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Unusual Human Activity Recognition in ATM'S

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Abstract: This paper addresses the imperative need to enhance Automated Teller Machine (ATM) safetyand security through the integration of deep learning and OpenCV. Leveraging Convolutional Neural Networks (CNNs) for feature extraction and Siamese Networks for anomaly detection, our approach aims to fortify ATM systems against threats like skimming and unauthorized access. Realtime image processing with OpenCV facilitates efficient preprocessing. The study critically examines existing methodologies, highlighting vulnerabilities to adversarial attacks and environmental variations. Through rigorous evaluation and adversarial testing, this research of ATM security systems, fostering a more secure financial landscape.

I. INTRODUCTION

ATM has established to be an essential machine developed system that has enabled human beings to withdraw their cash easily, 24x7. Since ATMs are handy reservoirs of liquid cash, they are constantly focused via thieves and frauds to borrow the cash saved in ATM. This device is a proactive measure that ensures the protection of the people and prevents physical attacks by predicting the vulnerability of an ATM. With the increasing reliance on Automated Teller Machines (ATMs) for economic transactions, making sure the safety and safety of those systems has turn to been a paramount concern. The ability risks associated with ATM- associated abnormalities including multiple person detection, weapon detection and identification theft, necessitate the improvement of strong security measures. This paper endeavours to address these challenges by harnessing the power of deep learningand OpenCV, aiming to fortify ATM infrastructure against evolving threats. As technological advancements continue to shape the landscape of financial services, our focus on leveragingConvolutional Neural Networks (CNNs) for featureextractions and Siamese Networks for anomaly detection promises a sophisticated approach to augmenting security protocols. This introduction sets the stage for a comprehensive exploration of existing literature, methodologies, with the ultimategoal of contributing to the improvement of resilientand adaptive security systems for ATMs in an era ofescalating cyber threats.

A. Overview of Image Processing

The fundamental definition of image processing defines that processing of digital images by removing noise, any type of irregularities that can have crept into the image, both through its formation, transformation, storage and others. In arithmetic analysis, it can be(image) shown asa 2-D functions f (x, y), in which x, y are spatial coordinates and amplitude off at any factor (x, y) are referred as the of values f at that factor. In grey scale images, it's also calledthe grey level. When x, y and these intensity values are countable, discrete quantities, it is stated to be digital image. Its miles are crucialthat a dip (digital image) consists of estimated range factors, which has coordinates and a value. The ones elements are referred to as picture each element or pixels and are the small part of an image. Numerous techniqueswere superior over the past a long time. Maximum of those strategies are evolved for reinforcing images received at variousphotography equipment's. Image process has become famous due to smooth availability of effective personal computers, algorithms, memory devices, software, etc. Moreover, over the years, their usage has also become very simple and can be of use, not just to researchers and scientists, but to laymen as well, who can also use it in the right way to realize their potential better.

Image processes is utilized in diverse utility which includes

1) Remote Sensor
2) Medical image
3) Non-destructive Evaluated
4) Forensic Study
5) Textile industries
6) Material Sciences
7) Film Industries
8) Graphic design
9) Printing Industries

B. Digital Image Processing

DIP commonly determines the processing of a2-D image in useful resource of a virtual pc, itshows dip of 2-D data. A virtual image is arrayof real numbers represented via a finite wide type of data. The principle gain of virtual Image Processing techniques is its versatility, repeatability and upkeep of original information precision

The steps involved:

1) Image Pre-processing
2) Image Enhancements
3) Image Segmentations
4) Feature Extractions
5) Image Classifications

