iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 9 **Issue:** IV **Month of publication:** April 2021

DOI: https://doi.org/10.22214/ijraset.2021.33760

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue IV Apr 2021- Available at www.ijraset.com

Emergency Alert System for Vehicles using Fog Computing and Cloud Computing

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Abstract: ***In recent times there has been an increase in the number of road accident. Due to this, there as been a rapid increase in the loss of lives as they haven't been able to get access to first aid on time. Few existing system uses technologies like IoT and cloud which on their own are incapable of providing the services on time. Iot also has some limitations in terms of hardware capacities. Due to this loop holes present in the current system where cloud computing is used. We are going to use amalgamation of fog computing and cloud computing.***
Keywords: IoT Fog computing and cloud computing intelligent accident control system.

I. INTRODUCTION

Road accidents in addition to causing damage to the vehicles and to the people inside the vehicle also have its effects on the surrounding environment and the ones commuting on the road. Hence the emergency accident system proposed not only helps to save the victim but also overcome other losses. In this generation where internet is being used in day to day life, we are able to communicate in a faster pace thus reducing the time inefficiency. So it would be an ideal scenario to use the internet with other technologies to create a finer system.

Trending technologies like IoT, fog computing and cloud computing play a crucial role in developing new systems. IoT acts as a connecting dot between various physical devices with the help of sensors etc to share valuable data. With the use of IoT we can build smart devices which can be used in various accident alert systems to provide proper communication amongst the vehicles thus preventing major accidents from happening. IoT enables many other technologies to be used along with it. IoT is also used in various other places like home automation, smart watches, health gadgets, smart bus, smart subway, self driving cars, smart farms, forest fire alarms etc But one main reason why people step back from using IoT is data security and privacy issues.

Cloud computing is a centralized on demand availability of resources especially like data storage and computing power without direct active management by the user. Cloud data centres are available to many users over the internet. Cloud distributes its functionalities to multiple users living in different parts of the world via its central server. There are different types of cloud like private cloud, public cloud and hybrid cloud. Private clouds are limited to a single establishment whereas public clouds are accessible by everyone over the internet.

Hybrid cloud service is a combination of one private with one or more public clouds. Cloud computing makes use of huge data servers to store large amounts of data securely. Coming to applications, cloud has a huge range of implementations like Software as a service (SaaS),Platform as a service(PaaS),Infrastructure as a service(IaaS), testing and development, Big data analytics, backup and recovery etc. Cloud also supports IoT devices and applications. Most of the proposed systems make use of cloud services to store data pertaining to the vehicles, its owners, nearby hospitals and police stations. Main drawbacks of using cloud computing is that it has very high latency, bandwidth issues and also not all clouds provide the same type of services hence it would be more efficient to use fog computing along with cloud computing.

Fog computing is a decentralized computing infrastructure in which data, compute, storage and applications are located between the data source and the cloud. Fog layer being closer to the user has its advantages compared to cloud. Fog computing which is also known as edge computing is an extension of cloud computing. To improve the efficiency data is being processed closer to where it is created.

Fog has its own advantages like low latency compared to cloud, response time is high, highly secure, mobility is supported in fog computing unlike in cloud computing. Since fog computing can access data at a shorter range, it reduces the bandwidth consumption thus reducing the overall cost of the system. Since fog computing has many advantages it will be highly beneficial to use fog computing in the proposed systems.

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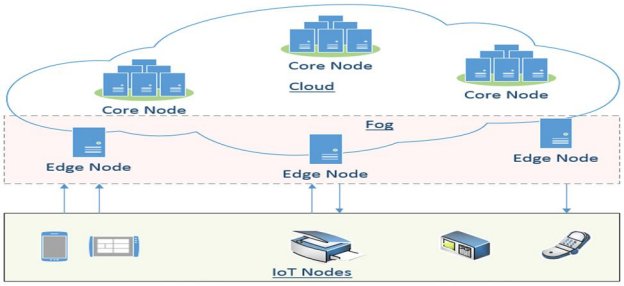

Fig 1. Conceptual model -IOT based cloud/ fog computing scenario

II. LITERATURE SURVEY

The paper Intelligent Accident Control System Using Cloud Computing written by Lakshmi Boppana, Sreedhar Pothuraju, Ravi Kishore Kodali talks about increasing rate of accidents as a consequence of rise in more vehicle usage.The paper describes that in spite of having Existing Systems like vehicle horn, Concave mirrors, Anti-Locking braking system, SRS Air Bags (Supplemental Restraint System Air Bags) and Parking sensors the accidents caused by road rage and reckless driving can be fatal sometimes. Hence usage of more advanced technologies can play a key role in predicting and preventing accidents. Here they have developed Intelligent accident control system (IACS) that warns the driver through SMS whenever the vehicle crosses the threshold speed to avoid accidents. As IoT being the main technology used, which enables the interoperability of the devices less human intervention is required which results in increased efficiency and adds to economic benefit as well. The proposed system is an accident alert system that is installed in automobiles to avoid accidents using the services of cloud computing. Fig 1 shows the block diagram with the vehicle and modules of the prototype. Here each module is referred as IACSM which is registered with the messaging number to receive SMS alerts on changing of direction. Example when a vehicle say Y moves closer in the direction of vehicle X from right module present on the right alerts the vehicle by saying “take a turn towards left”. This is done by calculating relative distance between the vehicles**.**

