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Detection and Recognition of Weapons using Image Processing Fundamentals

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Abstract - In present days, weapon detection is an important obstacle for the advancement of the security of people as well as the safety of public assets like airports and buildings. They should be taken into consideration and detection of weapons through videos and images should be made possible. Manually screening of the weapons is common in public places like airports, entrances to sensitive buildings, and public events. It is desirable sometimes to be able to detect weapons from a stand-off distance, especially when it is impossible to arrange the flow of people through a controlled procedure. The goal is to develop an automatic detection and recognition of weapons using sensor technologies and image processing. The focus of this paper is to develop an algorithm using images and a corresponding shapes and structures for weapon detection by the help of image processing.

Keywords— *Image processing, Weapon recognition, Weapon detection, Color image.*

I. INTRODUCTION

Most researches are based on object identification and its recognition as referred; these researches are more or less dependent upon logical reasoning as logical reasoning play an important role in the implementation of any solution to a problem [1]. Detection done by human and by some advanced technology has a vast difference. Also, the speed and efficiency play an important role here. Image Processing is used to implement the function to provide object identification. When the picture is clicked, it becomes difficult to extract and render the image and most importantly to segregate it from the background [1]. Identification of the object is much easier by using this aspect based on Image processing and artificial intelligence.

The aim is to identify the object correctly by processing the image and identifying the image even when the surrounding is not apt for the same [2]. Also, there are few complications that come across while implementing the same. The objects that are to be known can be of any form or structure. This makes it tough method the image and more rendering it. And the other problem is that the object to be identified is always surrounded by few other objects which make it really hard to focus on the one to identified associated process of such an object is once more another task which suggests segregating it from the background objects, that is, filtering of an image. Also, another downside is with the sunlight result or the shadow that makes it tough to be known.

Images sometimes are too illuminated or they lack sharpness because of the surrounding effect. But the advanced cameras can solve this problem. Some applications which are researched and referred can be resource hungry on devices sometimes, but the proposed system is efficient enough to avoid load on the device. Deep learning algorithms and neural networks play an important role in this implementation as well [4].

With security issues being necessary day by day, it becomes necessary to spot each and every unidentified object thereby strengthening the protection system.
Also, identifying of such objects could be tedious.

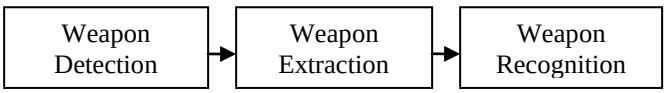

Figure 1: Weapon Recognition System

The system aims to review the state of the algorithm in image processing algorithms in computer vision by highlighting the contributions and challenges from recent research papers. It also, provides a short concerning about the deep learning algorithms and conjointly their latest finding as well as development. The operating of image

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processing at the side of computing makes it doable to spot the object justifiably. The use of such software will help make the security system get strengthened and thereby making its application effective at public places, e.g. malls, airports etc.

II. LITERATURE SURVEY

As analysis plays a vital role in implementation of an inspiration. The analysis done for Casper-the intelligent software involves an inventory of surveys done on the papers published before. The basics of the image processing and the algorithms and approaches involved are covered by Xin Jia [4] in the IEEE paper that was published in 2017, which strengthened the understanding of the basic concepts. The understanding of the neural networks is extremely clear within the explanations and also the use of deep learning algorithms is completely explained. Casper - the intelligent software works in implementing the basics found in previous papers and thereby making the research stronger by adding the advancements. Xuan Yang, Xiaoguang Chen, Jiancheng Zou and Maosen Wang have explained the concepts on neural networks in depth in their paper. Casper -the intelligent software implements neural networks in computing [5]. The fundamentals of the image processing and artificial intelligence along with the understanding of the algorithms have been effectively implemented using Casper - the intelligent software [5]. The implementation of the deep convolution neural networks has been explained by Michael T. McCann and Kyong Hwan Jin in their paper which was published in 2017. Casper- the intelligent software has managed to cover the basics and fundamentals involved in prominent published papers and therefore have made some positive changes based on study [6].

III. RELATED WORK

A. Content based image retrieval:

The field of Content based image retrieval is gaining attention quickly. In order to form the comparison of images possible all images have to be represented in similar forms. This is why the MPEG-7 standard has been developed. The MPEG-7 standard, also known as the Multimedia Content Description Interface, is an attempt to standardize the description of image content [7]. The descriptors it outlines can be used to describe both still images and other multimedia, like moving images and sound. The hope of its creators is that it will have a similar impact as previous MPEG standards, which have been adopted widely.

