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Newfangled Approach for Traffic Analysis Using Internet Of Things

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ABSTRACT:- Internet Of Things(IoT) is a revolution in the field of Science and Technology which connects physical devices with the sensors embedded on it. However this paper starts from the basics of IoT discuss about its cloud centric architecture. It also discuss about the MQTT protocol which is important in transferring messages. Later on we discuss with a case study on traffic analysis to understand its working procedure.

Keywords:- Intelligent System of Systems, Internet of Objects, Publish Subscribe.

I. INTRODUCTION

Internet Of Things (IoT) makes everything on the earth get connected with the sensors. The roots of IOT dates back to 1999 when MIT started working on the Radio Frequency Identification (RFID) emerging sensing technologies. Over a decade ago only one or two devices are connected over internet. But now there are many devices connected to the internet including television, refrigerators, video player etc… According to USA sensex by 2020 there will be 50 billion devices connected to internet and there will be 7.6 billion alive.
Therefore on an average there will be 6.6 objects per person connected to internet.

II. IMPLEMENTATION PROCEDURE

Let us know how do these connected devices work. Virtually every animate inanimate objects on earth could be generating and transmitting the data. We embed sensors and chips on each physical device. That sensor will send the data to the IoT platform. This platform integrates data from different systems and perform data analytics. As billions of devices are connected to each other over the cloud connected devices become intelligent system of systems and also known as Internet of Objects.

Fig 1: Interconnection of devices

III. ARCHITECTURE

Lets understand the cloud centric architecture of internet of things. The vision of IoT can be seen from two perspectives—'Internet' centric and 'Thing' centric. The Internet centric architecture will involve internet services being the main focus while data is contributed by the objects. In the object centric architecture, the smart objects take the center stage. In our paper, we see an Internet centric approach. A conceptual framework

integrating the ubiquitous sensing devices and the application is shown in the fig 2. In order to realize the full potential of cloud computing as well as ubiquitous sensing, a combined framework with the cloud at the center seems to be most viable. This not only gives the flexibility of dividing associated cost in the most logical manner but is also highly scalable. Sensing service providers can join the network and offer data using a storage cloud; analytical tool developers can provide their software tools; artificial intelligence experts can provide their data mining and machine learning tools useful in converting information to knowledge and finally computer graphics designers can offer a variety of Visualization tools. Cloud computing can offer these services as Infrastructures, Platforms or software where the full potential of human creativity can be tapped using them as services. This is in some sense agrees with the ubicomp vision of Weiser as well as Rogers' human centric approach. The data generated, tools used and the visualization created disappears into background, tapping the full potential of the Internet of Things in various application domains. As can be seen in the fig 2, the Cloud integrates all ends of ubicomp by providing scalable storage, computation time and other tools to build new businesses. In this section, we describe the cloud platform using Manjrasoft Aneka and Microsoft Azure platforms to demonstrate how cloud integrates storage, computation and visualization paradigms. Furthermore, we introduce an important realm of interaction between clouds which is useful for combining public and private clouds using Aneka. This interaction is critical for application developers in order to bring sensed information, analytics algorithms and visualization under one single seamless framework. However, developing IOT applications using low-level cloud programming models and interfaces such as Thread and Map-Reduce models is complex. To overcome this, we need a IOT application specific framework for rapid creation of applications and their deployment on Cloud infrastructures. This is achieved by mapping the proposed framework to Cloud APIs offered by platforms such as Aneka. Therefore the new IOT application specific framework should be able to provide support for (1) reading data streams either fro sensors directly or fetch the data from databases. (2) easy expression of data analysis logic as functions/operators that process data streams in a transparent and scalable manner on Cloud infrastructures, and (3) if any events of interests are detected, outcomes should be passed to output streams, which are connected to a visualization program. Using such a framework, the developer of IOT applications will able to harness the power of Cloud computing without knowing low-level details of creating reliable and scale applications. A model for the realization of such an environment for IoT applications is shown in Fig. 3, thus reducing the time and cost involved in engineering IOT applications.

