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Smart Surveillance System

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ABSTRACT:
Intoday'sworld,whereeveryonewantstokeeptheirval uablessafeandsecure,videosurveillance for observing a particular area has become the need of the hour. To address thisissue, we developed a smart monitoring system for locations such as bank vaults and houseswherehumanpresenceisnotconsistent.Atsuch places,itisnotworthtocontinuouslymonitorthe area with the cameras. We came up with an idea of smart surveillance system. The model identifies any security threats or lapses in the areas and immediately sends a theft alarm to the owner through mail or installed IoT sensors. Face identification, Noise, Restricted areas, Anti-theft are some of the features present in the model which works on algorithms such as Local Binary Pattern Histogram, Structural Similarity Index and HaarCascade. To capture images and record videos Open CV is used and the video recorded is used to find the intruder and send a report over the system for which SQlite3 database is used and with better accuracy than normal recordings this system can be used efficiently for security purpose.

KEYWORDS: Local Binary Pattern Histogram, Smart Surveillance, IoT, Structural Similarity Index, Open CV, SQlite3

I. INTRODUCTION:

Surveillance is becoming increasingly important in any public or private environment as risks grow. Closed-circuit television cameras or wireless sensor networks are the most common traditional monitoring technologies (WSN). Both technologies achieve their objectives in various ways. WSN aids in the capture of physical information from the environment, while CCTV cameras help to visually monitor the target region. As threats are increasing rapidly, surveillance is becoming vital in any public or private situation. Traditional monitoring systems include closed-circuit television cameras and wireless sensor networks (WSN). These two technologies accomplish their goals in different ways.WSN facilitates in the collection of physical data from the environment, while CCTV cameras aid in the visual surveillance of the target area.

We integrated the benefits of the two technologies in this project to create a smart surveillance system. With the use of a camera, we suggest a centralised computer programme that can recognise human movement in a particular region and keep visual proof of activity. Because this is an event-based system, no continuous area monitoring is required.

In this project, we used the advantages of the two technologies to develop a smart surveillance system. We propose a centralised computer software that can recognise human movement in a certain location and keep visual proof of activity using a camera. Because this is an event-based system, it does not require continuous area monitoring.

II. RELATED WORK:

Surveillance systems have been the subject of numerous studies. Some ground-breaking scientific projects have also been implemented effectively. In [1] the authors explored numerous features of various monitoring activities and tracking applications. One DRDO research team has already completed a collaborative research project in which they developed and executed human infiltration detection utilising an adhoc wireless sensor network in a big secure location. They used Passive Infrared (PIR) sensors to detect human footstep and other TelosB [2] motes to transmit sensory data, and they devised a training-based system to help identify a real invader in an outside environment.Work [3] was done to recognise, classify, and track numerous types of items in an unsupervised environment. Magnetometer sensors and micro power impulse radar sensors were used

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by the authors to track and identify metallic and non-metallic objects moving through the surveillance area. The authors conducted research on an interior monitoring system using a wireless and pyroelectric Infrared sensory fusion system in [4]. Their algorithm uses the PIR sensor detection methods as well as the RF propagation model to determine the fused position of a moving individual.This approach aids in the identification of several targets. PIR sensors and CCTV cameras are used to deploy the In2DS [5] system. The video surveillance subsystem and the WSN surveillance subsystem are used to describe a distributed object tracking architecture. The main Surveillance system processes the data acquired by the WSN and the video captured by the video surveillance system in the system architecture. [6] describes another effort on target tracking and finding the movement path. To create an accurate and better detection process, the authors combined the output from a PIR sensor, some static video cameras, a seismic sensor, and an audio sensor.The work, however, is lacking in trigger-based event detection. The authors of paper [7] developed a surveillance system that employs a trigger-based camera and integrated network camera with WSN that comprises of motes with microphone and tone detector. They expected that the target would make a sound or emit light so that the sensor could detect it. The authors of another paper [8] used a DSPcam and a FireFly sensor to identify movement in video frames acquired by the camera, compress the image, and send it over the network.

III. BASIC CONCEPTS:

Existing digital video surveillance systems merely provide the technology for capturing, storing, and distributing video, leaving threat detection to human operators. Even if such a job is assigned to a dedicated and well-intentioned individual, studies have shown that it will not support an effective security system. Monitoring video screens is both monotonous and captivating, and after only 20 minutes of monitoring and evaluating monitor screens, most people's attention spans have deteriorated well below acceptable standards. Smart surveillance systems offer a number of advantages over standard video surveillance systems, such as the ability to predict occurrences and better forensic capabilities via content-based multiple video retrieval. The amount of data required to shift the security paradigm from detection to prevention.The idea behind surveillance system is to enhance the security around the premises in which it is installed. Normally CCTVs are used but here chances of security lapses are much more than expected and the human interaction is also required time to time which makes it difficult for the end user to get the information about the theft or any other security issue. To overcome these lapses,we introduced certain features like:

Anti-thief: This feature is used to find what is the thing which is stolen from the frame which is visible to the webcam. Meaning It constantly monitors the frames and checks which object or the thing from the frame has been taken away by the thief.

