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IOT Based Surveillance System for CCTV

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Abstract*: Computer vision is the latest field of interest in image processing, digital signal processing as it roots towards the world of surveillance for safety and security enhancement. With advancement of technology vision application plays a major role in order to detect and recognize threat to heighten security. CCTV surveillance initiates visual real time monitoring incorporating motion detection techniques to monitor static and dynamic changes within the surroundings through a monitor host. But this system itself is prone to stability, quality, speed, storage, resolution, computation complexities and also requires imperative intuitive approach to identify and elude threats. Our attempt is on using hybrid approach, constituting background subtraction, histogram, pyroelectric principles in context with current methods to get a modified version.IOT plays a significant role in order to monitor locally and globally.

Keywords*: Computer vision, Real time monitoring, Motion detection, Surveillance, CCTV, IOT.

I. INTRODUCTION

Modern Surveillance methods use computer vision in order to meet the demand for safety and security. Systems use camera as sensor and an algorithmic approach to detect motion in the physical and virtual world. CCTV vision starts with real time monitoring of surrounding environment with aid of IOT to view it remotely.

In modern era IP camera are used over analog one for the ease of transmission and processing. Mostly RFID and PIR sensor cameras are used over to monitor [1]. Quality of image captured depends on the fps, resolution and compression used. Normally in order to get a good clarity vision 30fps is a minimal requirement. Traditional coaxial cable is outdated by wireless network now, but depends on application and distance.

Traditional systems supports real time streaming and playback but its storage is mainly tape recorders, but modern system can sense motion, give alerts to the client with respect to real time monitoring, storage required is less and uses cloud or Hard Disk Drive type. One can choose the kind of CCTV technology according to application requirement .Person identification depends on both biometric and non biometric features. Similarly to detect a vehicle it depends on its size, shape and illumination changes [2]. The main application level of interest for automated surveillance is:

A. Person identification
B. Vehicle tracking
C. Intrusion detection
D. Industrial Surveillance

Automated Surveillance relies on object identification and tracking. These leads to motion detection but tracking an object can be hindered by occlusion and illumination changes adding shadows, noises, air in to it. These leads to ambiguity in the captured vision which gives improper alerts [3] .So proper techniques should be employed to detect motion and real time streaming.

Person identification uses the property of local binary pattern with histogram in order to identify the face [4] [12]. For person identification we use both face recognition and matching based on general appearance and style [2]. A crowd can be automatically segmented in to individuals using online global optimization. Assuming there is no skew in camera and sensor focuses toward centre of person its focal length, height, and tilt can be calculated through Eigen value decomposition [2].

Vehicle tracking comprises image brightness, velocity, direction consistencies between frames [5]. More over filters can be applied in order to obtain consistency and stability between frames to remove noise and occlusion in between frames, while background can change spatially or temporarily, and effect of illumination, shadow, wind driven motions are added to frame .No uniform change occurs in traffic. Normally used techniques are optical flow and temporal difference [5].

Intrusion detection employs background subtraction method with use of inertial and vision positioning methods. It uses motion information from a static camera and an accelerometer to detect and track object. Floor plane acceleration is extracted from double

differentiation. These are done to keep track of trajectory of person. These are well suited in banking and home surveillance [6]. Industrial surveillance uses MOG based background subtraction. This method can handle both slow and fast illumination changes. This is pixel based multimodal representation of the background for eliminating repetitive motions like wind, shadows, noise in background [7]. This method is also effective for monitoring traffic when variance, learning rate difference metrics is applied.

II. LITERATURE SURVEY

There are many existing methods for real time monitoring and motion detection which comprises of both algorithmic and non algorithmic approaches.