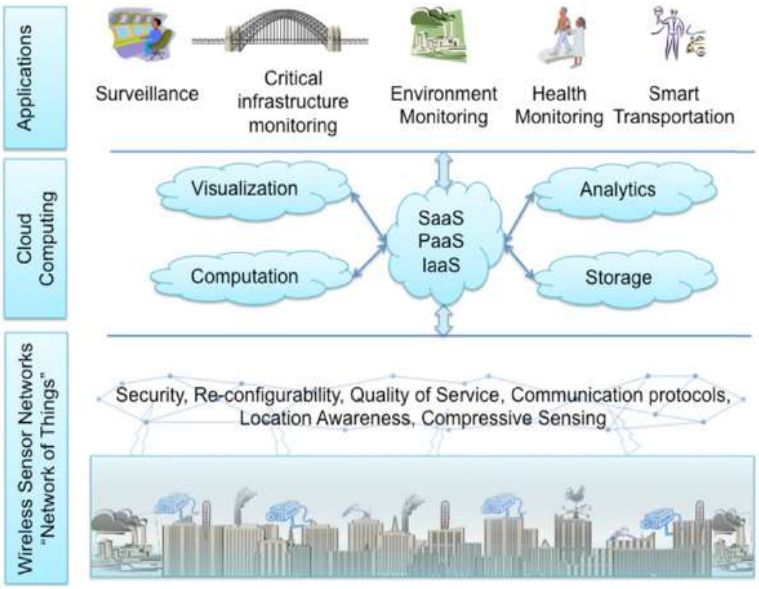

Fig 2: Conceptual IOT framework with Cloud at center

Aneka Cloud Computing Platform:

Aneka is a .NET-based application development Platform-as-a-Service (PaaS), which can utilize storage and compute resources of both public and private clouds . It offers a runtime environment and a set of APIs that enable developers to build customized applications by using multiple programming models such as Task Programming, Thread Programming and MapReduce Programming. Aneka provides a number of services that allow users to control , auto-scale reserve, monitor and bill users for the resources used by their applications. In the context of Smart Environment application, Aneka PaaS has another important characteristic of supporting the provisioning of resources on public clouds such as Microsoft Azure, Amazon EC2, and

GoGrid, while also harnessing private cloud resources ranging from desktops and clusters, to virtual. An overview of Aneka PaaS is shown in Fig 4. For the application developer, the cloud service as well as ubiquitous sensor data is hidden and they are provided as services at a cost by the Aneka provisioning tool. Automatic management of clouds for hosting and delivering IoT services as SaaS (Software-as-a-Service) applications will be the integrating platform of the future internet. There is a need to create data and service sharing infrastructure which can be used for addressing several application scenarios. For example, anomaly detection in sensed data carried out at the Application layer is a service which can be shared between several applications. Existing/new applications deployed as a hosted service and accessed over the Internet are referred to as SaaS. To manage SaaS applications on a large scale, the Platform as a Service (PaaS) layer needs to coordinate the cloud (resource provisioning and application scheduling) without impacting the Quality of Service (QoS) requirements of any application. The autonomic management components are to be put in place to schedule and provision resources with a higher level of accuracy to support IoT applications. This coordination requires the PaaS layer to support autonomic management capabilities required to handle the scheduling of applications and resource provisioning such that the user QoS requirements are satisfied. The autonomic management components are thus put in place to schedule and provision resources with a higher level of accuracy to support IOT applications. The autonomic management system will tightly integrate the following services with the Aneka framework: Accounting, Monitoring and Profiling, Scheduling, and Dynamic Provisioning. Accounting, Monitoring, and Profiling will feed the sensors of the autonomic manager, while the managers' effectors will control Scheduling and Dynamic Provisioning. From a logical point of view the two components that will mostly take advantage of the introduction of autonomic features in Aneka are the application scheduler and the Dynamic Resource Provisioning.