C. Image Pre-Processing

n this, the image statistics recorded through theusage of sensor in a digicam associated with geometry or contracts value of the pixels may not be very unique, as numerous noises may interfere with these bit values. Those mistakes are related using accurate mathematical models can be both particular or statisticalmodel. Image enhancements are themodification of images via converting the pixel values to enhance its visual effect. Imageenhancement involve a group of strategies to Enhance the seen appearance of image each to machines in addition to humans. Every so often, images acquired from satellites and digital camera lacks in comparison and brightness, because of restriction in imaging sub-systems and Heavy Light conditions while capturing the image. Images also have one-of- a-type forms of noises in image. An image enhancement, the purpose is to obtain the positive image functions for the following analysis stages or display. These may involve, contrast or edge enhancement, pseudospoofing, noise filters, sharpening and focusing. Image enhancement is done mainly using feature extraction, analysis of image anddisplaying. The enhancement system itself theextraction of information of data. It really ensures a unique image characteristic. These algorithms are mainly interactive and applications dependent. Group of strategies toimprove the visible look of an image- each to machines in addition to humans. Every so often, images acquired from satellites and digital cameras lack in comparison and brightness because due to the limitations of imaging sub-systems and illumination conditions while capturing the image. Images may have one-of-a-kind varieties of noise. In image enhancement, the aim is to accentuate positive image features for the following analysis stages or display. These may involve contrast or edge enhancement, pseudospoofing, noise filtering, sharpening and magnifying. Image enhancement is useful in feature extraction, image analysis and display. The enhancement system itself does not increase the inherent information in the data. It really emphasizes sure unique image characteristics. These algorithms are typicallyinteractive and application dependent.

Some of these are:

1) Noise Filtering
2) Contrast Stretching
3) Histogram Modification

Considering that we used noise filtering in ourpaper, we would describe it briefly as technique to clear out needless data from the image. Used to take away various forms of noise from the image. Mostly, one of the features is interacting. numerous filters used, like low pass filters, high pass filters, mean andmedian is also available. Here, we've used themedian filter to effectively filter out noise.

D. Image Segmentation

It is the process of partitioning the image into many segments or regions based on certain characteristics, which includes colour, intensity, texture, or other visual properties. The purpose is to simplify the representation an image, making it easier and understand. Segmentation is used in many applicationsincluding medical imaging, autonomousdriving, and satellite image analysis

E. Image Classification

It is used for naming pixel or organizing pixelsprimarily based on grey value. It is commonlyused methods to extract information. In classification, lot of factors are used for each pixel, In RSA (remote sensing area), the process assumes that an image of geographic vicinity is specified and is gathered in multiple areas of the (EM waves) electromagnetic spectrum also registered. The extracted information strategies depend on study of the spectral reference property of the photograph or image and algorithms are specialized and designed to carry out numerous kinds of spectral analysis.

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The method of multiple categorizing can be carried out the usage of any of the two techniques- supervised or unsupervised. In the first classification that is supervised, the specification of the related parameters also accompanies the image for 'learning' reason. These are usually referred to as the training sets because of the spectral are used feature of the recognised and for training the algorithm. The various parameters are calculated in every training set. Each pixel, both inside and outside those training sets is checked. They are assigned to the class having best probability in a part. Therefore, in unsupervised categorization, the classificationof the class kinds should specify as lesson inside a scene which are not usually called priori. Due to the fact floor truth is missing orfloor capabilities inside the scene aren't nicelydetermined. The supercomputer is needed to collect the pixel data that are of different spectral classes to statistically determined. Theassessment we've got used is majorly supervises, which commonly results in a high accuracy rate. Evaluated and assigned to aclass of which it has the best probability of being a member. In an unsupervised classification, the identities of the class kinds should be specific as lessons inside a scene which are not usually called priori due to the fact floor truth is missing or floor capabilities inside the scene aren't nicely defined. Thecomputer is needed to group pixel data into different spectral classes according to some statistically determined criteria. The assessment we've got used is majorly supervises, which commonly results in a high accuracy rate.

F. Motivation

Existing research, at the type of anomaly detection from images uses supervisedlearning and deep learning methods Used a deep learning using anomaly detection from photographic images. Furthermore, there maybe some overall performance degradation because of bad parameter and layer choice in the neural network model. In the suggested CNN model for classifying anomalies within the images, we also use a revised number of layers and parameter settings. Furthermore, weran experiments with diverse CNN model variants and in comparison, the findings to thebaseline studies.