A. Real Time Monitoring

Uses a CCD or MOS to capture incident photons entering to camera circuitry. It measures luminance and converts it to an electrical equivalent. Brighter image represented by higher charge and darker image by lower charge density. But it only corresponds to black and white image [8]. To get a colored image it has to detect total light level and levels of each color of light. This will result in a colored frame by combining three colors red, yellow and blue. CCD is to measure the levels of these colors to produce colored display. Lens on CCTV camera is the primary object in the sensor [9]. It focuses light or IR energy on image sensor. Its role is to deliver equally focused, undistorted accurate image to the sensor. There is also a band pass filter circuit in camera in order to remove unwanted rays from the incident light. Also in the case of low illumination an LED will be illuminated through an LDR circuit to provide necessary vision to camera.

B. Motion Detection

In order to detect change in movement its recommended principles starts with static object detection which deals with size, shape, type and occlusion [3]. Person identification deals with histogram taking local binary pattern in to account. Then it hints at moving object where it captures image, compares background, introduce filtering and applying algorithm. This depends on applying principles like

1) *Temporal Difference:* It is the simplest and fastest approach to detect motion. Here each consecutive frame difference is calculated. And the evaluated difference is used to estimate motion. But when change is slow it can lead to occlusion and blurring of image. Here a filter or window can be applied over in order to get the mean and variance of intensity value at each pixel [10]. It will be updated at every second according fps. The mean and variance depends on amplitude of change and duration of it [16]. It is highly adaptive approach. But it mainly applicable when background is static. Otherwise it will add up illumination change, shadow and noise.
2) Optical Flow: This is applicable when both motion and background changes with motion. Here clustering of the field flow with respect to motion vertices is taken. This is based on image brightness and flow velocity between frames. After detecting the object flow motion vectors are applied to segment it from background. Filter is applied to remove noise [3]. This gives an approximation of motion field from time varying image intensity relative to camera. This method is mostly applicable in traffic monitoring to track vehicles with the aid of blob analysis [5].
3) *Background Subtraction:* It builds up a pixel based model of background in which image of the object compare with previous sequel and difference is obtained and compared to threshold value to determine foreground. Here in each sequel background is compared and variation is determined. The variation in current video frame and reference background determines the moving object. It can be done recursively and non recursively. This is the only method where it can be used universally for motion detection, but the detection speed and convergence differ in regards to application interests. It depends on objects speed and frame rate. This is a complex computational approach but yield is robust in nature than previous methods [11].

These methods still produce ambiguity when the environment is complex for applications. These are some of challenges in vision applications.

a) Changes in illumination
b) Occlusion
c) Noise
d) Higher data dependency and frequent memory access in case of histograms.
e) Higher frame rate required

These can be dealt with modification in methodologies and the supporting processor for computation.

III. PROPOSED SYSTEM

The method is based on MOG based background subtraction for surveillance and capturing motion using time space modeling replacing pixel model. This is done by implementing new adaptive learning rate parameter, variance definition with threshold limit involving confidence interval and distance matrices for color representation. Learning rate depends on speed at which object moves in a background and tends to stop. To balance it out an interval is applied. This in fact solves the illumination change also. Use of these matrices provides a density function of pixel captured. With aid of spatio temporal region in MOG it is easier to extract minimum variance. Here each pixel will be modeled by MOG using region based model [7]. The confidence interval of color region is set to higher priority than illumination background so it will be easier to detect and filter out environment changes like wind, illumination, shadows. The use of independent threshold for each color component in time varying model overcomes contradiction with illumination changes. Subsequent processes such as tracking and behavior analysis are greatly dependent on the performance of this stage.