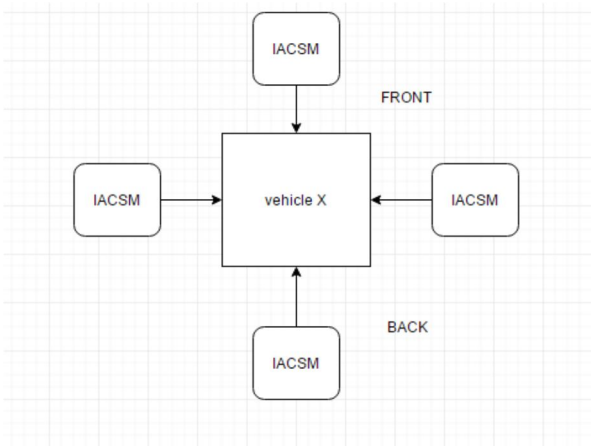

Fig. 1.1: Proposed system.[1]

To ensure safety of the vehicle of interest from collisions with neighbouring commuters, it is required to mount four units of this proposed prototype on front, back and sides of the vehicle. Each prototype calculates relative distances of other vehicles in that specific direction with respect to the vehicle of interest and alerts the driver through an SMS based on threshold value specified in the software by the user.[1]

The paper Accident Management System using Fog Computing written by Syed Usman Jamil, and M. Arif Khan (Member IEEE) highlights about how the new technologies like IoT, cloud and fog computing and 5G are being used in Emergency management systems to rescue people from accidents .Even though accidents are considered to be small scale holocaust’s the loss it creates sometimes may be huge, so helping people at the time of accident is crucial. We can use a smart auto generated response system as a solution .Most of the times life of a victim is in danger due to delay or unavailable emergency response. New technologies play a important role in saving one’s life in an emergency situation. There are many such systems existing to provide assistance, most of which are cloud based systems but there exists the problem of delay in those systems which can b overruled by using fog computing layer in addition to cloud layer .Fig shows the system which uses both fog and cloud computing.

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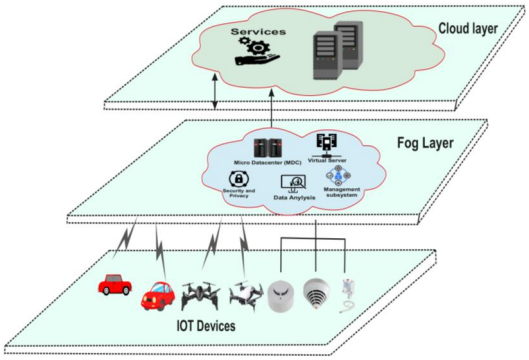

Fig. 2.1: AMFC conceptual system architecture.[2]

The usage of fog also guarantees us with more security to the application, which the existing system lacks. Due to increase in number of vehicles the data generated would be so high that send them to cloud would not be a good solution therefore computations must be carried out by devices also.

The main objective of the proposed system Accident Management using Fog Computing (AMFC) is to provide faster responses and to control road traffic and damage ,in order to achieve this AMFC uses fog computing instead of cloud computing for executing its basic actions .Android devices use fog servers to get the location of the vehicles which then are used by fog servers to notify the ambulance and police.

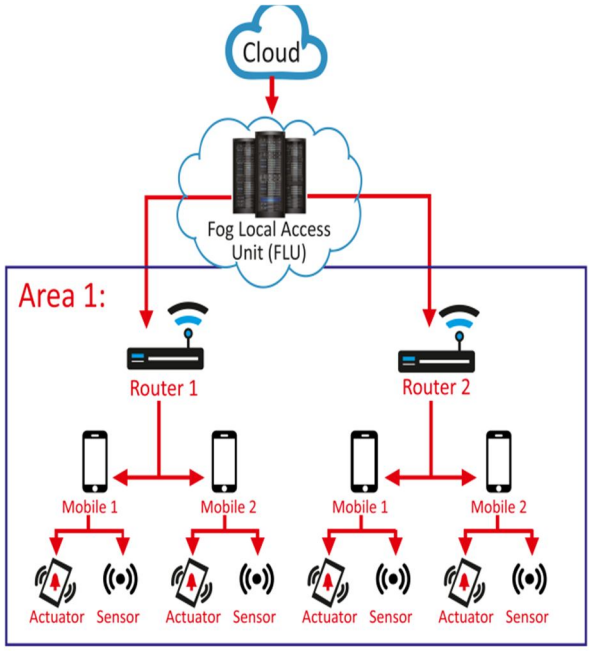

Fig. 2.2. MFC scenario setup for simulation of a single area[2].

The main conclusion that we can obtain from the AMFC Deployed system is that it provides less delay with minimum usage of network and latency. There also exists a limitation, as it is a simulation –based solution it places constraints on generalization and limits the results achieved

Bilal Khalid Dar et al[3] have spoken about how important it is to provide emergency services to the affected people with minimum delay. Cloud computing has been used in the past in disaster management systems. Since cloud computing involves uploading and accessing data present in the data centres, it increases the amount of time required for the emergency services to reach the people in need of it and thus might result in loss of life. The authors have tried to come up with a new system which can overcome these drawback which is shown in the Activity diagram [3].

