

Surveillance System Integrated with IOT

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Abstract— In gift state of affairs, the protection considerations have fully grown enormously. The protection of restricted areas like borders or buffer zones is of utmost importance; specially with the worldwide increase of military conflicts, smuggled immigrants, and coercion over the past decade. To solve this issue, this paper proposes the structure of a remote inserted intelligent security observing framework dependent on the OpenCV algorithm in computer vision which can easily detect the intruders. The framework utilizes the OpenCV algorithm to demonstrate the background picture which is procured from the camera, and at that point does the object detection using algorithm like YOLO, darknet and deep learning in the monitored condition. On the off chance that a moving object (including people) is detected, the system will consequently send an alert, while sending a message or calling user to take necessary measures. In the wake of testing, the framework can precisely decide regardless of whether there is something interfering the observing zone or on the other hand not. It is robust, real-time, and with a decent viable application esteem.

Keywords— *Motion, Detection, System, surveillance, Moving object detection and security.*

I. INTRODUCTION

In early era of video surveillance usage, it began with easy circuit tv observance it absolutely was once the video container hit the market, the recognition of video police investigation increase .The usage of the video-cassette recording allows the police investigation to be preserved on tape as proof. This makes the investigation of crimes rather more simply, quicker and with efficiency. An entire simple video-reconnaissance framework comprised of a camera, screen and VCR. All things considered, this technique has its own restriction any place the ongoing cylinder camera was exclusively useful in sunshine and furthermore the VCR may exclusively store eight hours of film at the best. because of this impediment, right away once the video-observation framework hit the market, house proprietors and laborers of such a framework would become smug and not change the tapes every day or the tapes would destroy once

month of being re-utilized. the appropriate response of this disadvantage shows up in 1990 once the Charge Coupled Device (CCD) that pre-owned microchip innovation was presented. This new framework utilize advanced multiplexing unit and once this unit gets sensible, it reformed the police examination camera exchange by sectionalize chronicle on numerous cameras speedily.

Three key components welcomed on the supported utilization of the advanced video recorder. They are,

1. The progression in compression ability, allowing a ton of information to be keep on a hard drive.
2. the cost of a hard drive, that has decreased drastically as of late.
- 3.The capacity ability of a hard drive, that has expanded drastically in late year.

Digital video surveillance created complete sense because the worth of digital recording born with the PC revolution. Instead of changing tapes daily, the user may faithfully record a month's price of surveillance on hard drive. Normalized Cross Correlation (NCC) algorithmic program is predicated on finding the cross correlation between two consecutive frames in a picture sequence. Correlation is largely accustomed realize the similarity between two frames. If the two consecutive frames are specifically same, then the worth of normalized cross correlation is in that. therein case no moving object is detected. currently suppose there's a moving object within the image sequence, suggests that the two consecutive frames aren't specifically same, with relation to positions of the pixel values. in that case price(the worth) of normalized cross correlation is a smaller amount than most value obtained. This idea of normalized cross correlation is employed for the detection of moving object in a picture sequence