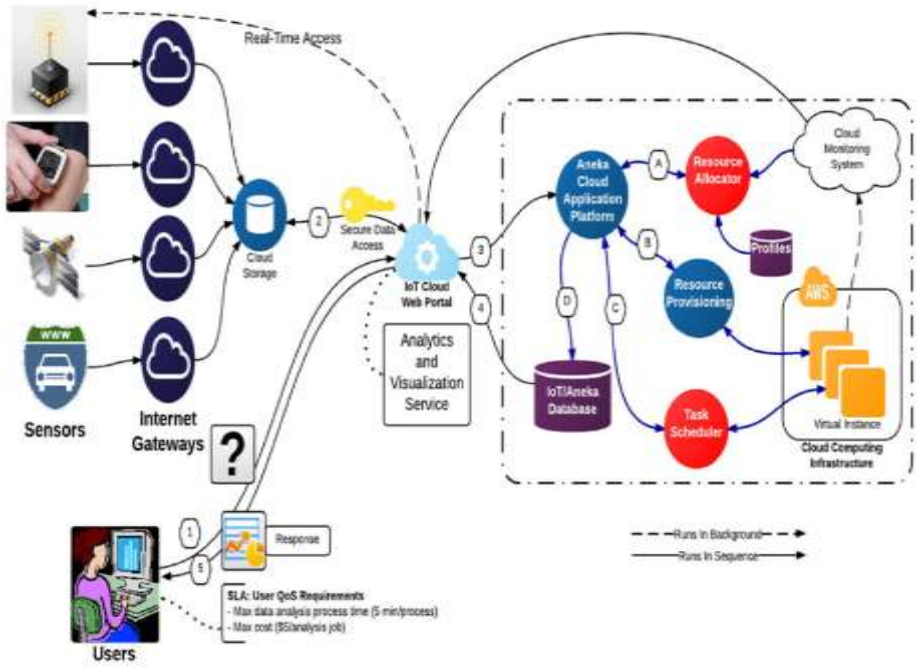

Fig 3: A model of end to end interaction between various stake holders in cloud centric IOT framework.

Application scheduler and Dynamic Resource Provisioning in Aneka for IoT applications:

The Aneka scheduler is responsible for assigning each resource to a task in an application for execution based on user QoS parameters and the overall cost for the service provider. Depending on the computation and data requirements of each Sensor Application, it directs the dynamic resource provisioning component to instantiate or terminate a specified number of computing, storage, and net-work resources while maintaining a queue of tasks to be scheduled. This logic is embedded as multi-objective application scheduling algorithms. The scheduler is able to mange resource failures by re-allocating those tasks to other suitable Cloud resources. The Dynamic Resource Provisioning component implements the logic for provisioning and managing virtualized resources in the private and public cloud computing environments based on the resource requirements as directed by the application scheduler. This is achieved by dynamically negotiating with the Cloud Infrastructure as a Service (IaaS) providers for the right kind of resource for a certain time and cost by

taking into account the past execution history of applications and budget availability. This decision is made at runtime, when SaaS applications continuously send requests to the Aneka cloud platform.