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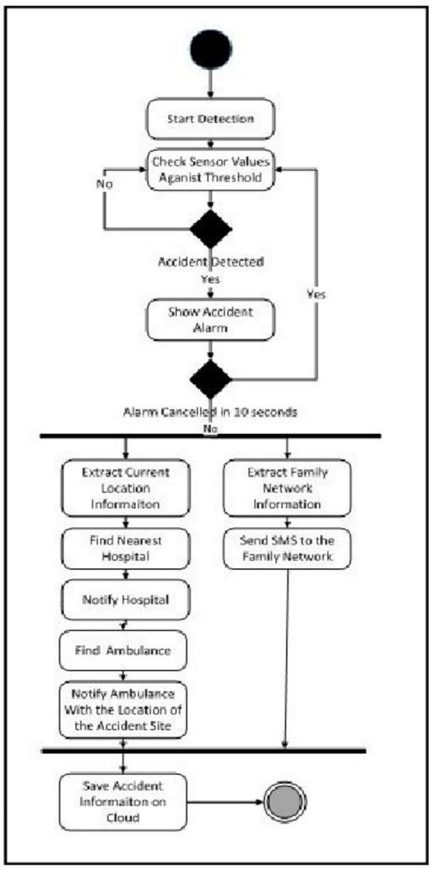

Fig 3.1 Activity Diagram [3]

There are mainly two phases in the suggested system (1) Accident detection phase and (2) Emergency response and notification phase. The GPS, Microphone and Accelerometer are used to recognize an accident. A threshold value is pre-set on the sensors in order to detect the accident. The next step is to execute the plan of actions which is dealt by the next phase. Here the ambulance, hospitals and the family of the affected are informed after accessing the information on the Web database. The main conclusion that we can draw from this system is that the latency is very less as compared to cloud computing Fig 3.1[3] and with the usage of fog nodes the congestion on the network Fig 3.1 [3] has also drastically reduce thus improving the efficiency of the system to provide in time first aid to save the lives of the needy. The main setback in this system is that no real results are available and the entire proposal is based on simulations which cannot be considered in order to effectively implement the system.

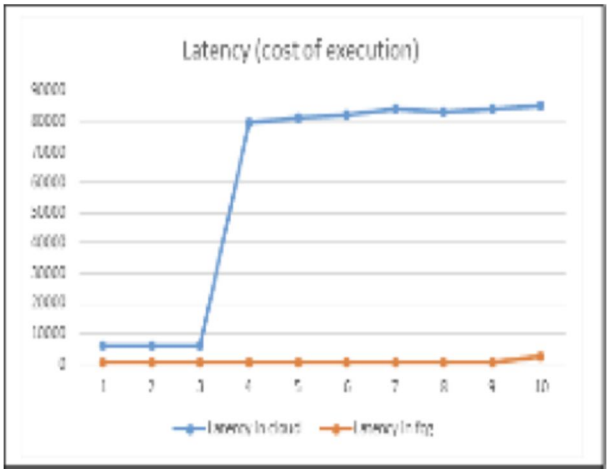

Fig 3.2 Comparison of latency[3]

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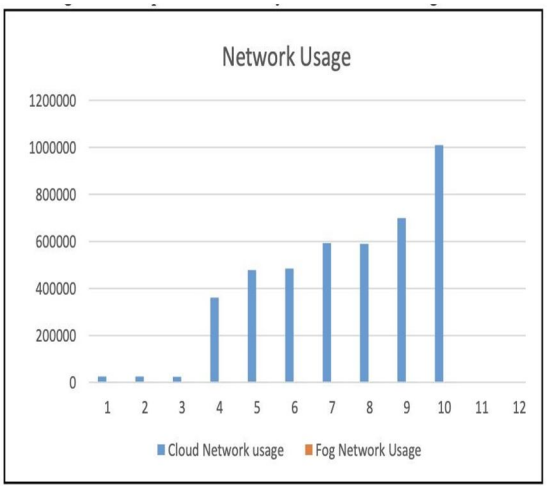

Fig 3.3 Network Usage[3]

Salman Raza et al[4] have spoken about integration of Vehicular Edge Computing and smart vehicles in order to improve the efficiency and Quality of Services(QoS)[4]. Using cloud computing commuters on the roads can share valuable information which can guarantee safe travel. But due to the increasing number of vehicles, the efficiency is slowly coming down due to more consumption of time to access the data on the remote servers. A more viable option to overcome this setback is Edge computing. It uses local servers to store the data and the edge nodes present in the vehicles collect the necessary data and upload it to the servers. Fig 4.1 shows the main differences of using VEC and VCC.

Fog computing architecture fig4.1 [4] has 3 main layers. First one being the cloud layer which helps in storing data. The edge cloud layer provided a link between the cloud and the vehicles with the main aim to reduce latency. The last layer i.e. smart vehicular layer helps in sharing of data amongst the vehicles which are in close proximity.