II. LITERATURE REVIEW

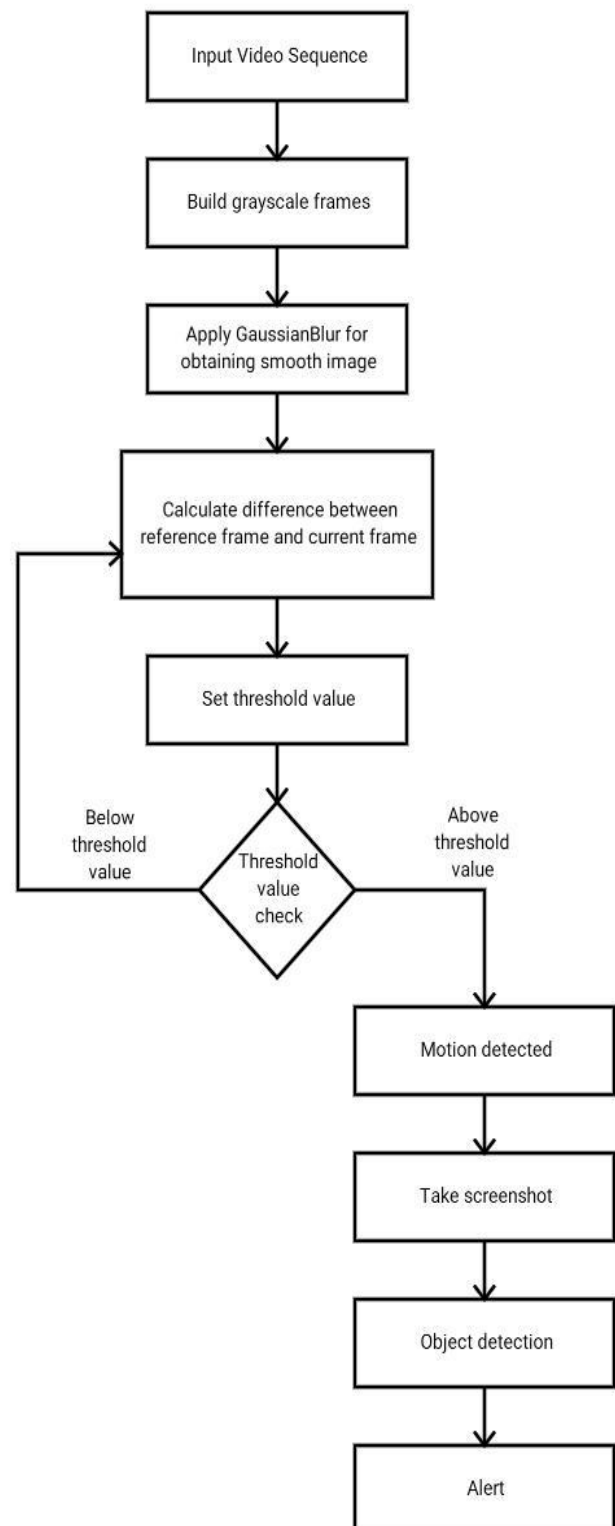
Motion detection is one in all the foremost vital subjects in fashionable info acquisition systems for dynamic scenes. The

work of this paper is an extension of the algorithm developed for motion detection [1] using frame difference,[2]. To make decision whether motion is detected or not, threshold [3] is used [4], in their thresholding method used for motion detection. Different algorithms for motion detection such as background subtraction method [5], normalized cross correlation algorithm [6].

III. PROPOSED WORK

IoT in people groups be right now various advantages helping personals, enormous business just as on common source. IoT in people groups be right now various advantages helping personals, enormous business just as on common source. This could be exact worthwhile to join IoT into security conspires other than the reason for the venture is to consolidate IoT in security structures to see signal, similar to consistently when oneself were at movement you would be fit to eyewitness at that point got alerts condition some activity happens at his each administrator who is proficient in the current framework may consider of a framework that may include more adaptability in addition to run with some basic applications, for example, android. This work is pointed in such a manner to escape the course of action bolsters greater flexibility, unwinding limit and security. The further most significant advantage for example here course of action would hand over the extra exists for example it will isn't at all requiring having apparatuses by commonly house handlers the game plan will be appeared enroot to remain of noteworthy use like that one eats up less force usage other than too starts by a little charge. This improvement purposes to make more straightforward sign finding as well as the intersection point to be there client congenial, whichever will show bring about notification once sign be present took note.

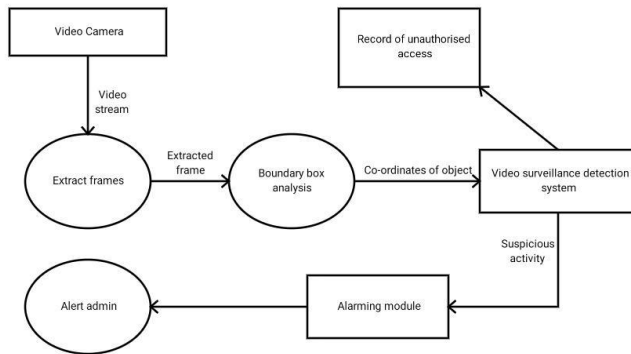
In this paper we implementing the system in which input is given as sequence of video frame through web cam, which can further be implemented on camera. After getting the input system build grayscale frame. The further processing is done on this grayscale frame. Now Gaussian blur algorithm is used to smooth the frame. After the process of smoothing is done then the difference between the reference frame and current frame is calculated. If the calculated difference exceeds the threshold value then the motion is detected. As soon as the motion is detected system takes the screenshot of that frame and send it to the server for further processing. As the image is received at the server side. The machine learning algorithms like YOLO, darknet, and deep learning is used to detect the object in that image. Now depending on object detected the user is alerted to take the necessary precaution.