The MPEG-7 descriptors are made for indexing shapes, which is not exactly what we want for object recognition [7]. It uses Curvature scale shape for describing a shape.

B. PicSOM:

The PicSOM is a Content based image retrieval application that allows the user to find images similar to query images in an iterative process. The PicSOM system is driven by two main principles, Query by Pictorial Example (QBPE) and Relevance Feedback (RF). As the basis for finding similar images, a tree-structured SOM is used, which consists of several SOMs layered on top of each other. The system has a number of these SOMs running in parallel that have each been trained using image data extracted with different feature extraction techniques [8].

A query of this PicSOM will take place as follows. Using the principle of QBPE the user selects images from a set of images that is uniformly selected from the SOM that he considers representing best what he is looking for. In an iterative process, RF the user keeps getting new pictures that are the result of his query, of which he can indicate whether they are relevant irrelevant. Places on the SOM where mainly relevant pictures are found are given positive weights, while those where mainly irrelevant pictures are found are given negative weights. Using these weights new pictures are selected for the user to choose from [9]. By continuing the process of the user should be able to find a satisfactory selection of pictures.

IV. METHODOLOGY

A. Object preprocessing

Our system first processes images with pre-processing steps to extract entities that can be used for recognition by a neural system. This is done as the system for recognition we are proposing mainly relies on the fact that an object can be decomposed into many shapes that can be extracted from an image [10]. Therefore the pattern and shapes will then be the basis of the system.

The steps in object pre-processing involve:

1) *Shapes:* The main motivation for the recognition by shapes is that in recognition of an object as a whole every discrepancy, even if it is only a small one, can disrupt the recognition process. The object will be described by a set of shapes, making shapes the parts that make up an object

The figure 2 gives the description of data flow diagram for Image Recognition and then how artificial intelligence is used to detect the output. The Recognition process is a simple process where first of all shape descriptors are interpreted by the first network. When all shapes are collected and interpretations, combinations are created, these vectors are then mapped onto the SOM and finally the object is classified using object recognition network.

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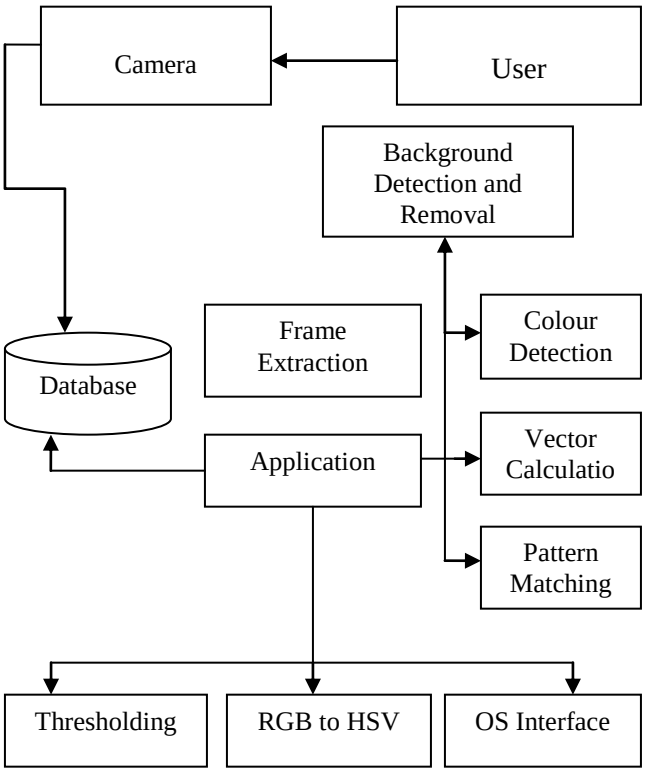

Figure 2: Data Flow Diagram of image recognition

B. SUSAN edge detection algorithm

SUSAN Edge Detection algorithm has many advantages where the main advantage being that the edges it produces are more solid and better connected, i.e. there are fewer missing parts in edges. This makes it easier to extract whole shapes. Also, it determines per pixel whether it lies on an edge, by comparing it to the pixels in a surrounding area.