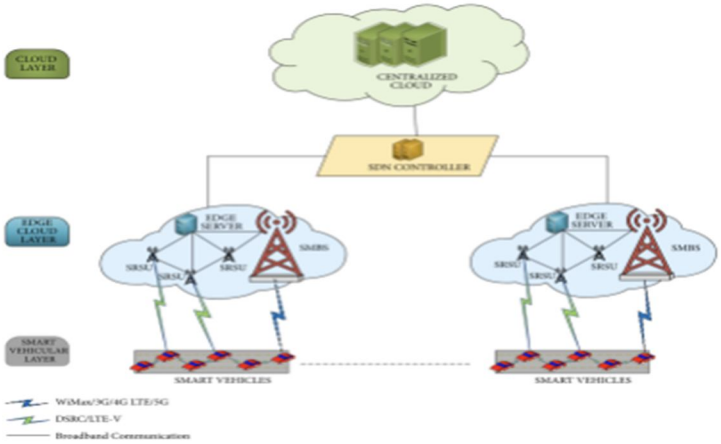

Fig 4.1 Edge computing Architecture[4].

The authors have further spoken about the various components in smart vehicles and how they form a network to share information. They have also provided information on the two types of communications ie. inter vehicle communication and extra vehicle communications. The authors have explained in detail about the various services provided by Smart vehicles and also about the various safety and non safety applications. They have concluded by saying that VEC has greater potential and many such studies can be carried out in the future to identify them.

In this proposed system they mainly concentrate on accident occurrence in the outdoor system. So it only detect the problems related and convey the message to the nearly health centres. This system uses fog approach in which the different devices at the edge to do the task and they performs few actions according to occurred events at same time when there is imbalance health of the person like strock, at this it also saves time and guarantee a minimum delay to send the messages[5].

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It uses FPGA hardware for detecting events.

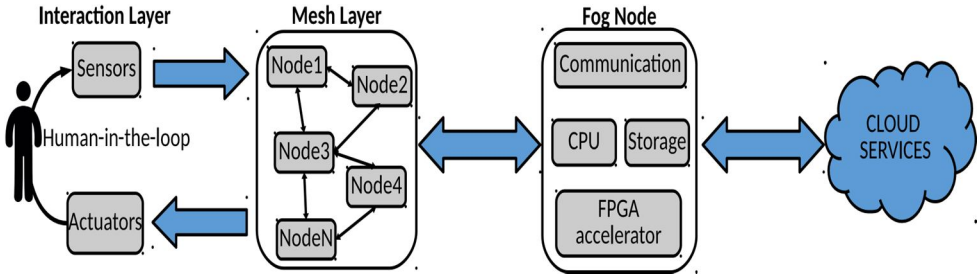

Fig 5 Representation of the proposed architecture[5]

A. It has Three Layers

Interaction layer

1) *Sensors:* produces data
2) *Actuators:* That consumed the data in the form of commands to generate a physical outcome
3) *Human in the Loop:* That can produce and consume data and act upon it

In this paper they present service architecture for emergency alert using fog computing Cloud computing and the Fog computing, can play a important role in not only emergency alert system but also, in the overall emergency management. Fog computing extends the cloud computing paradigm to the edge and it also known as Edge Computing. As compared to the cloud, the fog is more centralized and Fog computing is aimed at services with widely distributed deployments.This service sends the location of the incident or accident of the vehicle and contacts to the nearby health centres the emergency related information is then synchronized automatically from fog computing to the cloud computing. On smart base service known as emergency help alert mobile cloud(E-HAMC) provides a quick way notifying the relevant emergency details.This has to be done by any near by passer by clicking a single button using E-HAMC in his/her own phone.This application also provides the witness mode for the users.It's default mode is victim mode and only expectation is it won't be informed to the family members.Once the alert has been made by the fog data it is proposed for the further refinement and stored in cloud[6]

Disaster are natural and also manmade but the important thing is to decrease the loss of life, this can be achieved by immediate response after the accident. Immediate response can be provided by smartphone-based disaster management system, cloud-based accident detection and disaster management system, and also fog based disaster management systems. Cloud based accident detection have concern towards reducing the delay in time. An emerging concept that can help to address these issues can be done by fog computing, which reduces delay and it utilizes smartphone sensors to detect the accidents where the cost becomes very less and can be affordable to all category of vehicles. The data which is collected by the sensor is sent to near by hospitals and ambulance and also for emergency contact in smartphone. The data contain location of accident, blood group, emergency contact details and type of vehicle, this data is sufficient for immediate response to save the life. The below figure shows how the accident is communicated[7].

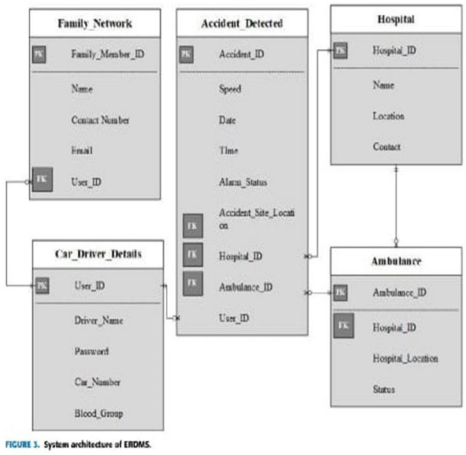

Fig 7.1 System Archtecture of ERDMS[7]

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It is evident that the fog computing saves bandwidth where cloud utilizes more network data while transmitting the data. In case of using cloud for computing and storage, all the jobs are sent to the cloud data-centers. These jobs traverse the whole network from source to destination. Below figure shows the comparison between fog computing and cloud computing