Visitors: This is the feature which can detect if someone has entered the room or went out.

Face Identification: This feature is used to find ifthe person in the frame is known or not. It does this in two steps:

1. Find the faces in the frames.
2. Use Local Binary Pattern Histogram face recognizer algorithm to predict the person from an already trained model.

Restricted Area: This feature is used to detect the motion in a restricted area where human intervention is prohibited.

IV. DESIGN AND IMPLEMENTATION:

- **AUTHENTICATION** - The program uses a QR code to verify the user's authenticity. The QR code generator and scanner are implemented to register new users and login existing individuals interacting.

- **HIGH-VALUE VIDEO CAPTURE**- This is often an application that augments real- time alerts by capturing selected clips of video supported by pre-specified criteria.

- **THEFT ALERTS**- here the system recognizes a variety of events that occur in the monitored space and notifies the user in real-time, thus providing the user with an opportunity to evaluate the situation and take preventive steps if necessary.

- **MOTION CHARACTERISTIC DETECTION**- This detects a variety of motion

properties of objects, including specific direction of object movement (entry or exit) and the number of people in the frame at a given instance of time.

V. ALGORITHM USED:

- Structural Similarity (SSIM):

SSIM is a metric that is used to compare the similarity of two photographs. Because SSIM

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has been available since 2004, there is a lot of information discussing the theory behind it, but few sites go into great detail, especially for a gradient-based implementation, as SSIM is frequently used as a loss function. The structural similarity index measure[9](SSIM) is a technique for estimating the perceived quality of digital television and film visuals, as well as other digital images and videos. The SSIM algorithm is used to determine how similar two photographs are.

- Local Binary Pattern Histogram (LBPH):

The Local Binary Pattern (LBP) texturing operator labels pixels in an image by thresholding each pixel's neighbourhood and treating the result as a binary number.It was first described in 1994 (LBP) and has since been discovered to be a useful texture categorization trait. On some datasets, it was also discovered that combining LBP with the histograms of oriented gradients (HOG) descriptor increases detection efficiency significantly.[10] We can represent the facial photos with a simple data vector using the LBP and histograms. Because LBP is a visual descriptor, it may also be utilised for face recognition tasks, as seen in the steps below.

- Haar Cascade:

Paul Viola and Michael Jones introduced an effective object identification method utilising Haar feature-based cascade classifiers in their paper "Rapid Object Detection with a Boosted Cascade of Simple Features" in 2001.[11] It's a machine learning approach in which a cascade function is taught using a large number of positive and negative images. It is then used to other photos to detect things.The method needs a huge number of positive images (images of faces) and negative images to train the classifier (images without faces). Then we need to extract features from it. They look a lot like our convolutional kernel. Each feature is based on a single value obtained by subtracting the number of pixels beneath the white rectangle from the sum of pixels beneath the black rectangle.

VI. TOOLS USED:

- **Open CV:**OpenCV is an open-source, highly optimised Python library targeted at tackling computer vision issues. It is primarily focused on real-time applications that provide computational efficiency for managing massive volumes of data. [12] It processes photos and movies to recognise items, people, and even human handwriting.

- **SQLite3:** SQLite is an in-process library that creates a transactional SQL database engine that is self-contained, serverless, and requires no configuration. SQLite's code is in the public domain, which means it can be used for any purpose, commercial or personal.[13] SQLite is the most extensively used database on the planet, with an uncountable number of applications, including some high-profile projects.

- **Tkinter:** Tkinter is the de facto technique to develop graphical user interfaces (GUIs) in Python, and it comes with all standard Python distributions. It's the only framework that comes with the Python standard library.[14]

- **Pillow:** Pillow is a Python Imaging Library (PIL) that allows you to open, manipulate, and save images in Python.[15] The current version can recognize and read a wide range of file formats. Support for writing is purposefully limited to the most widely used interchange and presentation formats.

VII. MODEL ANALYSIS AND RESULT:

- **Structural Similarity Index Metric (SSIM)**

The measure SSIM (Structural Similarity Index) derives three main aspects from an image:

  - **Luminance**
  - **Contrast**
  - **Structure**

The comparison of the two photos is based on these three characteristics. This system calculates the Structural Similarity Index, which ranges from -1 to +1, between two photos. A score of +1 indicates that the two photographs are very similar or identical, whilst a value of -1 shows that the two images are very dissimilar. These numbers are frequently changed to fall inside the range [0, 1], with the extremes having the same meaning.[9]

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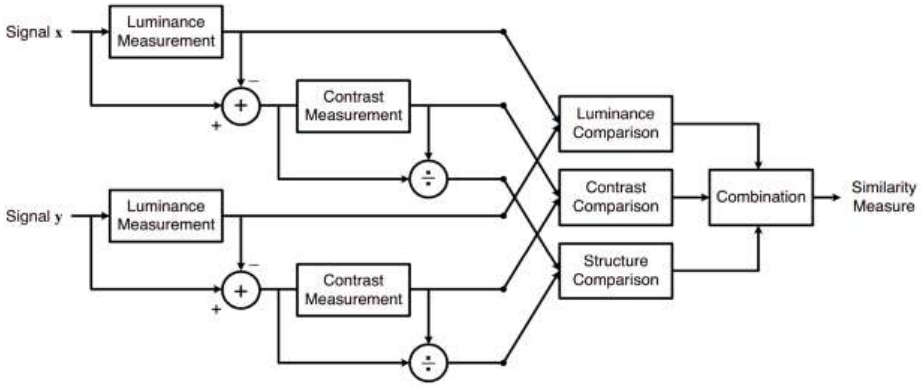