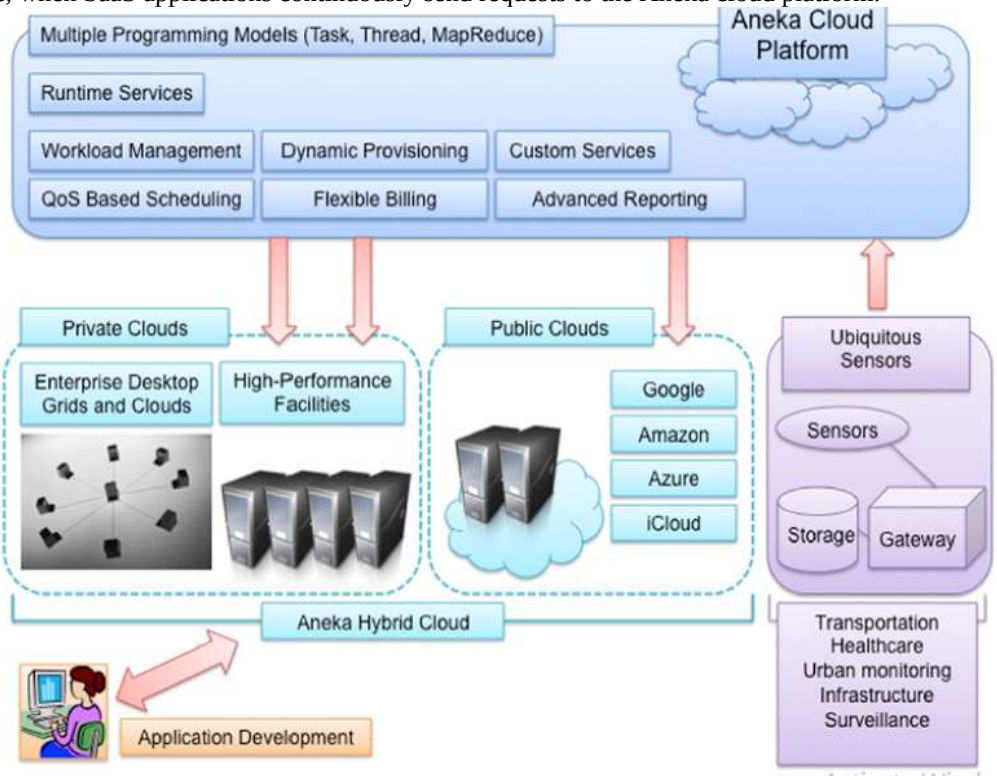

Fig 4: Overview of Aneka with in IOT architecture

IV. MQTT PROTOCOL

We had seen that the messages are passed to the cloud by the sensors but let us know the protocol that implements this feature. MQTT is a machine to machine(M2M) or IoT connectivity protocol. It is formerly known as MQ Telemetry Transport Light weight messaging protocol used on the top of TCP/IP protocol which is used in the real time applications like facebook etc.., It is designed as an extremely light weight protocol. The architecture form a publish/subscribe design. It is useful for connecting devices at remote location.

Architecture

MQTT has a client server model where every sensor act as a client and is connected to a server known as broker over TCP. It is a message oriented protocol where every message is a discrete chunk of data, opaque to broker. Every message is published to address known as "Topic". Each client may subscribe to multiple topics. Every client will receive topics of subscribed topics. Observe the figure 5.

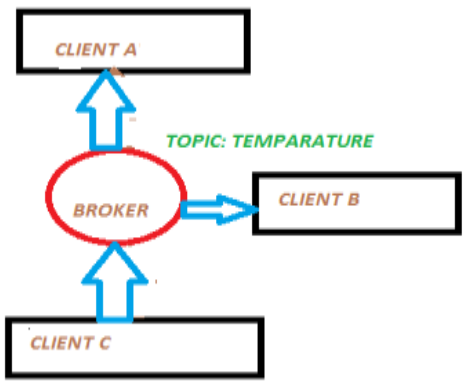

Fig 5: Publish Subscribe architecture of MQTT protocol

In the above figure we observe three clients A, B, C subscribed on the topic Temperature. The client C had updated the value of temperature. The broker has publishing the updated value to other clients A, B.

V. CASE STUDY

In this section we observe practically about working of IoT with a case study. Let us see the example of a smart traffic system of a city. A smart traffic system is the one with camera which monitors traffic , congestion, accident and weather condition by a camera and pass the information over the cloud to city transportation system by a sensor embedded in it. All such traffic systems which are placed at different locations of the city sends the information over the cloud to city transportation system. The gateway integrates data from different traffic systems, analyze it , perform analytics over the data in the cloud.

Assume that traffic on a specific road has been congested due to an accident. Now this information has been sent to city transportation system. We shall see what are the consequence that takes place.