In our system, we used MOG as criterion to detect moving areas in stationary scenes. But in order to go for person identification mostly used metric is histogram using local binary pattern. Mainly histogram variant is based on three factors image gradient, image intensity and lbp[12]. In the table each area is represented by a binary digit according to frequency of occurrence in matching character. The integral histogram value equals the summation of histogram regions in the summation area table. But in a crowd to do this it requires more access to memory and too much data correlation occurs. This in turn produces lot of redundant space and computation complexity. All these leads to slow down in facial identification. This can be solved using strip based memory partitioning to support maximal parallelism and data correlation based memory compression mechanism to reduce redundant space and improve efficiency. As a part with camera module a pyroelectric sensor [14] is embedded. Camera will behave as Omni directional, reason is in the absence of ambient light the illumination circuit inside camera module has to power LED to transmit light to the region of object. This is for an intuitive detection purpose but is the fastest and easiest mode to identify an object [13]. This method characterizes the Stefan Boltzmann law to identify an object based on radiation spectra. Every object differs in the emission spectra characteristic. With help of a microprocessor and matching spectra data we can get an idea of the object in the region. This method is similar to thermal imaging but differ in its principle. This application mainly deals with threats. It will only give an idea of object only. In combination with MOG, histogram it can definitely improve the rate of detection and tracking.

To get the surveillance stream in a monitor it requires processing of current captured content, this has to be done by a PC processor. But it is tedious process and memory sharing for PC is too high in terms for real time surveillance. This due to the fact that for compression it is better to have hardware compression rather than software compression. Modern CCTV uses H264 compression format. In normal streaming not all the frames are of same size and don't require the same amount of work to process regardless of compression. Mean while PC itself will be processing GUI and other running parameters. This will lead to lot of memory wastage and it is better to employ hardware compression using configurable parallel architecture employing strip based memory partitioning. Normally for the vision application Raspberry pii is used as hardware processor. Its yield is good. But when the frame rate increases with increase in object to detect and track, it will slow down surveillance. More over quality and computation with regards to algorithm will begin to crack down. It will be wise to use Matrix display video cards plugged with processor; this will initiate the computation process in its own by three phases.

Fig.1 Real Time Motion Detection

A. Video Input
B. Video Matrix
C. Video Output

In these phases MDI card will take the real time frames or recorded file and decodes it with help of application software and software development kit to matrix video control using DS module in MDI card. Now the surveillance video is ready to stream with a monitor source.DM processors are used when HD video frame are required.

The use of IOT is to transmit the images locally received to any remote location for the purpose of real-time streaming, security and it can also be used to bypass the storage device if cloud storage is enabled [15]. Also if an intrusion or threat is detected it can annunciate to Mail, SMS or any other indications [1] [15].

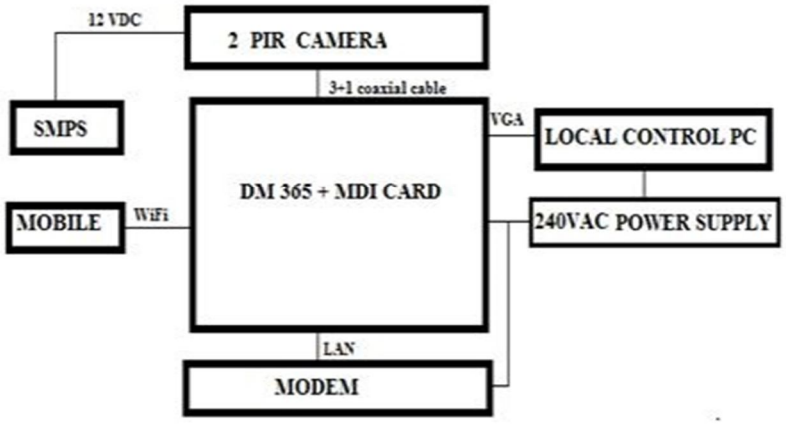

Fig. 2 CCTV Block Diagram

Fig. 3 IOT implemented CCTV with MDI Card

IV. CONCLUSION

CCTV Surveillance is advancement in video surveillance in terms for computer vision. Users can effortlessly monitor home, office, traffic, industrial area or any other premises 24-hours a day. There are various methods used for object detection and object tracking said in this paper like temporal difference, optical flow, background subtraction and histogram. The proposed methodology will ease up the monitoring and detection process with improvement in speed, storage, quality. The strip based memory partitioning and correlation based memory compression will add more parallelism and speed up computations. The use of IOT will make it flexible to monitor locally and remotely by using ip camera.

