Venturing Cloud Surveillance in Concur to Deep Learning with Artificial Intelligence

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Abstract - **The whole world has most certainly seen a great rise in the development of an array of technologies such as Artificial Intelligence, Deep Learning and Cloud Surveillance. As a matter of fact, a great deal of AI based devices have been setup and implemented in order to revolutionize our world. Smart homes, self-driving cars are some of the exceptional examples of such devices. Cundong Tang et al amazingly cited in [1] that the majority of artificial intelligence technologies are computer-based. It investigates the process of translating human intellect into artificial intelligence using electronic technologies. Its entire design demonstrates intelligence and its ability to do tasks that only human intellect can.**

In this paper, a comprehensive review of development of future applications of Deep Learning Algorithms with the help of Artificial Intelligence is presented in a clear and concise manner. Likewise, we have presented a detail oriented review of the applications of Cloud Surveillance aided with Artificial Intelligence and Deep Learning Algorithms in various modern day systems. In the same way, Computer Vision (CV) aided Cloud Surveillance models and frameworks of several other researchers and its working has been explained in an all-inclusive manner.

Keywords: Artificial Intelligence, Deep Learning, Cloud Surveillance, Neural Networks, Computer Vision.

I. INTRODUCTION

The term "artificial intelligence" was first coined by John McCarthy in 1956 when he held the first academic conference on the subject [2]. Rui Lima et al amazingly described the definition of AI given by John McCarthy himself in [3]-"a branch of computer science dealing with the simulation of intelligent behavior in computers".

Marvin Minsky, a brilliant scientist, was optimistic about the future of this technology. AI is a broad term that encompasses all aspects of making machines smarter. Deep Learning is a branch of artificial intelligence that is based on how the human brain filters data.

The origins of Deep Learning can be traced back to 1943 when Walter Pitts and Warren McCulloch developed a computer model based on human brain networks. To mimic the mental process, they use a combination of algorithms and mathematics known as "threshold logic." In-depth reading is a topic that creates a lot of noise right now. It is a subset of machine learning (another popular problem) that uses algorithms to identify objects and understand human speech, for example. In-depth learning algorithms with multiple processing layers (thus "in-depth") used by scientists to develop models from large amounts of unwritten data (such as captioned images or voice recording).

Crowd analysis has become a prominent topic in the social and technological fields due to population growth [4]. Crowd analysis is used in community events, public space construction, visual inspection, and visual areas to improve crowd management strategies. The primitive ways of dealing with mob-related protests and overcrowding was extremely violent and one which led to multiple casualties. However, now due to the support of Artificial Intelligence and Deep Learning the same process is done readily and as soon as possible without leading to many casualties.

A) Artificial Intelligence

Artificial Intelligence (AI) is a method of programming a computer, a robot, or a product to think like a smart human. The goal of artificial intelligence is to improve computer functions that are linked to human understanding, such as reasoning, learning, and problem-solving.

Finally, in this paper we will review the generated intelligent software systems.

How is artificial intelligence used in surveillance?

Discrepancies, such as a person entering a restricted area or strange activity, are detected by AI and reported to the system. Another example is the amount of space available in a parking lot. Countries such as the United States and China have deployed millions of cameras and are the market leaders in AI-based surveillance.

What are the most common algorithms in artificial intelligence?

The most popular artificial intelligence algorithms are:

- Linear regression.
- Logistic regression.
- Linear discriminant analysis.
- Decision trees.
- Naive Bayes.
- K-Nearest Neighbors.
- Learning vector quantization.
- Support vector machines.

B) Deep Learning

Deep learning is a branch of machine learning that is entirely based on artificial neural networks. Because neural networks are designed to mimic the human brain, deep learning is likewise a human brain mimic. We don't have to explicitly program anything in deep learning. Deep learning is not a new concept rather it is thoroughly and exceptionally developed branch of machine learning as well as artificial intelligence.

How is deep learning used in surveillance?

The camera makes smart judgments about the movement it takes based on these classifications, distinguishing between important activity and irrelevant data. Deep learning prevents spurious motion detection alarms from being triggered by security cameras.

What are the most common algorithms in deep learning?