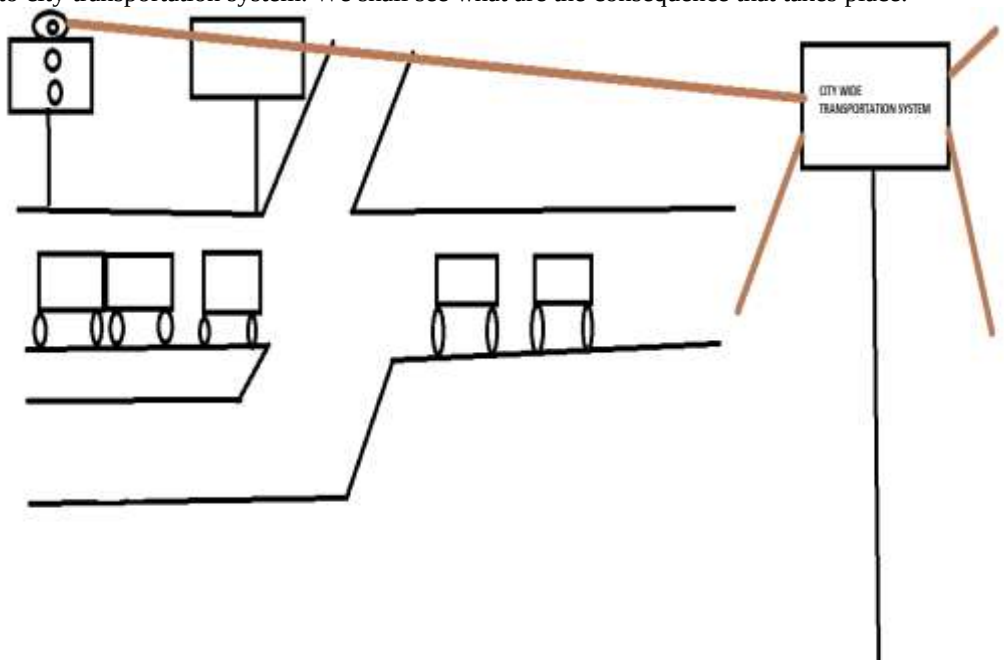

Fig 6: A smart traffic camera identifying congestion and sending the information over the cloud.

VI. DATA ANALYTICS

As we said that analytics are performed over the cloud we shall see what it means. It is a science of examining raw data with the purpose of drawing conclusions. There are three different types of data analytics those are explanatory data analytics, confirmatory data analytics and qualitative data analytics. Data mining is a technique of retrieving more relevant and efficient data from large data set. There are different types of data mining techniques such as hypothesis testing, linear regression, logistic regression, factor analysis and cluster analysis.

In our paper we had performed K-means Cluster Analysis using the Weka tool in order to draw conclusions about the city transportation system. It is a multivariate method. Even though it do not have specific definition it can be said as a method which aims to classify a sample of objects into number of groups such that similar group objects are placed in one group. The clustering analysis can be divided into hierarchal and non hierarchal cluster analysis. Hierarchal can be further classified into Agglomerative and Divisme cluster analysis. K-means clustering can be said as non hierarchal method.

K-means Clustering

It is one of the simplest clustering technique that forms k clusters for n observation. The main idea is to define K centroids one for each cluster which are far from each other. The next step is to take each point belonging to a given data set & associate to nearest center. When no pending point left the step is over and repeat the step by replacing from locating centroids. This process is repeated until the centers don't change. Finally the algorithm aims at minimizing the objective function known as squared error function.

$$J(V) = \sum_{i=1}^{c} \sum_{j=1}^{c_i} \left(\left\| x_i - v_j \right\| \right)^2$$

||Xi-Vj||= Euclidean distance between Xi and Vj
Ci = Number of data points in ith cluster
C = number of cluster centers
The data that had been collected from the different objects were dumped into the Weka tool for processing. The conditions were set to find the efficient route.

