International Journal of Engineering and Advanced Technology (IJEAT)
ISSN: 2249-8958 (Online), Volume-8 Issue-4, April 2019

A Machine Learning Algorithm for Jitter reduction and Video Quality Enhancement in IoT Environment

J.Jagadessan, B.Nikita, G.Deepti preta, H.Hari priya

Abstract: ***Multimedia traffic has been abnormally increasing nowadays due to its greater usage and necessity. CCTV cameras (closed circuit television camera) are widely used in these days as it a matter of security concern. From shopping malls to home the usage CCTV camera plays a vital role. But the challenging part arises when the media data captured by the camera is to be transmitted to the display monitors of the owner. There are scenarios where more than one CCTV camera covers a particular region. The 70% of network traffic is caused due to CCTV surveillance. It is important to reduce the traffic and delay packets to deliver the data to the user on time. We have used wireless SDN network (software defined network) to transfer the multimedia data to the display monitor. The SDN control switch is integrated with AI module where machine learning algorithm is implemented (BAT algorithm) to prioritise the data packets. For more efficient storage data is uploaded to the IOT cloud.***

Index Terms: Artificial Intelligence (AI), Closed circuit television (CCTV), Internet of Thing (IoT), Software Defined Network (SDN).

I. INTRODUCTION

Multimedia traffic has become a major drawback for CCTV surveillance nowadays. Statistics state that the amount of video traffic in 2021 will be three times greater than that in 2016 [2] [3]. This is a considerable increase and a major drawback for the implementation of CCTV surveillance. In order to overcome this serious disadvantage and to ensure QOS (Quality of service) and QOE (Quality of experience) the SDN network is used. Previously the CCTV cameras transferred data through wired connections which were secure and traffic free but, where limited to a geographical area as the wiring included more costs. This transmission problem was replaced by transferring the video data through the networks which were open networks and the possibility of packet loss and malicious activities are more [7]. This also caused increase in multimedia traffic which in turn leaded to the data packet loss and jitter. The connections are either lost or broken in this type on network. The open network structure contains the transmitter and receiver along with a switch that connects both. When data is transferred through the switch and it is overloaded at times and connection is lost. To overcome the disadvantage present in the open network SDN network is used. The switch is connected with SDN controller which finds another path to transfer the data without connection loss. SDN is similar to creating virtual networks where new paths for the transmission of data packets are identified. This system is further improvised to increase the efficiency of the system by integrating the control switch with the AI module. This utilises a machine learning algorithm to prioritise the data packets and optimise the transmission by utilising the user defined sets mentioned in it previously. The algorithm used here to implement is a BAT algorithm that aids in optimising data packets to ensure the QOE and QOS [11]. The algorithm inputs the data structures like the transmission time and the packets queue to output an optimised solution.The security during transmission is also important as the data packets should not be manipulated or lost during the transmission process from the camera to the system. Previously external storage media like hard drives and disks were utilised to store data. The camera used to record even without a presence of objects which caused more unwanted storage and memory. In this system data is uploaded to the IOT cloud and retrieved from the cloud whenever required at any number of devices [5]. The camera and the display are connected to the same network Recording the data even without the presence of anomaly would causes excess of data to be stored and a very time consuming procedure while analysing. Thus cameras use motion detection principle to detect anomalies based IR sensor (Infrared sensor) [6]. The IR sensor uses heat signatures emitted by objects and human beings to identify them. Using this data is recorded only when anomaly is detected and is uploaded to the IOT cloud. The data is then displayed to the receivers with warning signals in case of enormous amount of heat signatures.

Manuscript published on 30 April 2019.
***** Correspondence Author (s)
Dr. J. Jagadessan*, Department of CSE,SRM Institute of Science and Technology, Chennai, Tamil Nadu, India.
Nikita. B, Department of CSE, SRM Institute of Science and Technology , Chennai, Tamil Nadu, India.
G. Deepti Preta, Department of CSE, SRM Institute of Science and Technology, Chennai, Tamil Nadu ,India.
H.Hari Priya, Department of CSE,SRM Institute of Science and Technology, Chennai, Tamil Nadu, India.