IV. SYSTEM FUNCTIONALITY

A. System Overview

The system consists of five main functions. The apex function is of video recording. Thereafter, motion detection and object detection come into effect. In the event that an object is detected, the user is most hastily contacted by our contraption.



B. System Architecture Functioning

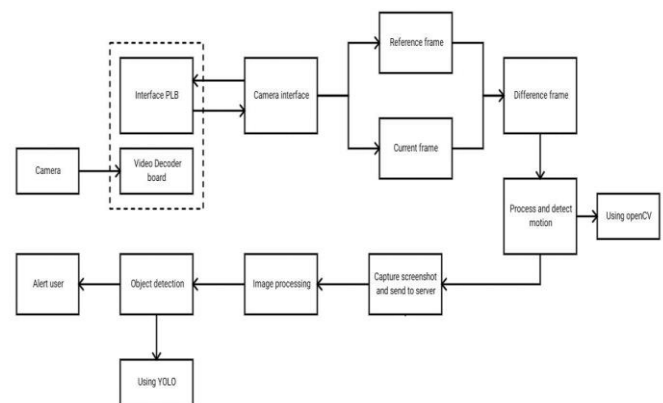
The system architecture is functioning in the following way:

Catching the live feed through a web cam: To identify movement, the initial step is to catch live video casings of the territory to be checked and kept reconnaissance police work this is frequently done by utilizing a web cam that unendingly gives an arrangement of video outlines specific unequivocal speed of FPS (outlines every second).

Comparing the current edges caught with past edges to distinguish movement: For checking whether any development at all is accessible in the live video feed, the live video traces being outfitted by the web cam with each other so changes can be perceiving in these edges and accordingly predict the occasion of some development.

Storing the casings on the memory happens if movement is identified. On the off chance that movement is being recognized, we'd need putting away such movement all together that the client will peruse it inside the near future. This conjointly helps the client in giving a lawful confirmation of some improper action.

These put away edges are then passed towards the article recognition calculation. On the off chance that the calculation yields the recognized article as a human, the approved client is sent an alarm.



Right now executing the framework in which info is given as grouping of video outline through web cam, which can additionally be actualized on camera. In the wake of getting the information framework assemble grayscale outline. The further handling is done on this grayscale outline. Presently Gaussian haze calculation is utilized to smooth the casing. After the way toward smoothing is done then the contrast between the reference casing and current edge is determined. On the off chance that the determined distinction surpasses the threshold value, at that point the movement is detected. When the movement is recognized framework takes the screen capture of that outline and send it to the server for additional preparing. As the picture is gotten at the server side. The AI calculations like YOLO, darknet, and profound learning is utilized to recognize the object in that picture. Presently relying upon object identified the client is made aware of avoid potential risk.

V. MOTION DETECTION IN LIVE VIDEO STREAM

Recognizing changes in picture arrangements of indistinguishable scene, caught at very surprising occasions, is of noteworthy intrigue in light of a larger than usual scope of uses in numerous orders. Video observation is among the crucial applications, that need dependable recognition of changes inside the scene.

As people become increasingly more security sagacious, they're going to request genuine insurance for their property. The new computerized video frameworks can should raise that security to another level. They should cause the clients to feel great and the individuals who do endeavour to beat the framework should confront a so a lot greater danger of getting captured. Henceforth, the new computerized video reconnaissance frameworks ought to be prepared to give a high suspicion that all is well and good. The true serenity will exclusively be accomplished once the individual is guaranteed that he will be educated regarding any burglaries of his property while they are in progress. He would likewise feel more secure in the event that he might be ensured that the observation framework that he utilizes won't exclusively give him confirmation against the culprits anyway conjointly endeavour to prevent the robberies from going down inside the underlying spot.