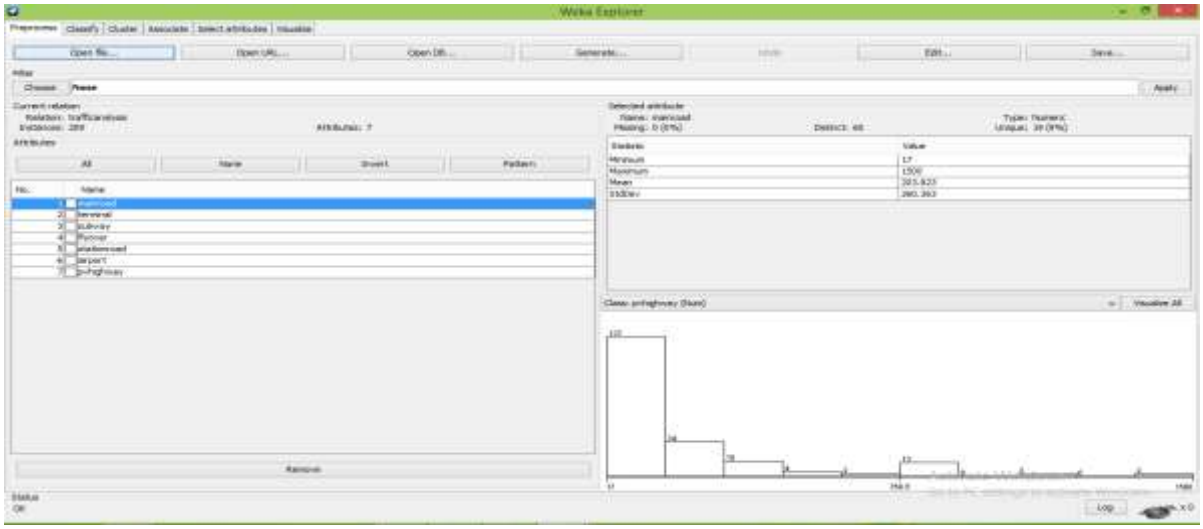

Fig 7: Data dipped (Preprocessed) into the Weka tool

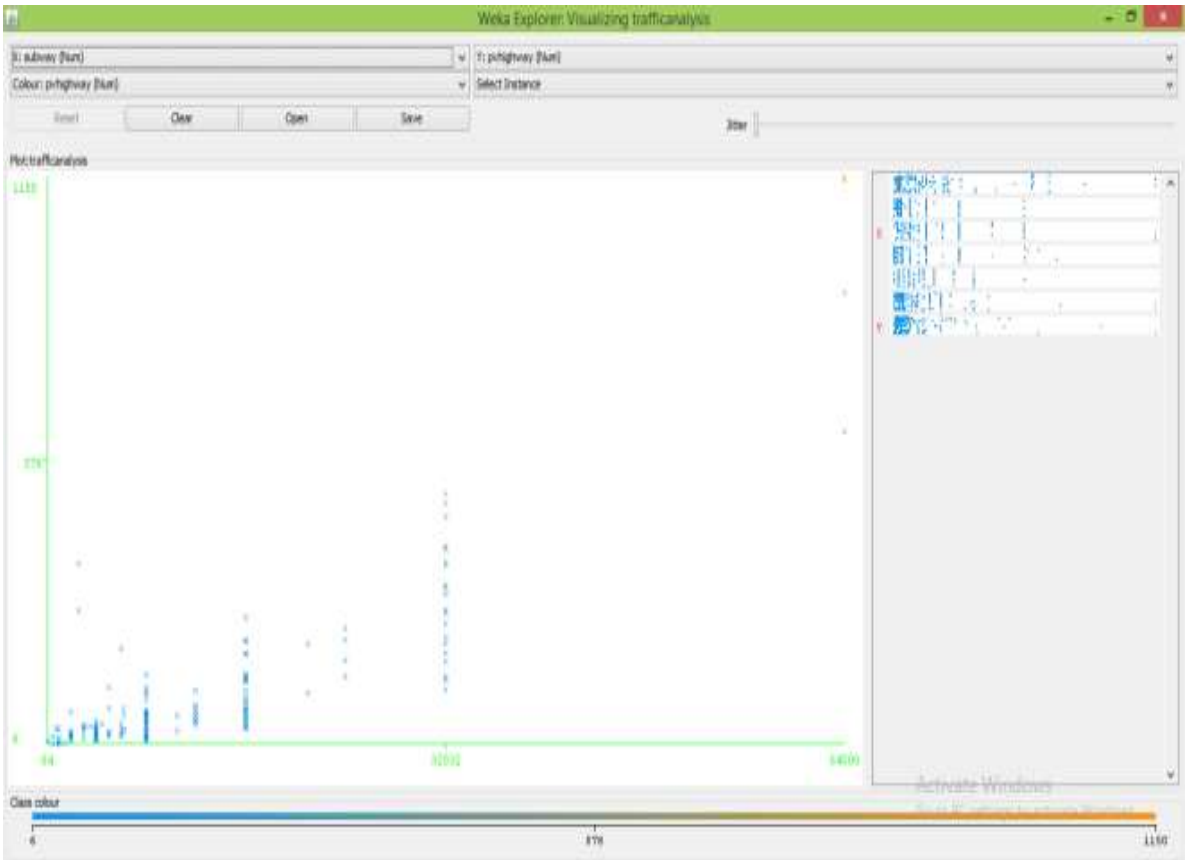

Fig 8: Graph plotted against two attributes.

