

A Case Study: Cloud based Solution for Road Accidents Alerting System in Connected Cars

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Abstract:- The goal of this research paper is to adopt cloud computing services in connected cars to handle the system after road accidents in an effective way. Road accidents are one of the main causes of death rate across India and its poor handling facilities. Cloud computing can play a significant role in reducing the number of road accident fatalities. In order to decrease road accident death rate, a post-accident emergency reporting system is much needed. This research paper develops the cloud computing system that will alert the nearest Point of Emergency (POE) centers like Hospitals, Traffic control station, Fire engine, Police station by using Cloud Computing.

Keywords:- Cloud Computing, Emergency Reporting System in Vehicles, Accident Alerting Systems, Accidents Prevention.

I. INTRODUCTION

Car is a complex system, which needs expertise to drive safely. If there is any abnormality in the performance of system or driver mistake will make the life dangerous. Vehicles such as bus, trucks, bikes etc. are used for travelling by human beings. The number of vehicles increasing to meet the public demand every year, which causes traffic jam, road accidents and many problems.

The role of information technology in reducing the road accidents will be studied by analyzing the data. These statistics are given by the Government of India regarding the road accidents and death rates during 2005-2016.

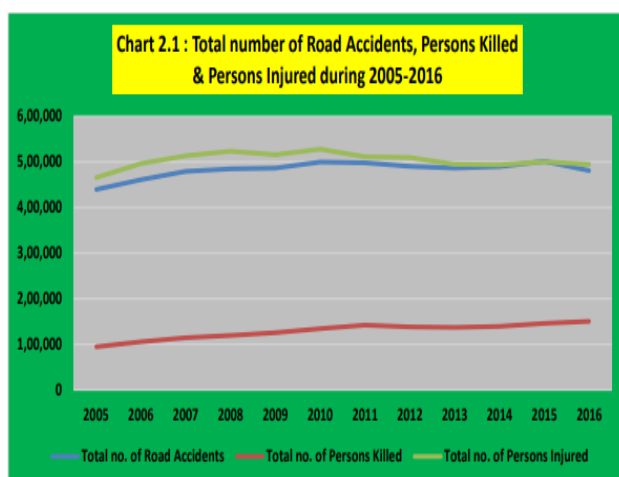


Fig 1:- Road accidents and death rates statistics

II. CLOUD COMPUTING IN THE ACCIDENT HANDLING SYSTEM

Cloud computing is defined by NIST as a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.

Cloud computing in car accidents alerting system is an emerging paradigm. This helps in fast and reliable results using computing resources to collect, store, process and communicate are much needed during accidents. We have multiple cloud service providers to architect the accident handling system by leveraging required services.

Cloud computing is the best solution and provides numerous advantages in the process of accidents handling. Resources such as computing, storage, analysis and communication are much needed to yield the effective output. It is mandatory to put post-accident actions in place soon after the accident happened such as medicating the injured people, notifying the traffic updates to traffic control system to avoid unnecessary confusion and panic among people. Police, Hospitals, Traffic System can take leverage the use of Personal Digital Assistants (PDAs) and wireless technology for transmitting the accidents report, therefore this can be the best system than installing and managing the huge and complex systems.

III. INFRASTRUCTURE MODELS FOR CLOUD COMPUTING SOLUTION

The Traffic, hospitals and Fire engine involved in accidents alerting system can architect the limits of cloud computing which helps in deploying their applications and offer services as per the objectives set by their organization. Police and insurance organizations are interested, dig deep to know the base factor and causes of an accident while the hospitals are interested in medicating the injured people by bringing them trauma center. The cloud computing is classified into four categories which are Public cloud, Private cloud, Hybrid cloud and Community cloud.

For accidents and traffic handling it is recommended to use public cloud. Public clouds are designed to be “out for many” on web sites on the Internet. Therefore the report and result of analysis can be accessible to the world

via Internet. Although, information can be hosted on private cloud exists on premises of POE centers.

Public clouds are transparent in nature as the workloads are deployed on cloud exists out of an organization and run by the third party. The cloud service provider is solely responsible for maintaining and processing the workloads in an faster and reliable in producing the best output. Public clouds do not entertain any direct business deal which enforces transparency in the system. The applications POE centers can be deployed on the public cloud's server, on storage systems, and on the defined networks so that accessibility and availability to these services can be made easier, faster and reliable.