II. RELATED WORKS

In this section we have discussed we have discussed about the papers which were related to this project.

A. *Motion Detection based Multimedia supported Intelligent Video Surveillance System*.[1]

Multimedia traffic is the very big concern nowadays as there are lot of communication happening through the internet .Internet is also used in video surveillance as the safety is the primary concern .More inexpensive cameras are launched in market which are of new technologies as wireless digital cameras, motion sensor etc. These cameras have the potential to retain the recorded video, similarly there are more drawbacks as it uses more storage space ,there can be loss of packets ,the signal may weakened at times. In this paper an integrated multimedia supported intelligent video surveillance system that gets through the new technologies available based on motion detection and tracking.

B. *Intelligent Embedded Video Monitoring System for Home Surveillance*.[2]

Since few years there is tremendous growth in adopting surveillance facilities as the security has become primary concern ,the security camera are been installed everywhere in malls , Teaching organizations , movie theatres etc. This paper proposes a monitoring system which includes motion detection algorithm is implemented along with alarming features .This system utilises IoT based image processing with internet connectivity for easy transfer of data anywhere even to remote servers like cloud. The main idea behind this system is to detect the presence of moving object and start recording the video from when the object/human is in movement, the recorded video is been uploaded to the cloud which from there can accessed anywhere at any time.

It only captures most significant videos that eliminate process reviewing that takes more time like normal video surveillance .There is no improvement in the network traffic observed, it used the same traditional network. The isolation of traffic based data packets and the priority set are balanced.

E. Video Based Traffic Congestion prediction on an Embedded System.[4]

In the recent years the computer vision is used in traffic surveillance systems as the security is the main concern. The surveillance system performs the image processing.ie).prediction of events, extracting the traffic from the recorded data , in particular it is used to detect the traffic congestion. This paper contains embedded computer vision system which collects traffic data and reports an innovative method for predicting the traffic congestion. This paper proposes method to test data from the real life scenarios which been collected by embedded computer vision system .it was designed to work in motorway which required online evaluation in real time and offline evaluation with pre-recorded video scenes. The surveillance in the city limits is used to record the fore coming traffic. If there is the signal of traffic to be happened the embedded system platform used for image processing detects the presence by average speed, vehicle density and the amount of change in the lane. Lane changes is used for predicting the traffic majorly.

C. *A Bat Algorithm for SDN Network Scheduling*.[11]

When the data packets are passed it encounters more network traffic, may get interrupted by external noised in the channel. SDN(Software Defined Network) is programmable network such a way a packet can be sent without any jitter. SDN checks the path for the data transmission if suppose any collision happening or any packet is jammed in between it finds another path to send the packets .as it is dynamically programmable this way it avoid traffic in the multimedia network .In this paper we use the algorithm for a simplified model of data request ,bat algorithm is used in order to get the optimized solution. This further solution is use to test the real life scenarios.

D. Survey on QoE and QoS models for Multimedia Services.[9]

QoE and QoS tells about the Quality of Service and Quality of Experience about the system respectively .It is generally obtained for the multimedia services. QoS refers to the network behaviour, so that the data can be transported with minimum packet loss, delay and maximum bandwidth. Whereas QoE is subjective measure which deals with human dimensions like users perception, experience of application and the network performance. The authors have adopted the combination of qualitative and quantitative approaches. Paper uses the Holy Grail subjective measurement to predict it from the objective measure that prediction of QoE from the given set of QoS parameters. and it is very much necessary that the service providers has to continuously monitor the QoE and improve if there is any necessary There are many models available to enhance the quality of the multimedia services in here we use QoE /QoS. The QoE/QoS Model will be taken to highlight the challenges face when identifying quantitative relationship between quality of service and quality of experience.