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VI. MOTION DETECTION USING SUM OF ABSOLUTE DIFFERENCE (SAD)

This algorithm is based on image differencing techniques. Present frame is subtracted with the previous frame, sum of absolute value of the difference image is calculated, and this value is compared with the threshold value. If the difference value is above the threshold value indicates the moving object in the video frames [8]. It is mathematically represented using the following equation..

$$D(t) = \frac{1}{N} \sum |I(t_i) - I(t_j)| \quad \text{..(i)}$$

Where N is the number of pixels in the image used as scaling factor, $I(t_i)$ is the image I at time i, $I(t_j)$ is the image I at time j and $D(t)$ is the normalized sum of absolute difference for that time. In an ideal case when there is no motion

$$I(t_i) = I(t_j) + n(p) \quad \text{..(ii)}$$

And $D(t)=0$. However, noise is always presented in image and a better model of the image in the absence of motion will be.

$$I(t_i) = I(t_j) \quad \text{..(iii)}$$

Where $n(p)$ is noise signal.

VII. OBJECTION DETECTION USING FASTER REGION-BASED CONVOLUTIONAL NEURAL NETWORK

We prepared the Faster Region-based Convolutional Neural Network (Faster R-CNN) model on Caffe profound learning structure by Python language. The Faster R-CNN is a locale based recognition strategy. It right off the bat utilized an area proposition organize (RPN) to produce identification recommendations, at that point utilized a similar system structure as Fast R-CNN to order question and change the bouncing box. The methodology is envisioned in 2. The preparation methodology of this model was as per the following: First, we prepared the RPN start to finish by back-spread and stochastic angle plunge. We picked the ZF and VGG16 net to extricate highlights for the RPN and all the layers are instated by a pre-prepared model for ImageNet order. We picked the learning rate 0.0001 for 40k smaller than normal bunches, an energy of 0.9 and a weight rot of 0.0005. Second, we prepared a different identification arrange by Fast R-CNN utilizing the proposition produced by the stage 1 RPN for 20k smaller than usual clumps. This discovery organize was likewise introduced by a pre-prepared model. Presently the two systems didn't share convolutional layers. Third, we utilized the indicator system to introduce RPN preparing for 40k min-bunches, yet we fixed the mutual convolutional layers. Finally, we kept the mutual convolutional layers fixed and adjust the one of a kind layers of Fast R-CNN for 20 k smaller than usual clumps.

VIII. IMPLEMENTATION OF MOTION DETECTION

ALGORITHM

A motion detection algorithmic program was applied on the antecedently browse pictures. There have been two approaches to implement motion detection algorithmic program. The primary one was by mistreatment the two dimensional cross correlation whereas the second was by mistreatment the sum of absolute difference algorithmic program. These area unit explained in details within the next two sub sections.

A. Motion Detection using two Dimensional Cross Correlation

Initial are pictures were sub divided into four equal elements every. This was done to extend the sensitivity of calculation wherever it's easier to note the distinction between a part of image instead of an entire one.

A two dimensional cross correlation was calculated between every sub image with its corresponding half within the alternative image. This method produces four values starting from -1 to 1 counting on the distinction of the two correlate pictures.

Because the goal of this technique was to achieve additional sensitivity, the minimum value of correlation will be used as reference to the threshold.

In traditional cases, motion will simply be detected once the measured minimum cross correlation price is employed to line the brink. However, detection fails once pictures contain international variations like illuminations changes or once camera moves.

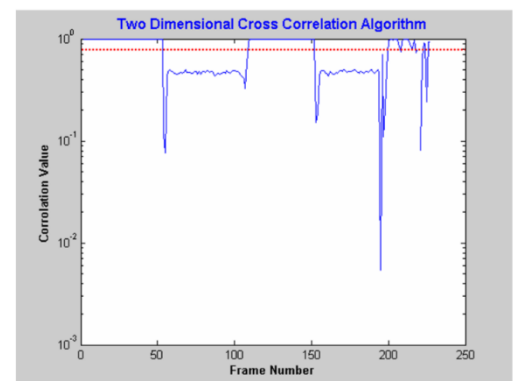


Figure 2 Direct Thresholds for Correlation values

Above figure shows a test suit that contains consecutive illumination level changes by shift the light on and off. throughout the time wherever the lights are on (frames 1-50 and frames 100-145) the correlation price is around 0.998 and once the lights area unit converted (frames 51-99 and frames 146-190) the correlation price is around 0.47. If the threshold for detection was mounted round the value of 0.95 it'll ceaselessly observe motion throughout the light off period.