II. LITERATURE REVIEW

In this paper [1] Proposed algorithm only usesclose morphological operation with disk like structuring element in the preprocessing steps to cope up with low resolution video. It furtheruses rolling average background subtraction technique to detect foreground object from dynamic background in a scene. Our proposedalgorithm is able to recognize the occurrence of uncommon events such as overcrowding orfight in the low-resolution video simply by using statistical property, standard deviation ofmoving objects

In this paper[2], We are proposing an EnhancedATM security system by proposing a system todetect unusual event detection even in the low-resolution videos using ARM 7 LPC 2148. Thelow-resolution camera fitted inside ATM can beused. We are using the inbuilt web camera of the PC or Laptop in designing of the prototype.Usually, the laptop inbuilt web camera resolution is low. Hence, we use the same. By using discussed algorithm, we design a systemto detect the unusual activity. Whenever an Unusual event gets detected in ATM then buzzer will be on and also Alert SMS triggeringhappens from the GSM module to which ARM7 sends the appropriate commands.

In this paper [3], The system is implemented on the credit card size Raspberry Pi board with extended capability of open-source Computer Vision (Open CV) software which is used for Image processing operation. High levelsecurity mechanism is provided by the consecutive actions such as initially systemcaptures the human face and check whether thehuman face is detected properly or not. If the face is not detected properly, it warns the user to adjust him/her properly to detect the face. Still the face is not detected properly the systemwill lock the door of the ATM cabin for securitypurpose. As soon as the door is lock, the systemwill automatic generates 3-digit OTP code.

TheOTP code will be sent to the watchman's registered mobile number through SMS using GSM module which is connected with the raspberry Pi. Watchman will enter the generated OTP through keypad which isinterfaced with the Pi Board. The OTP will be verified and if it is correct then door will be unlocked otherwise it will remain lock.

This paper [4] This system is designed for the detection of abnormal activities, as the people should take possible actions for the prevention of dangerous event.

The abnormal crowd detection is one of the abnormal activities of this system. Here, input will be a video and output by system would be the classification ofabnormal activity/object. This object can be a bag or a parcel with specifications of dimensions. For classification of objects support vector machine is used for accurate results.

The proposed method in [5]: Siamese Networks for anomaly detection, OpenCV for preprocessing Thus, the security of the transaction is improved to a greater extent. Sensitivity to environmental changes, false positives with non-malicious anomalies.

III. METHODOLOGY

The methodology of this paper is a complicatedapproach of enhance Automated Teller Machine (ATM) safety and security. It begins with an in-depth literature review to grasp existing methodologies and challenges. The system integrates deep learning techniques, employing Convolutional Neural Networks(CNNs) for extraction and Siamese Networks for anomaly detection. Real-time image processing using OpenCV ensures efficient preprocessing of surveillance data. Training thesystem in a complex dataset facilitates robustness, and adversarial testing is conducted to assess resilience against potential attacks attac. Methodology emphasizes adaptability and proactiveness, aiming to address not only known threats but also emerging risks. Rigorous experimentation and performance evaluations validate system, contributing to the advancement of ATM security in the ever- evolving landscape of cybersecurityeffectiveness of the proposed system,contributing to the advancement of ATM security in the ever-evolving landscape of cybersecurity.