The most popular deep learning algorithms are:

- Convolutional Neural Network (CNN)
- Recurrent Neural Networks (RNNs)
- Long Short-Term Memory Networks (LSTMs)
- Stacked Auto-Encoders.
- Deep Boltzmann Machine (DBM)
- Deep Belief Networks (DBN)

C) Cloud Surveillance

- Security in the Cloud is similar to security in on-premises data centers but without the costs of buildings and hardware maintenance [5]. In the Cloud, you don't have to worry about managing actual servers or storage devices. Instead, you monitor and protect the movement of data into and out of your Cloud resources with software-based security solutions."
- The goal of Cloud security is to keep your data safe while it is stored in the cloud. Although Cloud projects

are becoming increasingly popular, a growing number of executives and business owners are concerned about how to protect their Cloud environment against cyberattacks, data breaches, and invasions – and properly so.

- Cloud surveillance is a remote storage for online video recording. It does not require portable tools or cables, only an internet connection.
- When a cloud-based surveillance camera records video, the recording is converted to a file and sent to an online storage host.
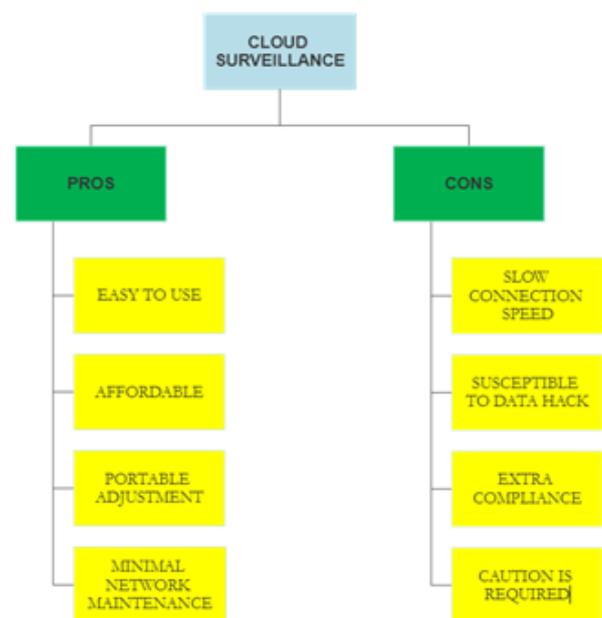
- This host is usually a web page that requires the user to use a different identifier. Once logged in, users have access to all recorded videos and can even control the cameras remotely, a feature that is becoming increasingly important as more people are working from home.

II. LITERATURE REVIEW

The field of Artificial Intelligence is ever-growing. Nowadays, every daily activity has a technological aspect to it. Through the path of camera surveillance which mainly uses cloud surveillance framework we can easily understand the application of Deep Learning Neural Networks in everyday life.

In this paper we highlight the importance of Deep Learning in Artificial Intelligence. For this motive, we reviewed numerous technical papers.

➢ Logesh and Shyam [6] highlight the use of BigData, Artificial Intelligence and Deep Learning for crowd surveillance and crowd management through real-time data entry. Subsequently, they use a Dilated Convolutional Neural Network called CSRNet.

Moreover, for image classification the expertly developed VGG-16 algorithm was implemented.

- ➤ ITS is basically the advancement of our transportation system which uses AI as well as Deep Learning in its working using new and enhanced technologies to increase the efficiency and mainly to stop the road crimes [8].ITS analysis mainly depends on Computer Vision (CV)Techniques. Furthermore, sensors include Visual Surveillance Systems (VSS) as well as light detection and ranging (LIDAR) systems.

- ➤ Fine-Grained Visual Classification (FGVC) helps to sense the incorrect doings and also facilitate the discriminative crimes if occurred [8]. Consequently, object detection technique helps FGVC to play an essential role in ITS. Similarly, Recurrent Attention Convolutional Neural Network (RA-CNN) trained several networks in order to implement the model.

- ➤ The researchers explain how EFISS based software equipped with Cloud Surveillance can help in the future smart cities by crime detection, threat detection algorithms and models [11]. Altogether, this model uses various systems such as EFISS, CNN model—YOLOv4 as well as UCF-Crime (27) dataset for training and testing of the model.

III. ADVENT OF DEEP LEARNING IN CLOUD SURVEILLANCE

A) Crowd Monitoring

Every year many people die due to the crowd tragedies. This especially happens in the events where people gather in terms of enormous numbers such as Kumbh Mela and many more. Although, they are termed as 'peaceful gatherings' there isn't anything peaceful about people dying. The research duo Mr. Logesh Rajendran and Mr. Shyam Shankaran R had the same thought process. In order to avoid such mishaps they proposed a surveillance model.

This surveillance model uses BigData, Artificial Intelligence and Deep Learning for its basic working structure [6]. Furthermore, it mainly uses the Dilated Convolutional Neural Network: CSRNet.