To overcome this drawback continuous re-estimation of threshold value was needed. this can be done by using an adaptive filter however it's not easy to design. Another

resolution is to look at the variance of the set of information created from the cross-correlation process, and observe motion from it. This technique resolved the matter of fixing illumination and camera movements.

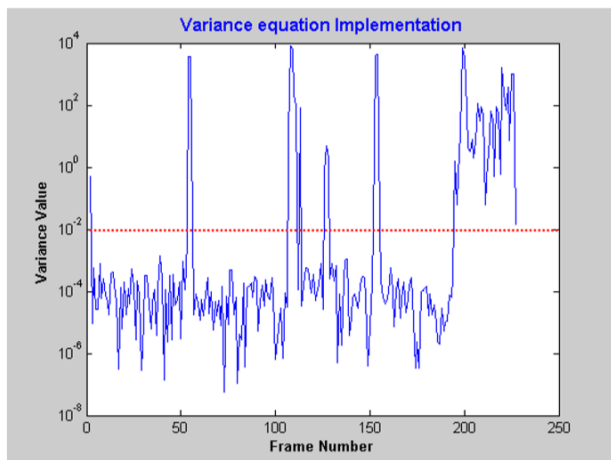


Figure 3 Variance Values as Reference for Threshold

Above figure shows the variance signal calculated from the same set of pictures. It will be seen that the necessity for ceaselessly re-estimate the brink price is eliminated. selecting a threshold of 1×10^{-2} can observe the days once solely the lights area unit switched on and off. This results into a robust motion detection algorithmic program with high sensitivity of detection.

B. Motion Detection Using Sum of Absolute Difference (SAD)

The MATLAB interface permits the user to outline the commands to be performed at the run time. Once the user setup of the video supply is complete the algorithmic rule comes into play. The algorithmic rule is constructed to require advantage of the strength of MATLAB i.e. to store knowledge as a type of matrices

The frames noninheritable area unit keep within the MATLAB directory as matrix within which every part of the matrix contains info concerning the constituent worth of the image at a selected location.

Therefore, the pixel value are stored in the workspace as a grid wherever each element of the matrix corresponds to an individual pixel value.

Since MATLAB considers every matrix jointly massive assortment of values rather than a bunch of individual values it's considerably faster in analyzing and process the image knowledge.

The algorithmic rule thus checks every frame being noninheritable by the device with the previously noninheritable frame and checks for the distinction between the whole values of every frame.

A threshold level is set by the user with that the distinction of values is compared. If the distinction exceeds the brink worth the motion is claimed to be detected within the video stream.

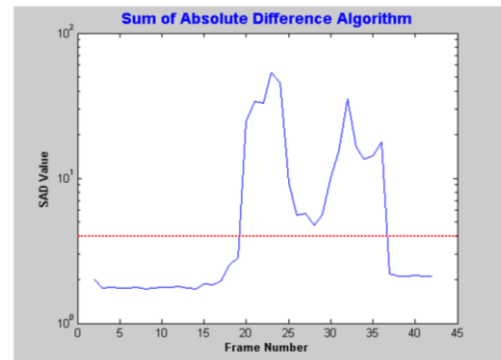


Figure 4 Direct Thresholds for SAD Values

The above figure shows a action at law that contains an oversized modification within the scene being monitored by the camera this was done by moving the camera. throughout the time before the camera was affected the unhappy worth was around 1.87 and once the camera was moved the sad worth was around 2.2. If the threshold for detection was fastened round the value less than 2.2 it'll ceaselessly observe motion once the camera stop moving. to beat this drawback constant answer that was applied to the correlation algorithmic rule are going to be used. The variance worth was computed once assembling 2 unhappy values and therefore the results shown for constant action at law in figure 5 below.