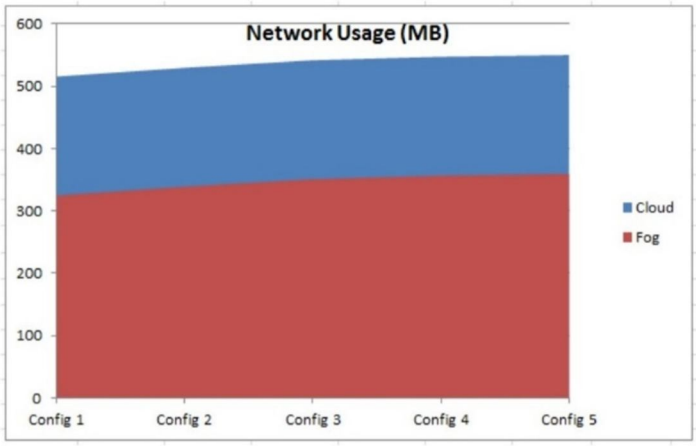

Fig 7.2 Comparision of fog and cloud network usage[7]

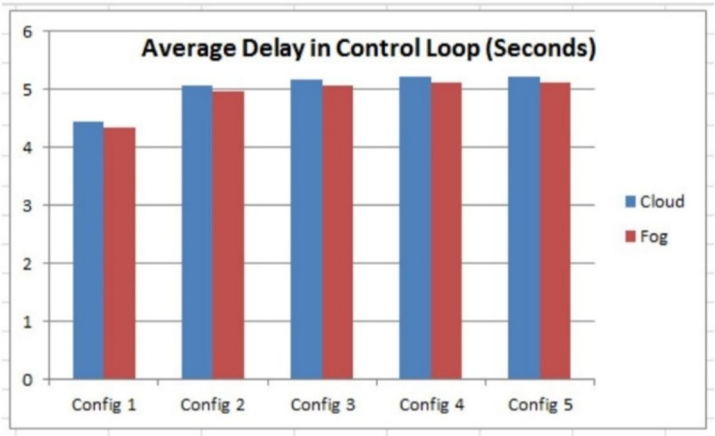

Fig 7.3 Comparision of fog and cloud latency[7]

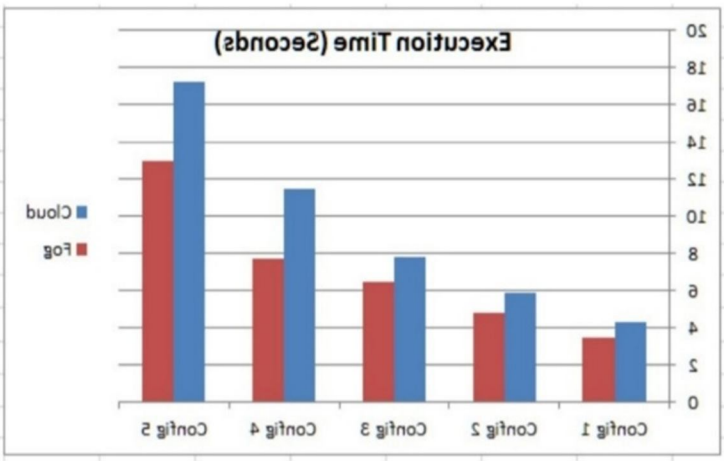

Fig 7.4 Comparision of fog and cloud execution[7]

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In Developing an e-health system based on IoT, fog and cloud computing the author states that quality of life is one the important parameter. Many organization are working effectively to develop application services. The e-health systems based on IoT devices using fog and cloud as been developed as shown in below Figure 8. The IoT devices (sensors) are responsible for collecting data and send that data for microcontrollers in order to unify the patient data, then the microcontrollers send this data to fog devices, where the data can be pre-processed, and getteing the fatser response if any problem is identified. For the further analyze of fog layer will also send the patient data to the cloud. According to Miotto there should be some technology such as , deep learning (DL) implemented at fog to analyze to guarantees the faster response if any abnormality is identified. Since we are using IoT we need sensors to collect persons data such as heart rate ect. Based on the architecture presented in above Figure 8, to build a prototype. To follow up this, Patients should use sensors to monitor vital signs at low cost perspective, these sensors can be smartphones or wearable devices. The data integration layer is done by a microcontroller. uses an Arduino2, that is an open-source platform, and it has an interface with wide communication standards and with diverse types of devices (sensors and smartphones); . At fog layer, the data collected from the sensors are initially classified . To do this data pre-processing, Raspberry3 Pi,is used due its capacity and accessible price. The cloud layer is used to stores the data and makes analyses on a larger scale. public cloud, such as Amazon4, can be used due its ease management and high availability[8].