Figure-1The Structural Similarity Measurement System [16]

Result:

After executing all the modules, following results were obtained:

Features	Normal CCTV	Smart Surveillance
Authentication	No	Yes
Stolen Detection	No	Yes
Restricted Areas	No	Yes
Theft Alarms	No	Yes
Noise	Sometimes	Yes
Face Detection	No	Yes
Recording	Yes	Yes

Table-1 Comparison between Normal CCTV and Smart Surveillance

Features	Accuracy (%)
Authentication	83-85
Stolen Detection	80-82
Restricted Areas	90-95
Theft Alarms	92-95
Noise	92-95
Face Detection	80-85
Recording	95-98

Table-2 Accuracy

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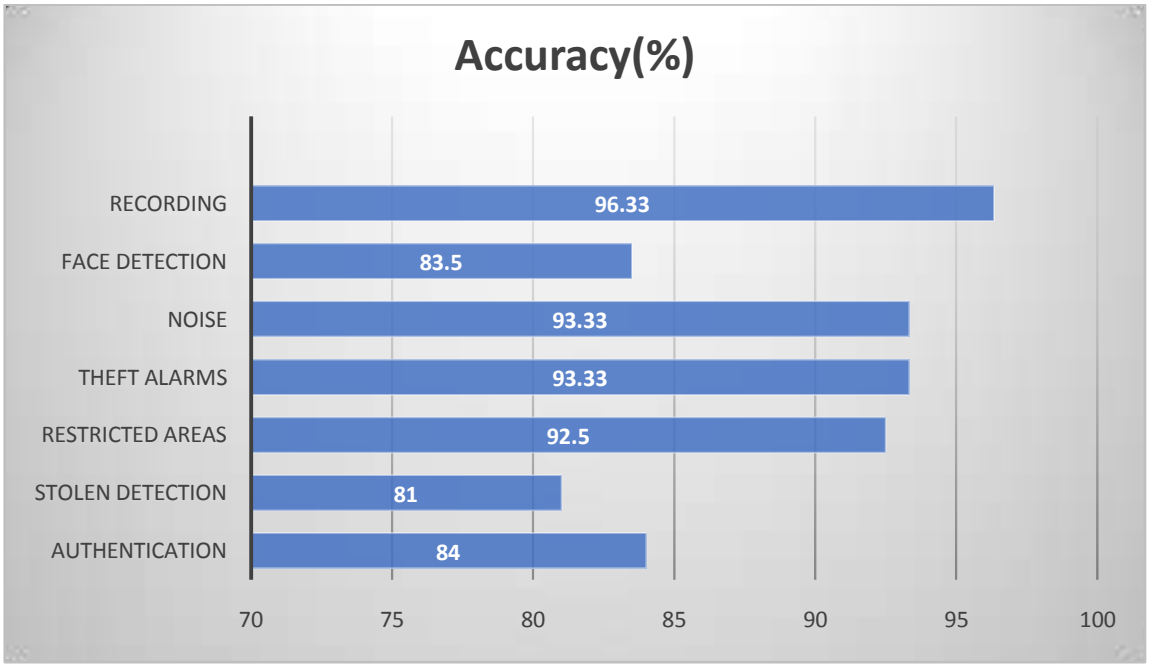

Graph-1 System Accuracy

Figure-2 Before Stolen

Figure-3 After Stolen

VIII. APPLICATION AND FUTURE SCOPE:

- Application:

  - For the betterment of the security systems where Human interaction is less.
  - The model can be deployed in area like bank vaults, homes, ATM center.
  - It can be used in area where no human entries are allowed except the identified once.
  - In comparison to CCTV's, it provides features like identification, visitors monitoring and stolen object detection.
  - Direct theft alarm on owner's device using IOT.

- Future scope:
  - Creating Portable CCTV.
  - Adding in-built night vision capability.
  - Adding deep learning if having high power device.
  - Deadly weapon detection
  - Accident detection
  - Fire Detection
  - Making a standalone application with no requirements such as python, etc.
  - Making standalone device.

IX. CONCLUSION:

The main purpose of smart surveillance system is to create such an environment in which

least human interaction is required. The proposed system provides 100 % surveillance in restricted areas as well as it provides features like noise detection, anti-theft, high quality video recording, face detection, theft alarms which are not available in a normal CCTV. The following system is easy to implement and can be installed in different areas like Bank vault, home, Shopping complex etc. Just by adding database server which will store all the information an effective security system can be maintained and the end user will keep getting all the logs regarding security through different methods like email and immediate theft alarms if any unusual activity is detected.

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