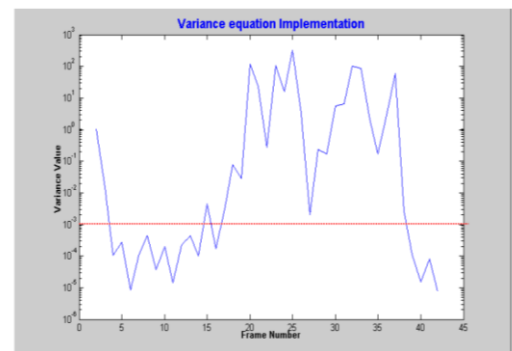


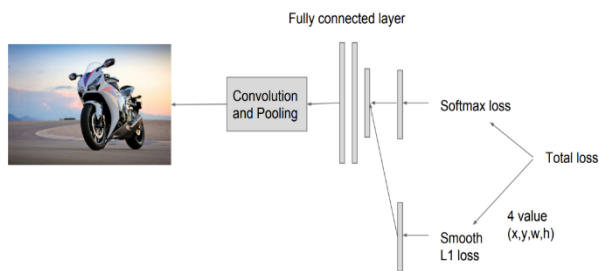
Figure 5 Variance Values as Reference for Threshold

This approach solve the necessity for ceaselessly re-estimate the brink worth. selecting a threshold of 1×10^{-3} can observe the days once solely the camera is affected. This results into a strong motion detection algorithmic rule that can't be littered with illumination modification and camera movements

IX. IMPLEMENTATION OF OBJECT DETECTION

ALGORITHM

First, a picture is taken and YOLO rule is applied. In our model, the picture is part as networks of 3×3 lattices. we will partition the picture into any range frameworks, contingent upon the multifaceted nature of the picture. When the picture is separated, each matrix experiences arrangement and confinement of the article. The objectness or the pomposity score of each matrix is found. On the off chance that there's no right item found in the



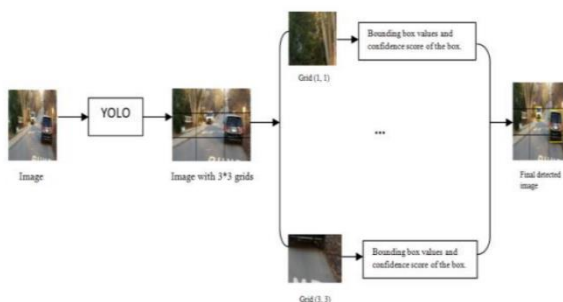
matrix, at that point the objectness and bounding box cost of the framework will be zero or on the off chance that there discovered partner object inside the network, at that point the objectness will be one and in this manner the jumping box cost will be its comparing jumping estimations of the discovered article. The bouncing box forecast is clarified as follows. Likewise, Anchor boxes are acclimated increment the exactness of item recognition.

A. Bounding Box

The bounding box could be a parallelogram drawn on the image that tightly fits the item within the image. A bounding box exists for each instance of each object within the image. For the box, 4 numbers (centre x, centre y, width, height) square measure foretold. this will be trained employing a distance live between foretold and ground truth bounding box. The space live is a Jaccard distance that computes intersection over union between the anticipated and ground truth boxes.

B. Classification + Regression

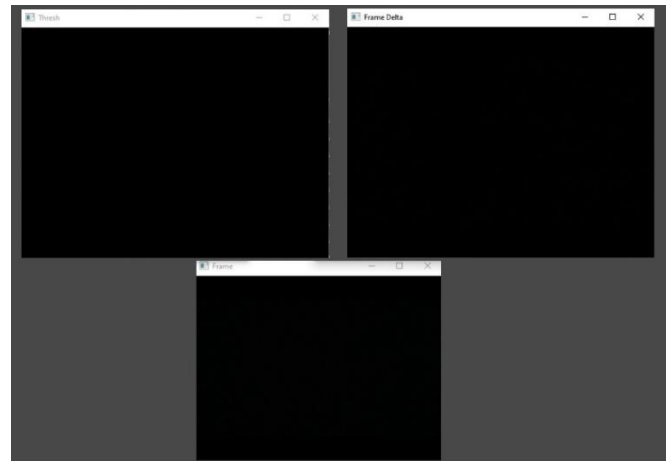
The bounding box is predicted using regression and the class within the bounding box is predicted using classification. The overview of the architecture is.



