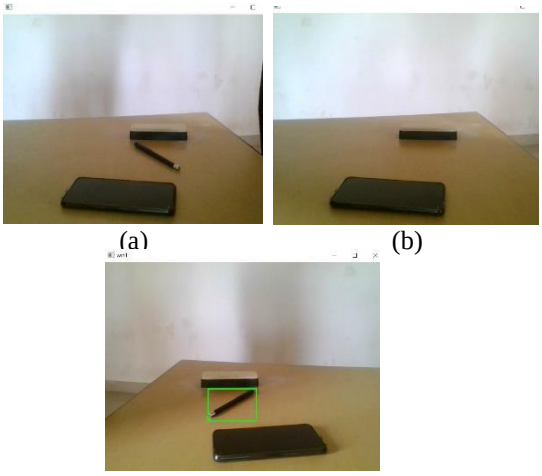
This uses Structural Similarity to find the differences in the two frames. Two frames are filmed first when no sound occurs and secondly when the sound stops happening in the frame.

SSIM is used as a matrix to measure similarities between two given images. Since this approach has been in place since 2004, there is much that explains SSIM theory but very few resources go into detail, which is mainly in gradient-based applications as SSIM is often used as a loss function.

The Structural Similarity Index (SSIM) metric brings out 3 key elements in an image:

- Luminance
- Contrast
- Structure

The skimage package in python: we don't have to replicate all these mathematical calculations in python as skimage has a pre-built feature that performs all these tasks by calling its built-in function. We just have to feed in two images/frames which we have captured earlier, so we just feed them in and it give us out the masked image with score.



(a) (b)

(c)

Fig 1. Detecting the stolen object (a)initial frame (b)object got stolen (c)the stolen object is marked

B. Identify family members

This is a very useful feature, used to determine whether a person in the frame is known or not.

It does this in two steps:

• Find faces in frames

• Use the LBPH algorithm to predict someone from an already trained model.

Cascade classifier, or cascade boost classifiers that work with haar features, is a special form of ensemble learning, called boosting. It usually depends on the Adaboost classifiers (and other models like Real Adaboost, Gentle Adaboost or Logitboost).

Cascade classifiers are trained on samples of a few hundred images that contain the object we want to identify, and other images that do not contain those images.

These features are called Haar Features. The feature removal process will look like Haar features such as these convolution kernels used to detect the presence of that feature in a given image and to do all of these we used OpenCV module in python language with an inbuild function called cascade classifier to find the faces in the frame.

So now we have detected for faces in the frame, and this is the time to point it out and check if it is in the database we used to train our LBPH model. LBPH uses 4 parameters-Radius, neighbour's, grid X, grid Y.

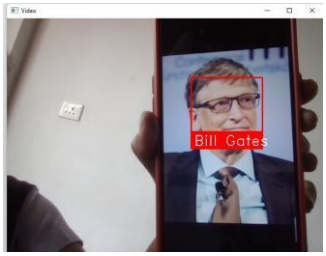
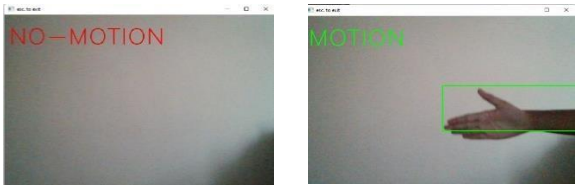


Fig 2. Identified the person on the screen

C. Detect for noises

This feature is used to find sounds in frames. In a simple way all frames are continuously analysed and monitored for sound. Audio imported into consecutive frames. Simply we make the absolute difference between two frames and in this way the difference of the two images is analysed with Contours (movement limits found) and if there are no boundaries there is no movement and if there is any, there is movement.

As you would know all images are just integer/ float values of pixels which tells the brightness of pixel and similarly every pixel has those brightness values. So, we just do simply absolute difference because negative will make no sense at all.



(a) (b)

Fig 3. Detecting the motion (a) No motion (b) Motion

D. Visitors in room detection

This is a feature that can detect if someone has entered the room or exited.

Therefore, it works through the following steps:

• Begins to hear sounds in the frame.
• Then in the event of any movement you find that it is happening left or right.
• Lastly when checking for left-to-right movement, it will detect it as entered and capture the frame.

So, basically, to know which direction the movement is taking place we begin to see the movement and later draw a rectangle over the noise and the last step is to look at the co-ordinates when those points lie to the left, then separated as left movements.

(a) (b)

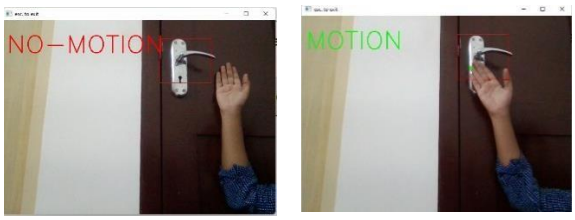
Fig 4. Recording the visitors (a) Image of the person coming inside a room (b) Image of person going out of a room

E. Normal recording

The real purpose of a normal cctv camera is to record videos continuously. The smart cctv system will also capture the video and save it to the hard drive.

F. Focusing a particular area

This works similar to noise detection. This feature also finds movement but only if the region is marked. The user can select a location and draw a rectangle on the frame. Noise is detected only when movement occurs within a rectangle. Any movement outside the rectangle is ignored.



(a) (b)

Fig 5. Detecting motion inside the rectangle (a) No motion (b) Motion

IV. RESULT AND DISCUSSION

Successfully integrated all the different modules into one platform. This program provides advanced features and security with cctv camera. It avoids theft and trespassing.

Feature	Normal cctv	Smart cctv
Stolen detection	No	Yes
Restricted Area	No	Yes
Noise	Sometimes	Yes
Face identification	No	Yes

Table 1. Comparison between normal cctv and smart cctv

V. CONCLUSION

The Project Smart CCTV camera Surveillance system is designed using wireless technology. This project is designed to provide security in various areas such as the military, banks, and industries etc. and save energy, required CCTV memory and CCTV video respectively. The smart video surveillance

system contributes significantly to the awareness of the situation. Such systems convert video surveillance from data acquisition tool to information acquisition and intelligence systems. Real-time video analysis gives smart monitoring systems the ability to respond in real time. Our system detects intrusion and sends notifications to authorized persons for action due to interference.

VI. REFERENCES

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