Public clouds are best fit in the developing countries because the expertise accident alerting can be made simpler and responsive. Traffic and accident cloud services play vital role in diminishing the accidents rate, death rate by proving the flexible and responsive cloud system. This can be used as a support system to cyber infrastructure used by police, hospitals.

Private clouds are constructed for handling secure and sensitive information. These are mainly designed for the limited use of agencies like insurance companies, which can provide the maximum control over the information, security, and quality of service for the vehicle, life insurance agencies. The insurance providers has special infrastructure and has a control over their application's architecture for the matter of insurance claims and finding the true causes about the accidents. The Private clouds can be deployed on premise datacenter, may also be deployed at a collocation facility focuses on specific requirement then the government.

Hybrid clouds leverages the features of both public and private cloud type. Hybrid cloud facilitates cost-effective, on-demand, scalable facilities. Hybrid cloud is helpful to private cloud with an extension collaboration of public cloud environment. Hybrid cloud can be very useful for traffic police and trauma center.

Cloud computing can illustrate the services being provided at any of the layers from hardware resources to built applications. The police and insurance companies are interested in the vehicle and the driver while hospital need for both. The cloud computing provides services in SPI model. Typically, the cloud computing likes to offer services in three categories:

- i. Software as a service (SaaS)
- ii. Platform as a service (PaaS)
- iii. Infra as a service (IaaS)

IV. PROPOSED SYSTEM

The proposed system has four main levels, which are:

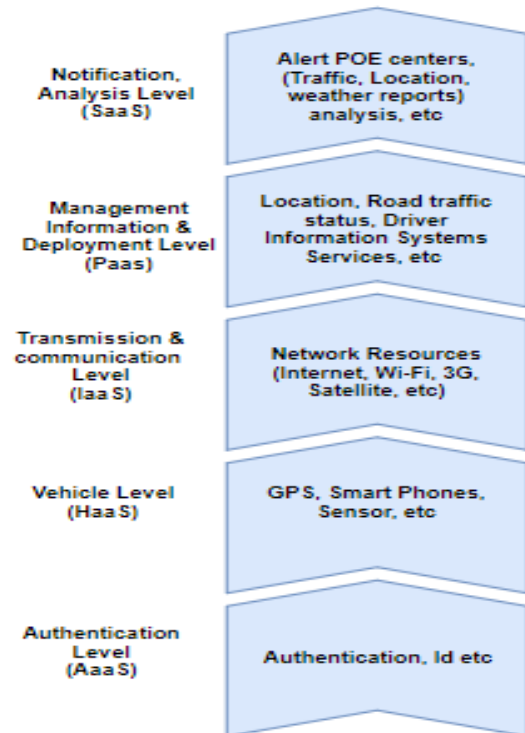


Fig 2:- Different levels in cloud system

1. Authentication as a Service (AaaS): This level is to increase the authenticity of vehicles. This is a registration process done by the Certification Authority (CA). Upon successful registration CA provides the static unique Identity key for each vehicle that is useful for further communication.
2. Vehicle level (HaaS): This level is used to detect the problem or abnormal behavior of the vehicle system and transmit this information to the closest data center. The GPS, smart phone, sensors are useful to collect the relevant information like location, speed and behavior of car etc. which is implemented in this layer of the cloud.
3. Transmission & communication level (IaaS): This level is mainly responsible for data transmission. It is used to support the vehicle system to transmit and receive the information across the layers using tools and technologies as a medium.
4. Information management & Deployment level (PaaS): the layer is responsible for analysis of the collected data. The data collected is related to car, car-driver, weather and accident location are analyzed and processed. This helps to conclude the context information, implement the data analysis and resulting the valuable information which helps in decision making.
5. Notification level (SaaS): This level discusses the ways to send notification.
 - a) POEs: The data about location, speed, weather and driver is received at the simple storage service (S3 in AWS) of the cloud computing. This data will be processed and send notification alerts to the Point of Emergency (POE) centers like nearest hospitals, Fire engine station, Police station and Traffic control station. This increase

situation awareness and reduce or eliminate road blocking and crashes.