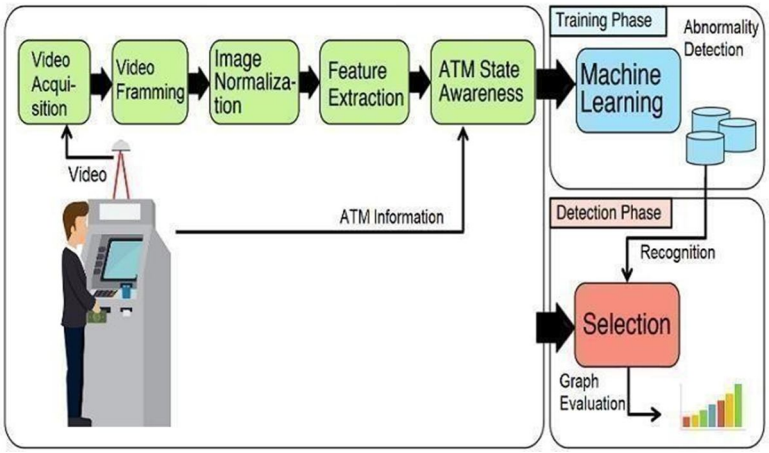


Fig 6.1: Working Model

The flows of the training and detection phases are shown above. Initially video is capturedusing surveillance camera and that video is taken as input to our device. Then video framing is performing on video to get images after getting images the images are normalized and which important functions as been extractedfrom those images. Then in the training phase, an abnormality detection dictionary for every ATM state is generated through machinelearning using only normal behaviours. First, animage is acquired from the camera. Then a normalized image is generated of each frame and feature value is extracted. The ATM state corresponding to the input frame is received. Thereafter, an abnormality detection dictionary is generated for every ATM state with respect to the accumulated characteristic values. Within the detection phase, normality/abnormality determination is made for each frame. The process from image acquisition to ATM state awareness is common with the training phase. An abnormality detection dictionary generated from the function value of same ATM state as the input frame is selected and recognition process is performed to determine normality/abnormality.

A. System Architecture

A System architecture is the conceptual model that defines the structure, behaviour, and more perspective of a system. An architecture description is a formal description and illustration of a device , prepared in a manner that supports reasoning the structuresin a mannerthat supports reasoning the structures.

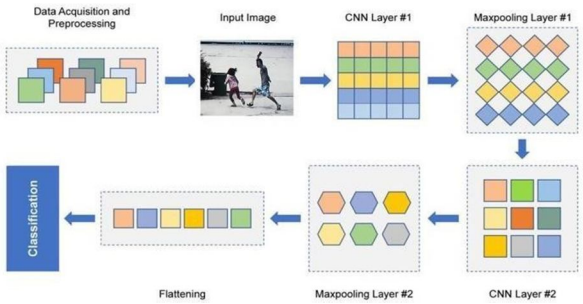


Figure 6.2: Architectural picture of theProposed System using CNN

System using CNN The figure 6.2 indicates the system architecture for the proposed method. Here we are able to see that the anomaly image input is fed into the anomaly detection system, in which it is pre-processed, then features are extracted. Then the extracted features are fed to SoftMax classifier that is the last part of CNN. The input image is pre-processed and convertedto grey scale image to find Threshold valuebased on input image. Based on Threshold valuefurther image sharpening is done, then further process is carried out. The system which is beingused currently performs the task of detecting thetype anomaly. The input image is fed into systemto find out edges and after sharpening the edges,features are been extracted and then fed into classifiers which can be trained according to theavailable dataset to detect the anomaly.

The proposed system has the following steps fordetection of anomaly

1) RGB to grey scale
2) Noise Removal
3) Thresholding
4) Image Sharpening
5) Feature Extraction and Classification

B. Conversion from RGB to Greyscale

The first step in pre-processing is converting theimage from RGB to Greyscale. We can be obtained by applying the below formula to the RGB image. The figure 6.4 depicts the Conversion from RGB to grayscale.

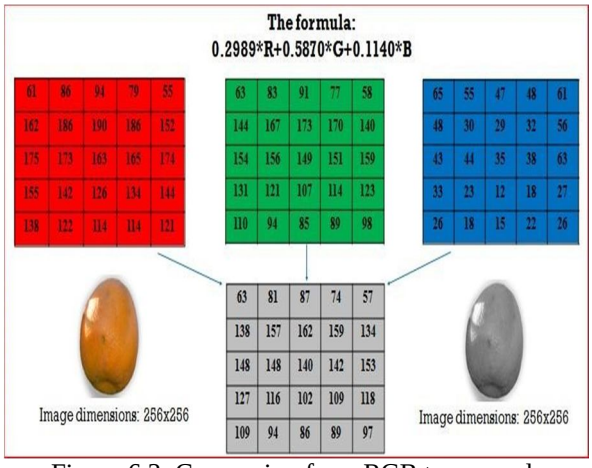


Figure 6.3: Conversion from RGB tograyscale.