1) Algorithm:

For each pixel do:

a) Place circular mask around pixel in question

b) Calculate the USAN, the number of pixels within the mask that have a similar brightness value

c) Subtract the USAN from the threshold to produce the edge strength of the pixel

d) Use moment calculations applied to the USAN to find the edge direction

e) Apply non-maximum suppression, thinning and sub-pixel estimation, if required.

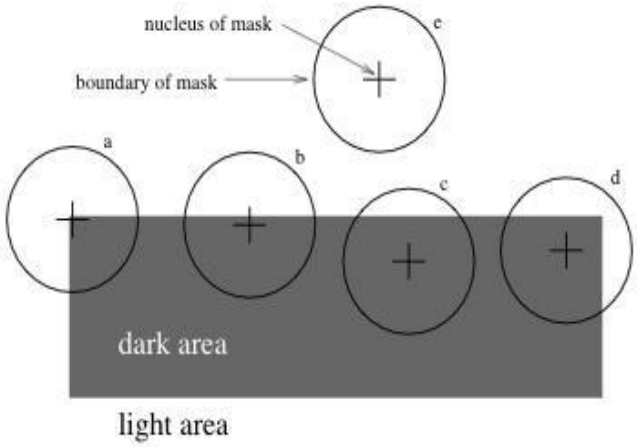

Figure 3: A number of circular masks used to mark the area around a pixel

C. Creating contours and extracting shapes

After generating the sting image, successive issue we would like is to extract the shapes within the image. This methodology of extraction consists of 2 steps. In the first step the image containing the edge pixels is dilated, making all edges one pixel thicker on each side. In the second step the initial edge image is subtracted from the expanded result. The result's a picture with whole shapes, i.e. there is a beginning and an end to each of the created contours.

D. Further pre-processing

There are even a lot of low-level imaging steps that we are able to use to form shapes a lot of simply acknowledgeable. This extra pre-processing will only be used for those representations that can benefit from it. In these extra steps we will take into account that it is not possible for a neural network to recognize shapes that are presented in a way that activates are in a completely different manner than seen before [10].

a) Rotating and centering the shapes
b) Flipping the shape
c) Resizing the shapes

E. Descriptor Creation

After having extracted the shapes the descriptors area unit created. These descriptors area unit created specifically to be invariant representations entailing the maximum amount necessary data of the form as potential. They are created in such a way that they will be fed into a neural network and permit for straightforward categorization

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F. Learning and Recognition

The adaptive system is a combination of both feed-forward neural networks and a self-organizing map (SOM). The coaching of the system is performed in many phases, each supervised and unsupervised. Broadly speaking our accommodative approach will still, as most accommodative systems, be divided in 2 phases. First, there is the learning phase, which is the phase where the system processes training data and adapts itself to their specifics. Second there is the recognition phase