The duo implemented their model in Kumbh Mela 2019. The increased analytics and developments in AI helped in surveying over 3200 hectares of land using 1100 cameras.

Consequently, to test and implement these model 41 cameras covering over 20 strategic points measured crowd density to generate alerts. Through real-time video transmission the handling of crowd density became easy.

Through VGG-16 image classification was done speedily and crowd density was measured. Finally, as per the algorithm crowd density dependent alerts were generated. Thereby, easily dispersing the crowd resulting into minimal casualties [6].

Similarly, Muhammed Anees V et al [7] has proposed a new Deep Learning Framework for Crowd Density Analysis using CUHK Crowd dataset.

B) Intelligent Transportation System [ITS] [8]

INTELLIGENT transportation system (ITS) is a system that uses sensors to collect traffic data from vehicles and traffic facilities and analyses it in real-time to provide better services to travellers and traffic controllers in various sectors such as :

- ▪ Transportation systems
- ▪ Traffic control
- ▪ Disaster management
- ▪ Driver monitoring.

With the growth of computation technologies and the demand for traffic services for travellers and traffic controllers, automatic analysis in the ITS based on computer vision (CV) techniques have been widely deployed in recent years. A growing number of machine-to-machine (M2M) applications, such as video surveillance, transportation, and connected vehicle applications, are driving the expansion of devices and connections, accounting for half of all connections by 2023, or 14.7 billion. Sensors can collect massive amounts of data, including visual data, from large metropolitan systems and use it to improve the operation of ITS services.

Visual surveillance systems (VSS) including video cameras, radar scanners, light detection and ranging (LIDAR) or laser radar scanners, global positioning system (GPS) signals, and inductive loops are among the sensors used in the ITS. The ITS requires an efficient infrastructure to acquire and analyze data to provide better ITS services to travellers and traffic controllers. Surveillance may be provided as one of the key intelligent applications using edge-cloud architecture, which uses terminal nodes, multi-access edge computing (MEC) servers, and cloud data analysis centers.

Network nodes such as base stations and access points supply MEC servers, or they can be located in a roadside unit (RSU). Because ITS services are both computationally and communicationally complex, the collaborative edge-cloud architecture can be deployed. These systems' devices share resources and provide a large amount of computational power, allowing sophisticated ITS services to be implemented.

The efficiency of a transportation system is crucial. The intelligent traffic control service analyses traffic flow before managing it based on the results.

It usually consists of three parts:

- Sensing of traffic flow
- Intelligent management
- Traffic signal control.

Meanwhile, another important duty of the ITS is to respond quickly to car accidents, which includes real-time incident detection and correct response.

Real-time incident detection and fast response can save lives as well as reduce property loss. Incident detection and decision-making are the two components of a disaster management system.

Furthermore, abnormal driving conditions such as fatigue, distraction, intoxication, and recklessness are the most common causes of accidents and can be seen on video by roadside cameras.

Based on the ITS services listed above, Jiyang Xie et al [8] divided CV techniques into three groups:

- Detection
- Categorization
- Tracking.

The importance of item localization in a single surveillance video camera, comprising autos, two-wheelers, and people, makes detection a crucial task in the ITS.

Meanwhile, fine-grained visual categorization applications are introduced, which use classification algorithms to automatically identify car models, detect license plates, and recognize driving behaviours (FGVC).

In addition, tracking technologies are used to follow an object in a single video camera, which could be useful for finding vehicles and monitoring driving habits.

In [9] another deep learning-based detection system was created in conjunction with CNN and Support Vector Machine (SVM) to track moving automobiles on city streets and highways through satellite.

C) Fine-Grained Visual Classification (FGVC)

In contrast to traditional classification problems, Fine-Grained Visual Classification (FGVC) distinguishes the sub-classes of a given object category, which plays a critical function in the ITS.

It employs object detection techniques to further identify any vehicle on the road and catch cars of defined models, rather than a coarse-grained categorization in detection. It can be widely used in traffic surveillance when authorities need to discover autos with specified attributes in a massive data environment.

The object tracking technology described in [10] has been effectively used for tracing targeted pedestrians and moving vehicles, accident monitoring in traffic cameras, criminal and security surveillance in a specific local area of concern, and many more applications. The high-resolution cameras used by FGVC can also help with the retrieval of a specific car using evidence such as a licence plate, making previously time-consuming or even impossible tasks possible.