Advantages of converting RGB colour space to Gray

To store single colour pixel of an RGB colour image we will need 8*3 = 24 bits (8 bit for eachcolour component).

only 8 bit is needed to store single pixel of the image. So, we will need 33 % less memory to store grayscale image than to store an RGBimage.

Grayscale images are much easier to work within a variety of task like in lots of morphological operation and image segmentation hassle, it's miles less complicatedwith single layered image (Grayscale image)than a three-layered image (RGB colour image).

It is also easier to differentiate functions of an image when we deal with a single layered imageNoise Removal:

C. Noise Removal

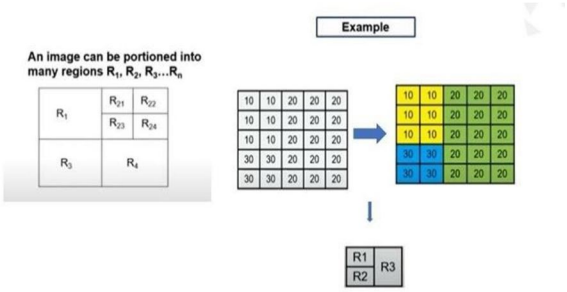
Noise removal is a process of removing or reducing the noise from the image. The noise removal algorithms reduce or remove the visibility of noise through smoothing the whole image leaving regions close to contrast boundaries.

D. Thresholding

Thresholding is a type of image segmentation, where we change each pixel of an image to makethe image easier to analyse. Most frequently, weuse thresholding as a way to select areas ofinterest of an image, while ignoring the parts weare not concerned with. We use Otsu Thresholding.

E. Image Sharpening

Image sharpening refers to any enhancement method that highlights edges and best details ofan image. Growing yields a greater sharpened image. Image sharpening is done by means of such as to the unique image a signal proportional to a high-pass filtered version of the image.



F. Feature Extraction and Classification

Extraction is a process of dimensionalityreduction by which an initial set of raw data isreduced to more manageable groups for processing. In the terminology of machinelearning language, classification is consideredan instance of supervised learning, i.e., learningknowledge of a training set is correctlyidentified observations is available. Thecorresponding unsupervised process is also known to be as clustering, and includesgrouping of data into categories based on somemeasure of inherited similarity or distance. Conversion from RGB to Greyscale.

G. Median Filtering

The median filter is non-linear digital filtering technique, where it is used to remove noise froman image or signal. Here 0's are appended at theedges and corners to the matrix which is the representation of grey scale image. Then for every3*3 matrix, set up factors in ascending order, then find median/centre element of those9 elements, and write that median value to that unique pixel function. The figure 6.5 depicts Noise filter using Median Filter.

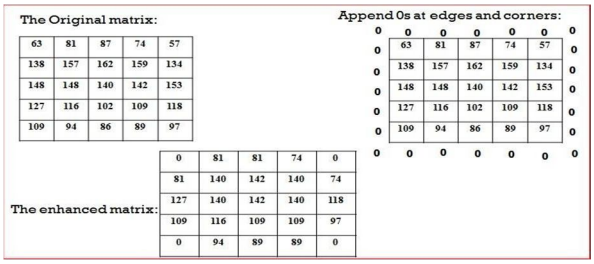
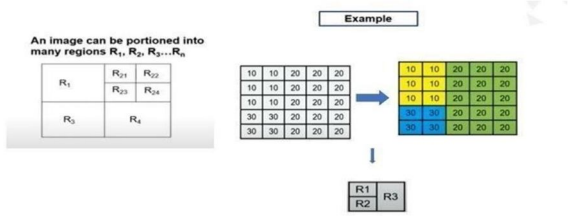


Figure 6.5: Noise filtering using Median Filter.