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication (BEIESP)

III. BLOCK DIAGRAM

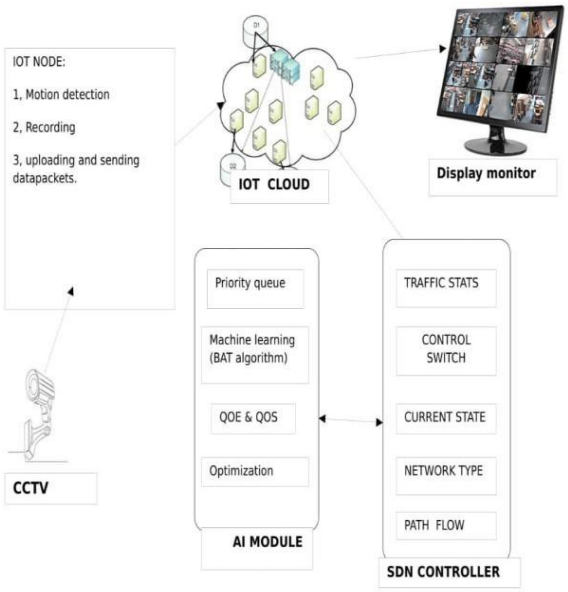

Fig.1: Representation of block diagram

The system architecture is illustrated in fig:1 with four components which are integrated together in the working. The IOT nodes are nothing but the cameras which cover a certain angle for its position and the display system which are at a topology covered by the IOT cloud. The recorded data can be verified and viewed from the cloud whenever required using the login ID and password mentioned for each authorised user [14]. SDN plays a role in delivering the data uploaded to the user in an effective way. The SDN controller in integrated with a AI module during the packet delivery service.The SDN controller inputs the traffic stats from the IOT node [15]. Comparing the current state, network type and path flow the controller gathers information based on the Open-flow standard. The AI module in turn inputs the status of the current network and then based on the traffic status it sends the data to the concerned machine learning algorithm where prioritization of the data packets take place. On comparing the user data sets the data packets are arranged according to priority and sent to the display monitors. After proper optimization and ensuring that QOS and QOE have been verified the data is uploaded and sent to the users. Alarm signal and warning are the features added to the unit. These modules coordinate to work together as follows [15]

The above is the proposed system architecture diagram in which Artificial Intelligence is integrated along with the SDN in order to ensure quality of experience and quality of service. The IoT nodes (CCTV camera) detect the security video traffic and other traffic applications. The SDN engages in topology discovery, traffic routing and the statistics required for AI module.

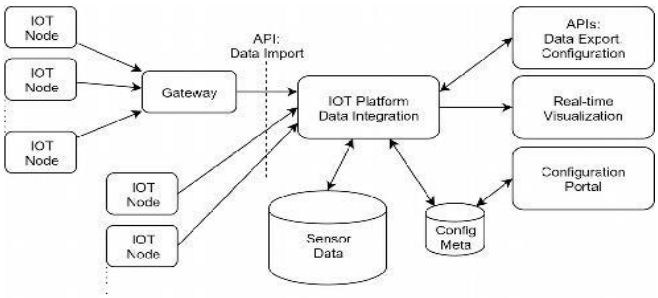

Fig.2: IoT nodes configurations

The AI module is uses decision making algorithm to arrange the data packets according to priority queue. It compares the data packets with the resources available and the current state of the network [11]. This comparison helps in differing the data packets to sleep, awake and buffer modes. The main idea behind is to reduce the network traffic caused by video surveillance and ensure QoS and QoE. The system refers to a series of advantages which are defined below. The SDN provides flexible and easy trouble shooting. Traffic priority (priority queue) is major advantage as the data is transferred only based on the predefined sets mentioned by the user [12]. Only the data with greater emergency is checked by the user along with warning signal on the display device. Buffer management is one of the key roles of the proposed system as the jitter, noise, data cross over, data manipulation, packets loss are all omitted and optimised in the proposed system. There is no delay in packet transfer as there active back nodes which identify the traffic in one path and directs the network through the other path ensuring connectivity in the network There is complete end to end transmission through secured network as acknowledgement from the receivers is also validated with SDN network. The camera starts recording only when anomaly is detected with the help of IR sensors employed in the motion detection sensor. The system also reduces storage space and memory by uploading data to the IoT cloud and retrieved whenever required. The number of display devices and the geographical area do not serve as a limiting factor. QoS and QoE are ensured by the optimisation of the data packets using BAT algorithm. They quality of service and experience are usually specified to the users view about the network process and an effective network procedure ensure QoE and QoS.