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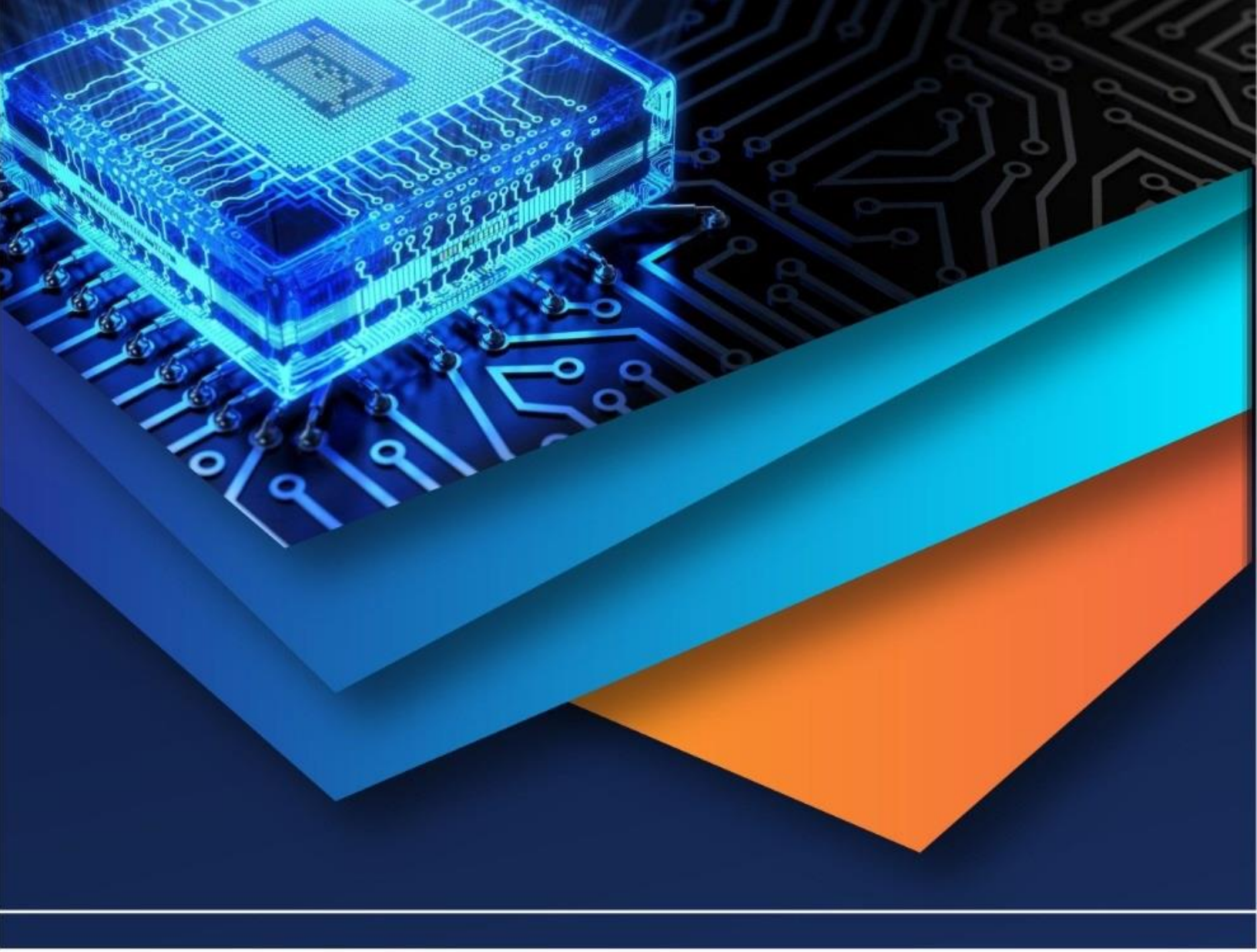

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