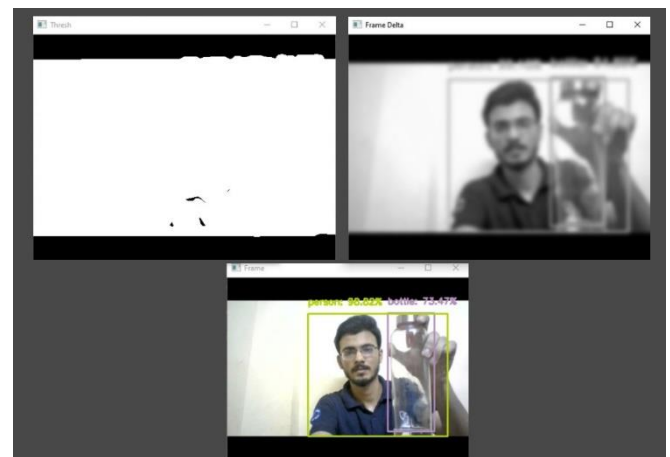
X. RESULTS AND DISCUSSION

All these algorithms have been tested and implemented on Window platform. the coding was written in jupyter notebook language. This software was connected to web camera to receive the live feed video. This system capable to store the video with contains 20 to 25 frames per second for video size of 320 x 240 pixels.

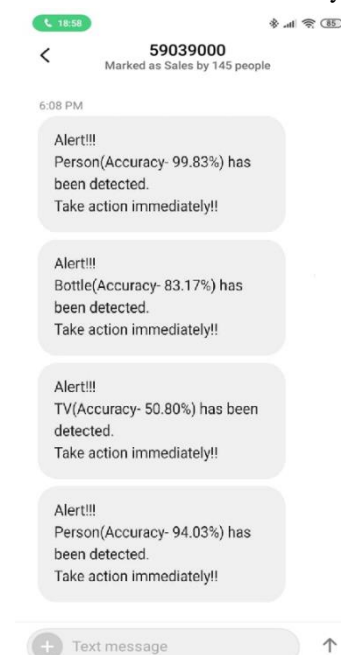
The first frame is black since there is no movement.



The below frame detects the different object



When the object is detected as person system alert the authorizer user. So that user can take necessary action.



An accurate and efficient object detection system has been developed which achieves comparable metrics with the existing state-of-the-art system. This project uses recent techniques in the field of computer vision and deep learning

XI. CONCLUSION

Calculations are proposed by Partitioning Normalized Cross connection and Sum of Absolute Difference (SAD) for the recognition of moving item from the picture succession. Significant bit of leeway of these calculations is that it requires exceptionally less pre-preparing of the edges from picture arrangement. The calculations are powerful against changes in enlightenment and lighting conditions. In poor lighting conditions likewise, the calculation is giving better outcomes. For object identification YOLO calculation is utilized which gives better outcome by utilizing methods in the field of PC vision and profound learning. A video observing and recognition framework was hence grown effectively right now. This framework basically gives an effective strategy to observation purposes and is expected to be exceptionally advantageous for any individual or association. Accordingly, movement based change location in avi video group was finished and effectively executed.

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saveu c:\dc-project\new-folder\models\research\object_detection\test_images\image4.jpg
Motion detected.. Do something!!!
saved E:\BE-PROJECT\New-folder\models\research\object_detection\test_images\image5.jpg
Motion detected.. Do something!!!
saved E:\BE-PROJECT\New-folder\models\research\object_detection\test_images\image6.jpg
Motion detected.. Do something!!!
saved E:\BE-PROJECT\New-folder\models\research\object_detection\test_images\image7.jpg
Motion detected.. Do something!!!
saved E:\BE-PROJECT\New-folder\models\research\object_detection\test_images\image8.jpg
Motion detected.. Do something!!!
saved E:\BE-PROJECT\New-folder\models\research\object_detection\test_images\image9.jpg
Motion detected.. Do something!!!
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Motion detected.. Do something!!!
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Motion detected.. Do something!!!
saved E:\BE-PROJECT\New-folder\models\research\object_detection\test_images\image12.jpg
Motion detected.. Do something!!!
saved E:\BE-PROJECT\New-folder\models\research\object_detection\test_images\image13.jpg
Motion detected.. Do something!!!

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