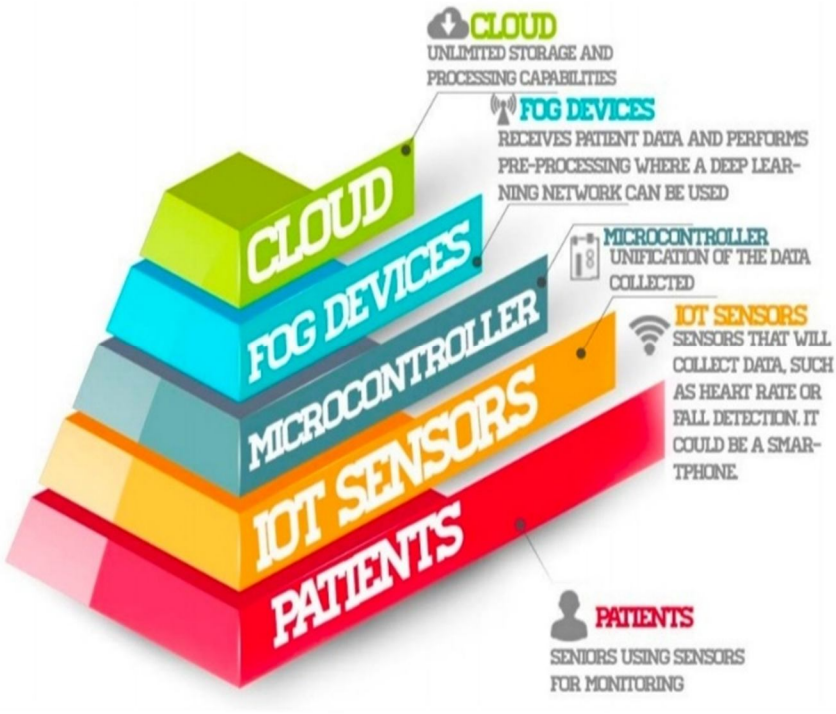

Fig 8 Comparision of fog and cloud network usage[8]

In the paper “HealthEdge: Task scheduling for Edge computing with Health Emergency and Human Behaviour considerations in smart homes” written by Haoyu Wang pt, they have spoken about how we can efficiently manage data using for or cloud computing. Resource management is very important in case of edge computing and the authors have spoken in lengths about the various ways in which fog and cloud can be integrated in order to have better data managing capabilities. Integration of Iot and healthcare has also been mentioned

Which can be used to enable personalised services based on each person's needs. The writers have also mentioned about healthedge which can be used to improve the performance and reduce the bandwidth consumption during any state of emergency. They have provided various mathematical formulations for catering the needs of scheduling problems and resource management.

They have concluded by proposing a system of task scheduling for emergency task management.

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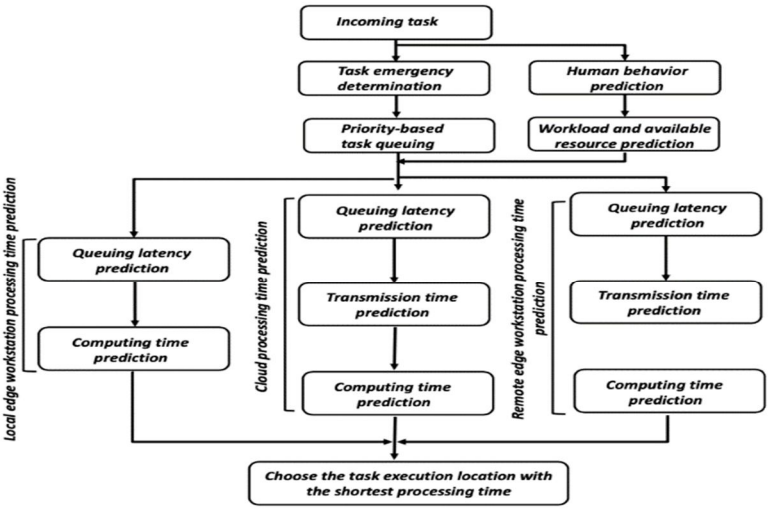

Figure 2: Flowchart showing how to assign a task to the edge workstation or the private cloud data center.

Fig 9 Flowchart showing how to assign a task to edge workstation or
The private cloud data center[9]

B. A Review of Adaptive Intelligent Traffic Control Systems

By Aminah Hardwan Ahmed, provides a detailed insight on the literature associated with adaptive intelligent traffic control systems.As a consequence of traffic congestion both physical and psycho-scocial problems are increasing leading to various health issues as commuters who travel across the city have to worry about the traffic and also start early from their place which requires them to take a step back from focusing on healthy eating and excercise. In their article, Subramaniyam, Sivaraman, Ramachandran, and Veeraraghavan (2017) cited the report of WHO that globally about 1.6 million deaths occur due to road accidents and 62% of these are due to lack of efficient traffic management.

Few reasons for heavy traffic congestions are increasing population, increasing number of vehicles and poor traffic management systems .So the only possible way is to implement intelligent traffic control systems adaptable to current traffic situation,to over come the problem of managing traffic and reducing congestion.

C. How A Typical Traffic Control System Will Look?

The recent traffic management systems (TMS) are using wireless sensor networks (WSNs) is gaining popularity as they not only help avoid congestion but also ensures priority for emergency vehicles and reduce the average waiting time (AWT) of vehicles at intersections and WSNs, RFIDs, ZigBee, VANETs, Bluetooth devices, cameras and infrared signals are increasingly being researched. A pictorial presentation of a typical WSN-based traffic management system by the authors is shown in Fig below, as it is very illustrative.

Fig 10: WSN-based urban transport management system (Nellore & Hancke, 2016)

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Even though there are many more research works regarding different methods of adaptive intelligent traffic control systems that have been used. Most of them talk about the additions to the topics dealt above rather than being newly implemented systems. Clearly the use of dynamic systems using real time data and predictive models are highly benificial than the commonly used static systems which are insensitive to changing traffic conditions. New developments to the existing system definitely has a significant need over the current ones in reducing wait times and fuel consumption and also pollution, giving way to emergency vehicles, reduce road accidents and ensuring orderly proper traffic management even during the odd hours.