IV. PROPOSED METODOLOGY

I. Iot Cloud Configuration

IoT (Internet of Things) Technology used to connect real world things to the internet. The CCTV camera is used to capture the image of the object movement .The cameras are in standby mode whenever if there a motion it detects, and start recording the scenario. The recoded footage is send to the IoT cloud [5].

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication (BEIESP)

Cloud is nothing but the platform which givers access to use its uploaded contents anytime, anywhere. The IoT cloud stores the footage and can only be viewed by authorized person who possess login id and password .The cloud platform is password protected and highly secured. The PuTTY software is used to create SSH terminal to establish authorized login and to provide interface between source and destination. The terminals at both ends are configured under same network as in fig: 2. The coding is done in Python language. The cloud in which the data packets are uploaded can be retrieved by many users at the same time [7].

II. SDN CONTROLLER

The SDN(Software Defined Network) is programmable technology which is used to detect the traffic in the network Cisco packet tracer is the standard networking environment which is used to establish connections between source and destination and also enables to provide control to the switch .The IoT node sends statistical data in case of huge network traffic to the SDN controller. Initially it sends open-flow standards to configure the controller and to determine the current state of the network, The resource available and the track of previous data packets. The function of SDN controller is integrated with AI algorithm to ensure QoS and QoE.

III. ALGORITHM

Having in account the resources required and the current state of the network the AI algorithm arranges the data packets based on priority queue given by user defined data samples. The BAT algorithm is used here for optimization of the data packets in the order of priority [11][13].

The Bandwidth, Occupied time , source time , latest termination time are taken as inputs in the bat algorithm which outputs the map sequence of the data packets.

BAT ALGORITHM

The BAT algorithm is a machine learning algorithm founded by University of Cambridge in the year 2010. This is similar to the ecological movement of Bats with transmitting and emitting radiations and detecting obstacles in the way. To implement this algorithm in networking there are few assumptions are made.

- Bats generally use their echolocation nature to detect the distance between the source and destination by the time taken by echo to reach the source back. It is a simple principle where source and destination are considered under a given SDN network.
- The source is considered as xi, the speed of the source is vi, initial frequency fmin, bandwidth l and loudness Ai .The adjustment of the wavelength is given as r ∈ [0, 1].
- Nearest short time is referred as Amin (minimum value) to latest termination time A0 (maximum value)
- Three dimensional or multidimensional calculations are ignored here and only one path is used. Time delays are also not taken under the assumptions specified.

[4][8] .It is similar to a virtual network where new path between the source and destination are identified incise if the switch is overloaded. The function of the controller is further enhanced by reducing the time that is used to track the state of previous packets as represented in fig: 3. The controller is divided into two parts data plane, control plane: Data plane-The data packets depending on the traffic are accumulated in this plane, Control plane-the switch between the source and destination is controlled to find new path in case the switch is overloaded. The SDN controller performs network management function by sending open flow standards that configures the network [10][12]. Having into account the network type, current state of network, bandwidth and path flow through the network. Traffic statics are recorded and send to the AI module for further optimization to reduce network traffic and to improve packet delivery service.

Fig.3: Representation of SDN Layers

Equation for the BAT algorithm

$$f_i = f_{min} + (f_{max} - f_{min})\emptyset$$

$$v_i^2 = v_i^{t-1} + (x_i^t - x_0)f_i$$

$$x_i^t = x_i^{t-1} + v_i^t$$

Bat algorithm is used to obtain the optimized solution

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication (BEIESP)