- b) Proximity Value Notification: Along with POE centers, it is also important send a prior notification alert to all the authenticated vehicles in affected location within a radius of 2 km. This helps to prevent traffic jam.
- c) Autonomous distress signal carrier notification: This notification comes into picture when a vehicle has poor Internet connectivity. An affected vehicle will send the distress signal to the nearest available, authenticated, connected vehicle using Dedicated short-range communications (DSRC) technology which will carry forward it to the cloud system. The cloud system will process the metadata or collected information and send the notification alert to nearest POEs followed by implementation of step 5(b).

V. A DEEP STUDY FOR OPTIMIZING A PATH TO POES

The proposed system utilizes authentic user attributes for notifying POEs in an optimized way. The user attributes are collected from the user at the time of registration in step 1. When an incident happens, the proposed system will take the static and also dynamic information such as contact numbers and geo-location etc for the best path analysis. The required attributes are listed below for each POE.

Hospital: Distance, Traffic, Response Time, Action Time, Rating

Police Department: Distance (nearest and second nearest police station)

Traffic Department: Nearest traffic control room

Insurance company (Person & Vehicle): The contact center of the insured company

Fire Station (Optional): Fire-station will be informed based on the severity of the accident.

Hospitals, Police department, Traffic department, Insurance Company and Fire station are notified based on the dynamic data such as the geographical location. This paper mainly focuses on saving the life of an injured person by admitting him/her in a hospital in a fastest way possible.

In this paper, we have developed a formula which helps the cloud system to find best suitable hospital by its attributes mentioned in above table. Cloud system receives

distance and traffic data from the accident location dynamically soon after an accident takes place. Action time and response initially set to zero.

- Response time is the time taken to accept an emergency notification request sent by the cloud system after it has reached the hospital network.
- Action time is defined as the time taken to bring the injured person to hospital since the inception of acknowledging/accepting an accident request.
- Action speed is defined as:

$$= \left[\frac{\text{Total distance covered in a particular action time}}{\text{Action time}} \right]$$

- Rating is defined as the average of the action speed related to the number of cases a hospital has accepted. This rating is taken every week or month to keep the performance high.

$$= \left[\frac{\sum \text{Action speed}}{\text{Number of cases accepted}} \right]$$

VI. ANALYSIS FOR OPTIMIZING THE RESPONSE TIME

This algorithm study will find the best solution for early ambulance service. In this analysis, we have considered the real time situation by taking into account two nearest hospitals in the proximity of the accident site. In the below table, '0' represents the hospital has not responded and '1' represents the hospital has responded after distress signals are sent to the nearest hospitals. Here, we have considered two scenarios where in Case 1, the distance between the two nearest hospitals are less than or equal to five kilometers and in Case 2, where the distance between them is more than five kilometers.

H1 – Hospital of Best Choice (Least distance from the accident site)

H2 – Hospital of Second Best Choice

'0' – Nil Response received from hospital

'1' – Hospital has responded

Case 1 (Distance between H1 and H2 is 5 kilometers or less)			
H1	0	1	0
H2	0	0	1
Action Taken	Waiting for response	H1 is chosen	H2 is chosen

Table 1

Case 2 (Distance between H1 and H2 is more than 5 kilometers)				
H1	0	1	0	1
H2	0	0	1	1
Action Taken	Waiting for response	H1 is chosen H2 is on standby mode	H2 is chosen Waiting for H1 response	Refer to comparison technique

Table 2

Computation of the comparison technique:

If $(Xh2 \geq (|D(H1) - D(H2)| * (3/4)))$

select H2

else

select H1

Where

Xh2 = Distance covered by H2 hospital ambulance.

D (H1) = Distance between the accident location and H1

D (H2) = Distance between the accident location and H2

VII. CONCLUSION

Cloud computing is an emerging new model for Information Technology. Life challenges like accident alerting system needs lot of infrastructure, experts and services from various fields. It is an attempt made in this paper to minimize the loss of life by handling the situation properly with the help of cloud computing system. There are many benefits of unlimited storage, data processing power and the ability to share information.

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