H. Image Segmentation

Image segmentation is a constructing block of computer vision technologies and algorithms. Itis used for lots of sensible programs consisting of clinical image analysis, computer imaginative and prescient for self-reliant automobiles, face popularity detection, videos surveillance and satellite image evaluation

I. Basic Global Thresholding



Thresholding is a type of image segmentation, where we exchange the pixel of the image to make the image less complicated to analyse.

A (i, j) is greater than or same to the threshold T, retain it. Else, replace the value by 0.

Here cost of T can be manipulated in the frontend, to suit the varying needs of different images

We use trial and error method here to obtain threshold value which may be best suited for us

1) Pick an initial estimate for

2) Segment the image with use of T. This can produce multiple groups of pixels: G1 inclusiveof all pixels with grey level value >T and G2 such as pixels with value<

3) Computes the average grey degree values ofμ1 and μ2 for pixels in areas G1and G

4) Calculate a new threshold value:

$$T = \frac{1}{2}(\mu_1 + \mu_2).$$

The threshold in a previous example was specified usage of a heuristic method, based onvisual examination of the histogram. The algorithm given below can be used to obtain T automatically:

a) We start with an initial estimation for T

b) We apply this T to the image, creating two groups of pixels:

- Group(G1): Pixels with intensity higher than T (likely foreground objects)
- Group(G2): Pixels with intensity lower than T (likely background)

c) We Calculate the average gray level values μ1and μ2 for pixels in regions G1and G

d) Compute a new threshold value:

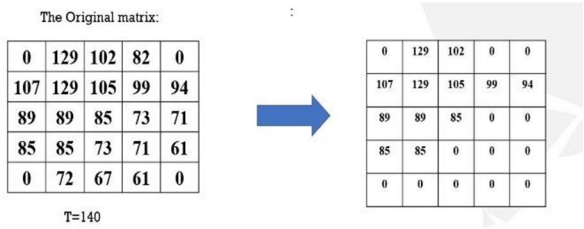


Figure 6.6: Thresholding using basic globalthresholding

J. High-Pass Filtering

A high-pass filter can be used to make an image appear sharper. These filters emphasizefine details in the image. Here the output from the thresholding is given as input. Here, we are making use of a filter, first we append the nearest values to pixels at the boundary pixels. The figure 6.7 depicts Image Sharpening using High-Pass Filter

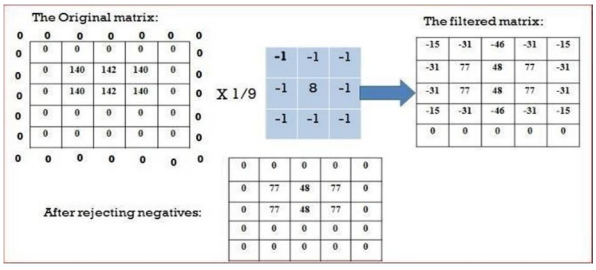


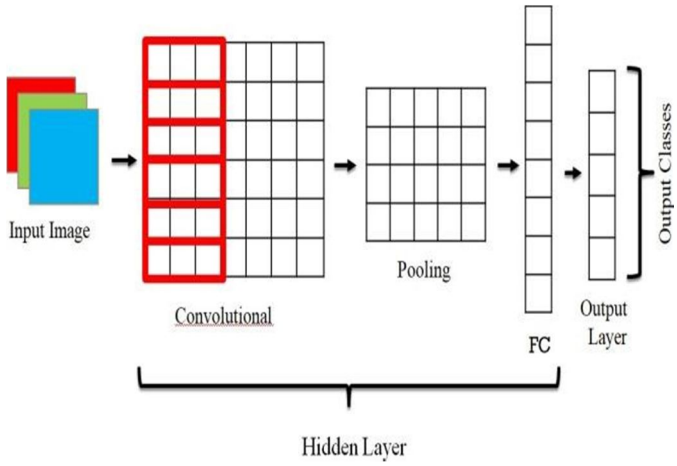
Figure 6.7: Image Sharpening using High-PassFilter.