Traffic problems has led to loss of human lives due to failure in transporting accident victims, critical patients, medical, equipments and medicines on time. With the unending growth in vehicular traffic everywhere, the fusion of Internet of Things (IoT) and Vehicular Ad Hoc Network (VANET) has embarked as a promising platform for an Intelligent Traffic Management System (ITMS). In the literature, researchers have suggested various solutions, but without taking into consideration how to prioritize emergency vehicles when traffic system is collapsed due to hacking. This paper proposes a novel intelligent traffic management system for a smart city after considering the research gaps which are yet to be explored in the current scenario. Our proposed solution, not only navigates ambulances to find the shortest possible paths till their destination, but also presents a counter measure to get rid the problem of the traffic light system when it is hacked during its operation

Several traffic organizing both the green light duration and green light sequence on the basis of distance measured with less delay and response time. At the outset, we propose an ITMS based on the type of an incident and hacking of traffic signals. It is inspired by the principles of VANET and IoT where every vehicle in a VANET system share information with one another within a certain range through wireless technology and every device (such as vehicles, Road Side Units (RSUs), users, mobile, traffic control server, etc.) are interconnected to exchange information among themselves.

The architecture for an ITMS inspired by the fused concepts of VANET and IoT that prioritizes the emergency vehicles on roads. The system firstly measures the gap between an intersection and the emergency vehicle, then dispatched EV from that particular intersection with the consideration that either the traffic signals are hacked or non-hacked, the type of incident and emergency car type. Our main motivation is to allow the emergency cars to bypass heavy traffic and reach their destinations on time as well as ensuring minimum transmission delay for emergency messages. Figure 1 demonstrates our proposed model comprising of Traffic Management Server (TMS), vehicles, RSUs, sensors deployed at strategic locations, all interconnected in a VANET system exchanging with one another. Every emergency vehicle has a unique identity that distinguishes it from the rest of the vehicles on the road.

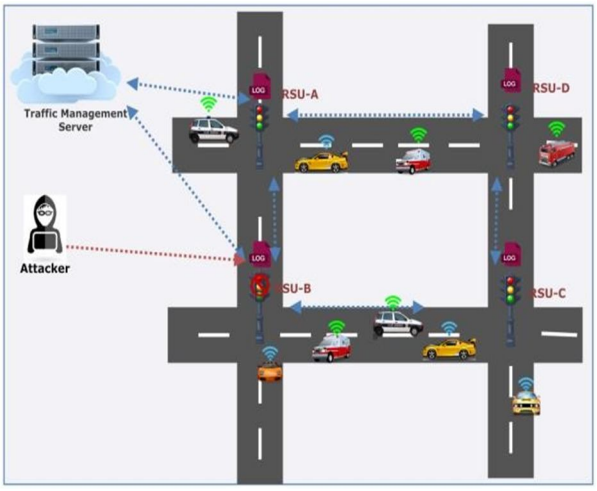

Fig 11 An architecture of an Intelligent Traffic Management System Prioritizing Emergency Vehicles

Several researches have been carried out on intelligent traffic monitoring system, but a secure and efficient solution for emergency vehicles is yet to discuss. Therefore, an ITMS has been proposed to prioritize emergency vehicle by fusing the concept of VANET and IoT with an effort to ease the flow for ambulances in urban areas. It also presents a method to detect and counter hacking of traffic signals which is a very common problem nowadays. The distance between intersections and emergency cars were estimated to achieve the target travel time of emergency vehicles with minimal delay time, considering both hacked and non-hacked traffic signals

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A Feasibility Analysis of Emergency Management with Cloud Computing Integration present us to know about Benefits and some problem of cloud computing that can be used when disaster occurs to communicate between any organisations. They says that Cloud Computing provides on-demand internet based access and provides a dynamically scalable resources and it does not require expensive hardware to recover the emergency situation and in which internet is replaced by metaphor cloud. There are several cloud uses such as individual consumer individual business startup small medium size business enterprise business. cloud as some advantages such as reduce it cost scalability flexibility of work practice allow pay-per-use Quick deployment .cloud computing can be deployed in three differet level such as Infrastructure-as-a-Service solutions deliver infrastructure on demand in the form of virtual hardware, storage, and networking. Virtual hardware is utilized to provide compute on demand in the form of virtual machine instances. Platform-as-a-Service They deliver scalable and elastic runtime environments on demand and host the execution of applications. These services are backed by a core middleware platform that is responsible for creating the abstract environment where applications are deployed and executed. Software-as-a-Service solutions provide applications and services on demand. Most of the common functionalities of desktop applications. Each layer provides a different service to users.

Some of emergency alert implementations in scenarios are senses generating alarm when they sense smoke or fire in which cloud can send communication action to prevent the disaster by sending messages email or connect to one or more person phone aur bhai controlling through remote action. Many Institutions store their business data in multiple data system in various server in various location. Maintenance of that data is very difficult and it is more expensive if they data is stored in cloud they can access through internet and use it efficiently. The resources the resources should be backup in a various location the various types of emergencies. One of the challenges in cloud computing is geographical separation in which distance leads to higher bandwidth cost and create a network latency.