The activities of drivers and cars, in addition to these automobile models, can be viewed of as fine-grained patterns that can be classified utilising FGVC techniques [8]. FGVC differentiates the sub-classes of a given object category, which plays a crucial role in the ITS, in contrast to typical classification tasks. Instead of a coarse-grained categorization in detection, it uses object detection algorithms to further identify any vehicle on the road and catch cars of specified models. When authorities need to discover cars with specific features in a big data environment, it can be widely employed in traffic surveillance.

Part-based Method: Part-based methods are used to capture small distinctions for fine-grained classification. Recurrent Attention Convolutional Neural Network (RA-CNN), which is taught to recognize both the object and its subtle parts, was the first to use CNNs for localization.

Because human annotations are difficult to get, the authors of the spatial transformer network (STN) asserted that CNNs are effective for part localization but lack spatial transformation invariance. A spatial transformer module was developed to do spatial manipulation within the CNNs to address this issue.

Method of Feature Representation Enhancement: Enhancing the feature representation ability of deep learning models is another way to eliminate the downsides of manual annotations. It can capture pairwise correlation between two models in a translationally invariant manner, with the ideal condition being that one of the networks locates the discriminative components while the other extracts local data, similar to how the human brain works.

Modeling feature interactions as a more discriminative higher-order representation is popular, but it has a severe drawback:

The dimension of features grows exponentially as the order is increased.

D) Threat Detection in Smart Cities

In the upcoming decade, the whole world will see the rise of a number of smart cities. In order to keep Law & Order under control diverse technologies as well as set of rules would be required. These technologies entail towards theft detection, threat or violence detection and various others. This not only pertains to the smart cities but also to the present case scenario.

Thinking of adapting the smart city Law & Order maintenance algorithm in present day, a group of lecturers from Egypt developed a Surveillance System which would help in prevention of crimes and predict criminal incidents.

Associatively, they implemented the Edge-Fog-based Intelligent Surveillance System (EFISS)-Multilayer computing based architecture system to conduct efficient and real-time data analysis.

As the name suggests this system mainly uses three types of computing systems:

- Edge based Computing System
- Fog based Computing System
- Cloud Computing System

This [11] system basically proposes a framework and implementing model which uses EFISS system to detect abnormal behaviour pertaining to criminal activities and alerting the concerned authorities to help them catch the criminals.

For this purpose, the fixed surveillance cameras capture all-day data and send it to the cloud for storage. If any abnormal activity is detected, the algorithm scans the timestamped footage and sends forward the video section which is concerned with the crime detection to the Fog data layer. Here, Fog Layer extracts additional features from the vehicle layer i.e. it summarizes the video, blurs the normal people's faces and computes the whole frame into relevant frame images for further processing to the traffic light layer.

The Traffic Light Layer processes the final incident to which a Deep Learning Algorithm YOLOv4 is applied. Further, Image Deblurring and face recognition software is run through the received images to ensure the identity of the criminal. Subsequently, this information is sent to the Cloud Computing Layer.

The Cloud triggers alarms to the nearest authorities and helps in identification and catching of the culprit. Moreover, it also backs up all the sent incident data and stores the whole surveillance data for records.

IV. FUTURE SCOPE

The vast potential of AI may be comprehended by looking at the several different technologies that fall under the AI umbrella such as

- Deep Learning
- Cloud Surveillance and many more

It is projected that in the next years, almost no industry will be left untouched by this powerful weapon [12].

Deep learning techniques employ feature learning to explore and evaluate the unknown structure in the input distribution. In today's world, the reach of deep knowledge for its self-adaptive characteristic is unlimited. Deep learning is not an easy field, and its full potential has yet to be discovered. However, it is a powerful field of machine learning with a wide range of applications which is ever growing and boundless in future [13].

Cloud surveillance, in general, is here to stay. The technology is both impressive and enthralling. For many firms, large and small, it proves to be a cost-effective manner of delivering services in the long term. Because cloud surveillance has a larger scope, especially in terms of accessibility, it is destined to have a bright future [14].

V. CONCLUSION

In this paper, we ventured the depths of Artificial Intelligence and one of its subtopics: Deep Learning. In the same way, we also reviewed how the various Deep Learning Algorithms and Neural Networks are used in another branch of the vast domain Artificial Intelligence i.e. Cloud Surveillance. Provided that, ample information about the various uses of cloud surveillance especially in the upcoming years was briefly highlighted here. Thus, we can evidently conclude that the field of AI, Deep Learning and that of Cloud Surveillance is limitless and has exceptionally spreading branches which is useful in every single sector of the world.

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