We multiply the elements of the 3*3 input matrix with a filter matrix, here we can berepresenting as A (1,1) *B (1,1), in this way all the elements in the 3*3 are multiplied and theirsum id divided by 9, which gives the value for the particular pixel position. Similarly, values ofall the pixel positions are calculated. The negative values are considered as zero, as therecan be no such thing as negative illumination.

K. Convolutional Neural Networks

In deep learning concept the (CNN) is part ofdeep neural network mostly used for analyzing visual imagery. They also known to be shift invariant or space invariant artificial neural networks (SIANN), based on common properties of shared-weight architectures andtranslation invariances. They have applications in mage recommender systems, image classification, medical image analysing, naturallanguage process, brain-computer interface, andfinancial time

L. Typical CNN Architecture



M. A CNN is composed of several kinds of layers

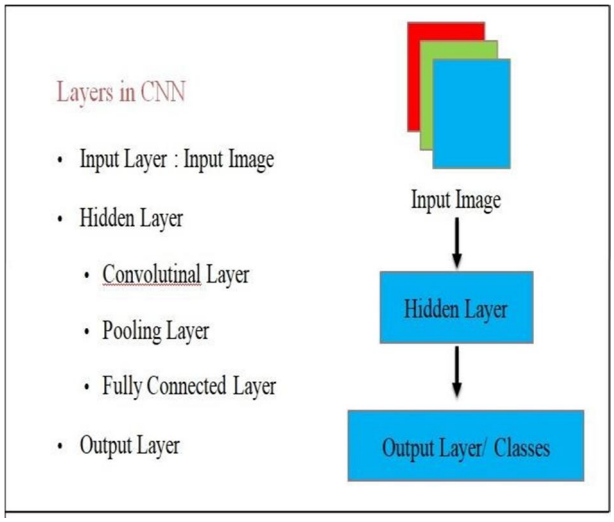


Figure 6.10: Layers in CNN.

Convolutional layer-creates a feature, which allows to expect the class probabilities for everycharacteristic via making use of a filter out thatscans the entire picture, it also shows few pixelsat a time.

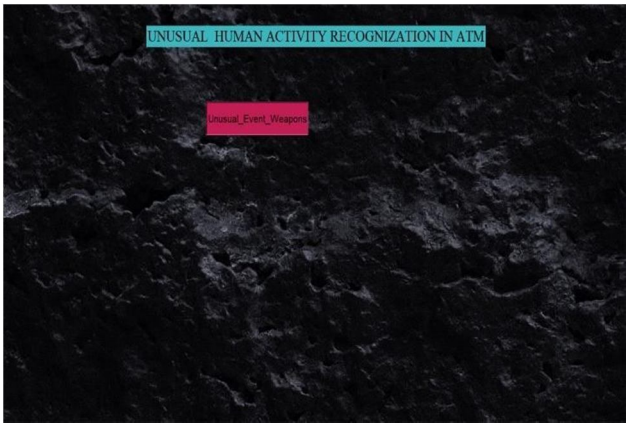
Pooling layer -scales down the amount of eachfunction and continues the maximuminformation that is generated using convolution layer (the method of the convolutional and pooling layers can be repeated many times).

Fully connected layer-flattens the output generated by way of previous layers to show them right into a single vector which are used asan enter for the subsequent layer. Applies weight over the input generated with the aid of the feature evaluation to expect an correct label.

Output layer-generates the final probabilities to decide a class for the image.