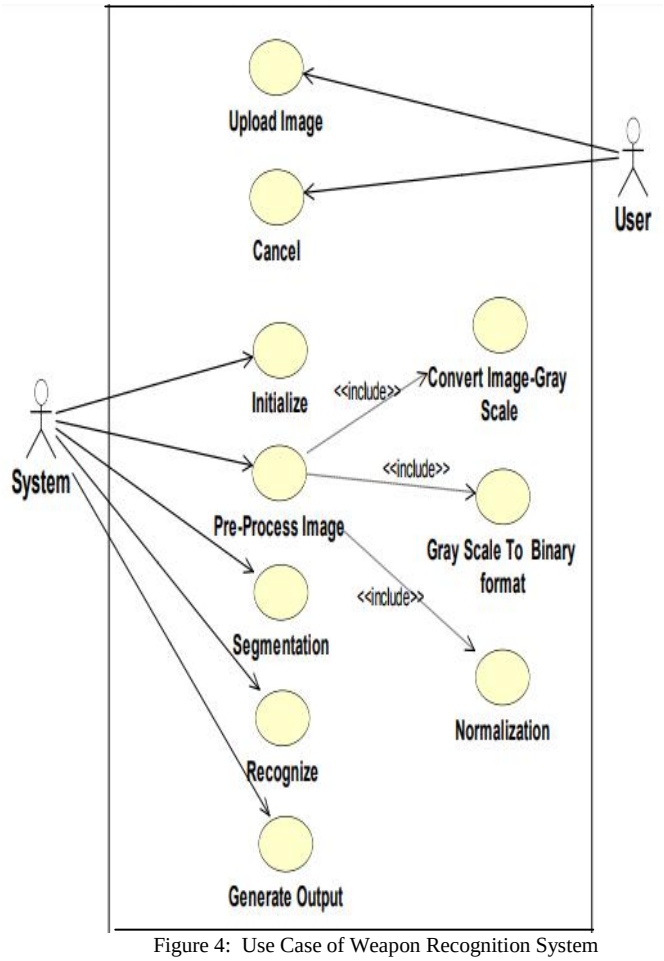

Figure 4: Use Case of Weapon Recognition System

V. RESULTS AND DISCUSSION

A. Weapon Recognition

Weapon images captured are represented as high-dimensional pixel arrays, but often belong to a lower dimension. In applied math approach, each image is represented in terms of the features. So, it's viewed as a degree or a vector in an exceedingly d-dimensional area. The spatial property variety of coordinates required to specify knowledge information purpose of this data is simply too high. Therefore, the goal is to choose and apply the right statistical tool for extraction and analyse. Therefore, it might be able to create it an outlined line, curve, plane or hyper plane that classifies faces belonging. Many of those applied math tools don't seem to be used alone. They are modified or extended by researchers in order to get better outputs and results. Some of them are embedded into higher systems, or they are a part of a recognition algorithm. Our system will be using Susan Edge detection algorithm to perform weapon recognition. First all shape descriptors are interpreted by the first network. After having collected all form interpretations, combos are created. These vectors are then mapped onto the SOM, increasing the activations of the neurons that make up the SOM. And finally, the object is classified using the object recognition network.

B. Objective And Discussion

The proposed system, implements the basics of Image Processing, to facilitate the function to provide identification of an object in focus of the device in real time whose output is generated by Artificial Intelligence. Deep learning algorithms are a subset of the machine learning algorithms that aim at discovering multiple levels of distributed representations. The aim is to develop software that assists human in monitoring CCTV footage. It identifies prohibited objects, threats and sends an alarm whenever detected. Strengthen the security system by eliminating human limitations.

C. Result

The software provides with a camera screen that captures the image, the captured image is processed and further matched with the one in database and the image is then compared and then the image is identified with the help of Artificial Intelligence. The output is the image which the name of the object which is identified. The process involves image processing techniques and artificial intelligence algorithms. Support Vector Machine (SVM) is one of the most popular supervised binary classification algorithms. SVM tries to find the best line that separates the two classes [11]. For this project we use Linear Support Vector Machine algorithm because it's precise. Techniques which are used here are linear filtering, neural networks, image restoration and editing, pixilation and few other image processing techniques. Every object class has its own special features that help in classifying the class – for example all circles are round.

Object class detection uses these special features. For example, when looking for circles, objects that are at a particular distance from a point (i.e. the centre) are sought [12]. Similarly, when looking for squares, objects that are perpendicular at corners and have equal side lengths are needed [12]. A similar approach is used for face identification where eyes, nose, and lips can be found and

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features like skin colour and distance between eyes can be found. The advantage is that an image is made of pixels.

VI. FUTURE SCOPE

The Intelligent software can be combined with the scanners at the mall for the surveillance process and also with the CCTV cameras for detecting suspicious objects. This will help to not just assist but will help to automate the working system in the near future. It could help in preventing the terror attacks and crimes by identifying suspicious and prohibited objects. It can also bring a change in functioning of the surveillance systems. It can also bring a change in the surveillance systems. Since, this haven't been implemented anywhere, it could be useful to industries and small-scale shops.

VII. CONCLUSION

Different methods and algorithms of weapon detection have been reviewed in this paper. We should choose the weapon recognition methods based on the applications demands and need to make the system more efficient. The search to search out and create a universal economical technique for the appliance remains happening. The projected system can facilitate and build an effect at each native and world levels if according modifications area unit created to the system. Further the system will be changed by mistreatment the conception of computer science, Machine Learning etc., will be able to enhance the system. At a local level, the system can be used for multiplex and public places in order to locate weapons. At a global level, the system can be used to find and track the weapon through CCTV cameras and videos, which will also be helpful for the police. It may be employed in banks, transport sector, hotels, company offices and it will create security and its functions additional outlined and systematic.

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