Disasters can also interrupt internet access and communication that makes difficult to access cloud based services applications and data storage even the telephone calls may be busy in that situation by using cloud computing we can provide information about the disaster to the government organisation Major suppliers such as salesforce.com higher level of service availability through virtualize service at multiple data centre the only disadvantage of cloud computing is data will be less secured but one of the layer in in cloud computing provides security for IT user that is SAAS.All aspects of the service are redundant from the location,network, servers, storage devices, databases and backups so that the user can access thier application whenever they want. Redundancy, availability and reliability are hallmarks of cloud computing, so that users can access your information quickly, no matter where they are located.Cloud Computing is one of the best way for the need of Institution and individual to control disasters.cloud Computing resources are ready to use when the emergency occurs Cloud Computing provides ability to user communicate between outside and inside the field Cloud Computing can be access through any portable devices such as computers tablet mobiles internet

III. CONCLUSION

Since human life is of top most priority, we are mainly focused on the efficiency of the system to provide on time services. Thus switching over from cloud to fog can be beneficial as vehicular fog computing provide less delay in response time of the system.it also ensures the network usage is minimal. Another benefit of using fog computing is mobility support which is not present in cloud computing and its distribution over several geographical location makes the processing faster. Fog computing works on the principle of sharing of data within a small range. Due to this communication of data happens faster amongst the various for nodes present in the vehicles nearby thus alerting the nearby commuters where there is a drastic change in the vital statistics. In addition to this our objective is to notify the passing by vehicles where there is an emergency situation.

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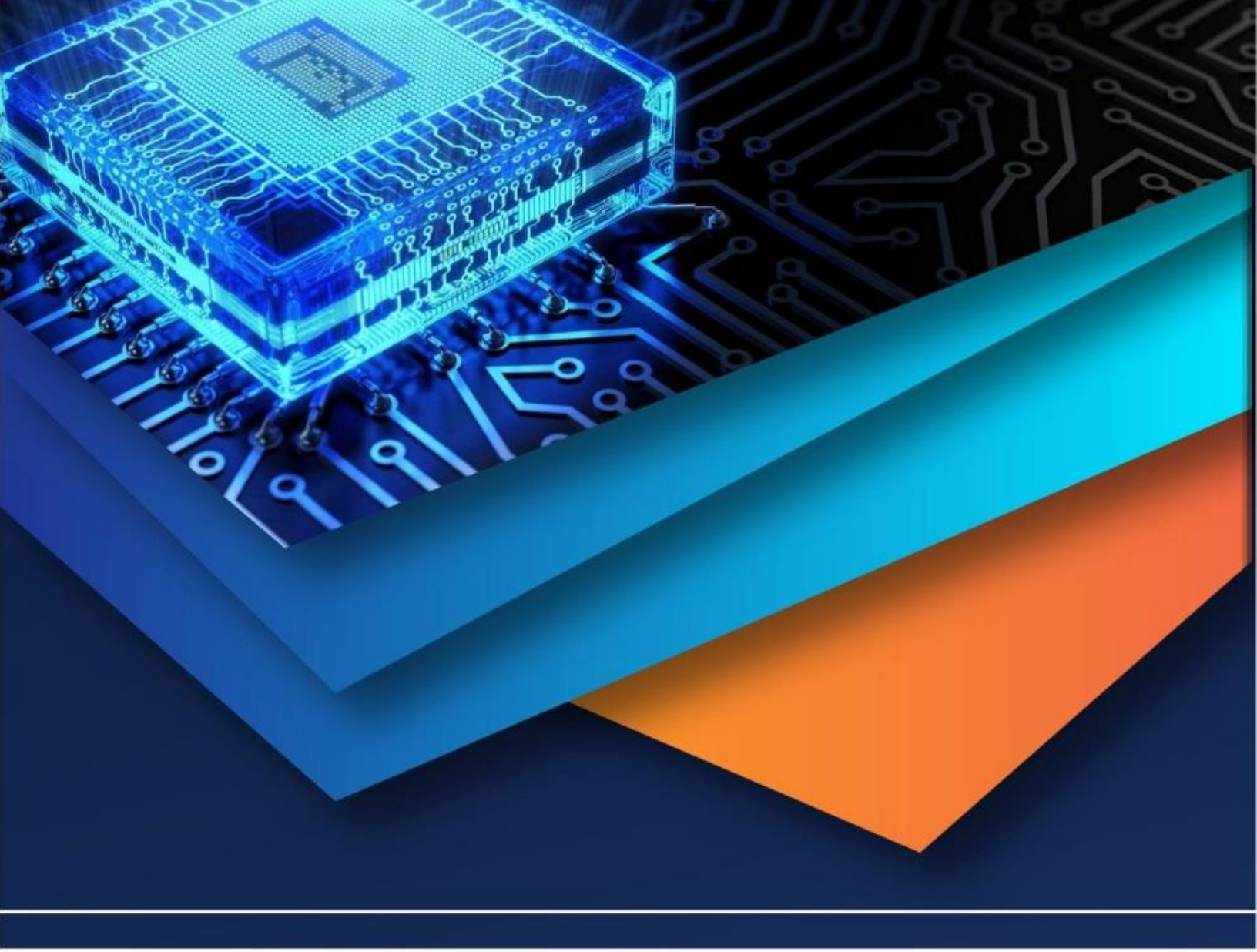

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