IV. RESULTS


UNUSUAL HUMAN ACTIVITY RECOGNIZATION IN ATM
Unusual_Event_Weapons


UNUSUAL HUMAN ACTIVITY RECOGNIZATION IN ATM
Unusual_Event_Weapons


Handgun 0.33


Axe 0.69



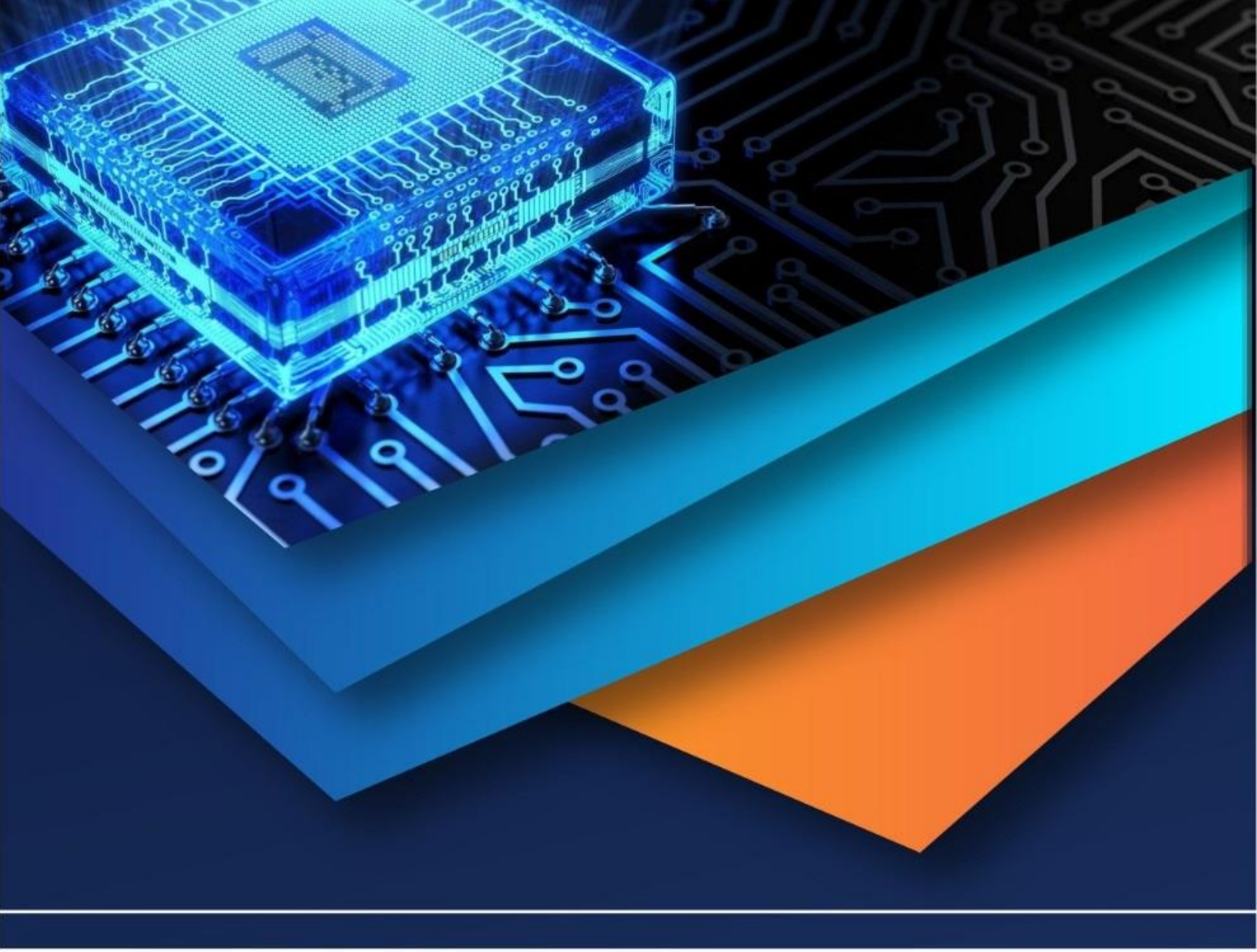


V.CONCLUSION

In conclusion, the implementation of unusual human activity recognition in ATMs holds considerable promise for enhancing security features and safeguarding financial transactions. By leveraging advanced technologies which includes machinelearning and computer vision, ATMs can now go beyond traditional security measures to detect and respond to unusual behaviours in real-time.

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