FLOW CHART

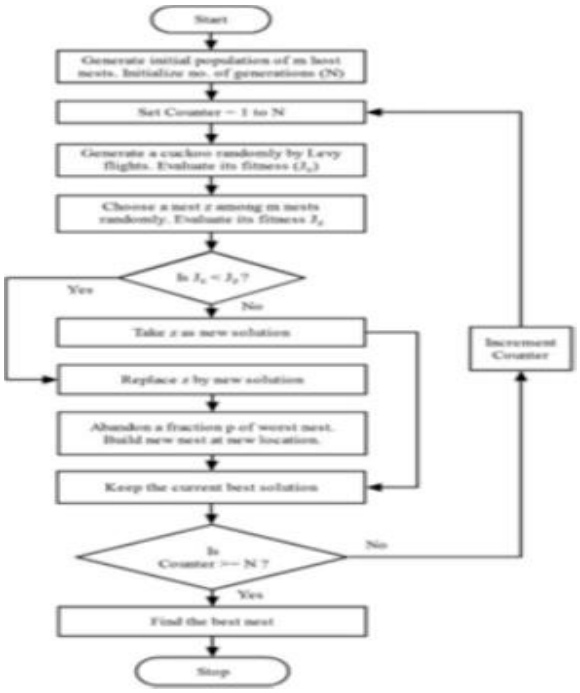

Fig 4: Flow of optimization algoritham

IV. RESULT ANALYSIS

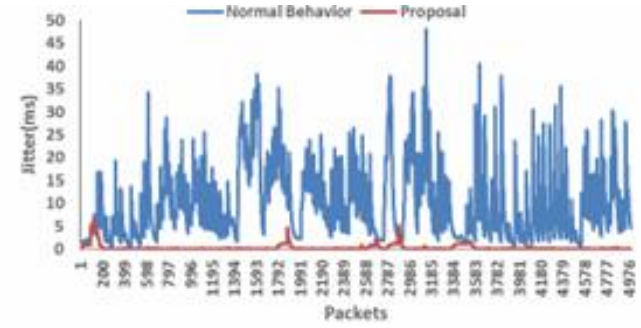

Fig.5: Jitter behaviour

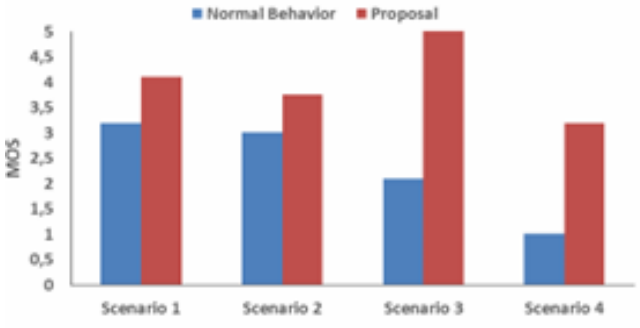

Fig.6: End user results

- QoS and QoE:

[Quality of Service and Quality of Experience]

An efficient network system ensures QoS and QoE as a prominent feature and it is to be satisfied by any network. This is known to be efficient only based on its network quality. Feature that assures the quality of the network is QoS (Quality of Service) [9]. It deals with the network behaviour like, nature of the network, whether the data is transported with minimum packet loss, delay and maximum bandwidth also, work related to updating routing table . Another feature which considers user opinion is known as QoE (Quality of Experience). It refers to user perspective views that include the quality of application, perception , performance. If a network provides low quality of data transmission user may not report it they can simply switch to different network which assures more quality. So it is important that the service provider of the network should continuously measure the QoE of the network and update it if there any necessary .

D. DISPLAY:

Based on the heat signature the anomalies are detected, and the camera starts recording only with the presence of the object. The recorded data is uploaded to the cloud and can be retrieved whenever needed [10]. However the initial video footage is displayed to the receiver with an alarm signal, based on the emergency that been prioritized by the priority queue (decision making algorithm). Both the CCTV camera and the display systems are connected under the same network, therefore the number of display devices to a single camera are not limited. The devices used are monitor, mobilephone, tablets , lcd display.

The scenarios 1,2,3 and 4 represent the traffic level with scenario 4 having greater network traffic and scenario 1 having the least network traffic. The result was tested by 10 users who where connected to the same IoT network and experienced various level of network traffic as in the scenarios 1 to 4.The fig : 5 represents the jitter behaviour throughout the 4 scenarios. The implementation of the project is tested based on. The scale rated by the users from 1 to 5 where 5 implies the best quality and 1 implies the least. The overall percentage increase of the proposed system to the existing one is 70 percentage resulting in successfull implementation of the project.

V. CONCLUSION

The system proposed ensures quality of service and experience by employing the machine learning algorithm which ultimately reduces jitter error that is occurred during transmission of data from the CCTV camera to the destination display unit. The process is carried out under IOT cloud with proper user authentication and enclosed security. Time of transmission and the acknowledgement for each packet that is being delivered are also recorded for improving the quality of transmission. As the system mainly focuses on the jitter reduction future enhancements may include reduction and optimisation of packet loss, packet duplication and packet manipulation.

REFERENCES

1. V . Zeljkonic , D.Pokrajac-"Motion Dectection Based Multimedia Supported Intelligent video Surveillance System", issue, 2006.
2. Dr.Virendra Shete, Niraj Ukande-"Intelligent embedded video monitoring system for home surveillance ", issue, 2018.

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication (BEIESP)

3. Wen-Tsuen chen,Po-Yu Chen,wei-shun lee,Chi- Fu Huang,-"Design and Implementation of a real time video surveillance system with wireless sensor networks", issue, 2008.
4. Hogler galsL , David Schreiber , Nikolaus Viertl, Stephan Veigal and Gustavo Fernande-"Video based traffic congeston prediction prediction on an embedded system", issue, 2008.
5. Liang Ming,Guihai Xie,Hao Li and Lei yang- "Research on remote intelligent surveillance using wireless network", isuuse, 2006.
6. Prakash . ,ThamaraiSelvi.V.G,"Detecting and tracking of multiple moving objects for intelligent video surveillancve systems", issue, 2014.
7. M.valera and S.A.Velastin,"Intelligent distributed surveillance systems:a review", issue, 2005.
8. M.H.Sedk, M. Monini and C.C.
9. Chibelushi, "Classification of smart vide surveillance systems for commercial appplications", issue, 2005. [9]. Mohammed Alreshoodi and Jogh woods,"Survey on QoE and QoS Correlation models for Multimedia services", issue, 2010.
10. Bing Xiong,Kun YANG ,Jinyuan Zhao,Wei Li,Keqin Li-"Performnace evaluation of openflow- based software defined network based on queuing model", issue, 2016.
11. Rongheng Lin and ZezhouYe-"A bat algorithm for SDN network scheduling", issue, 2018.
12. Majd Latah and Levent Toker-"Application of artificial intelligence to software Defned Networking", issue, 2016.
13. Mukherjee D , Acharyaa S .,"Ant colony optimization technique applied in network routing problem.", issue, 2010.
14. Dotecnko S,Valdyko A, Letenko I."A Fuzzy logic-based information security management for software-defined netwoeks", issue, 2014.
15. H Kim ,N Feamster,-"Improving network management with software defined networking", issue, 2013.

AUTHOR PROFILE

Dr.J.Jagadessan ,Received P.hD in Computer Science and Engineering, Anna University. His research interests include Software Engineering, Computer Architecture. He is a professor and Head of Department (HOD) in SRM Institute of Scienec and Technology,Ramapuram campus.

Nikita .B, pursuing B.Tech degree in the Department of CSE ,SRM Institute of Science and Technology ,Ramapuram campus, Graduating in the year 2019.Her research interests include Data analytics , Machine Learning and IoT.

G.Deepti Preta, pursuing B.Tech degree in the Department of CSE, SRM Institute of Science and Technology, Ramapuram campus, Graduating in the year 2019.Her research interests include Networking, Artificial Intelligence and IoT.

H.Hari Priya, pursuing B.Tech degree in the Department of CSE,SRM Institute of science and Technology, Ramapuram campus, Graduating in the year 2019.Her research interests include Data security and IoT and Networking.

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication (BEIESP)