Results

After performing data analytics using weka tool it is identified that lighter vehicles instead of going on the main road can take diversion through the city subway system to avoid delay due to traffic congestion. It cautions the drivers by displaying the message on digital signal display.

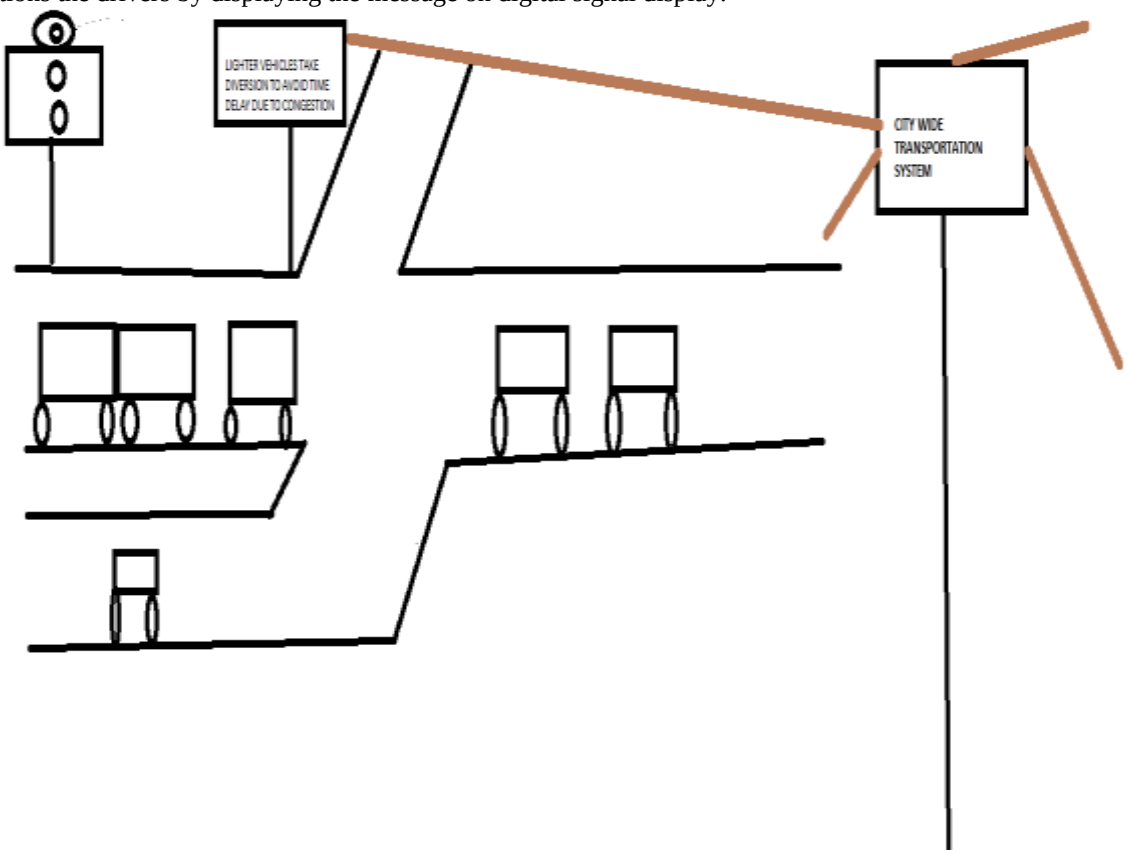

Fig 9: Caution message to drivers of vehicles.

VII. CONCLUSION

Internet of Things plays a vital role in transforming the lives of the people by making devices interconnected. The IoT makes an important role in the field of health care system to diagnosis and generate reports of patients. It help in conserving energy by making the appliances to communicate with each other. It also play vital role in many fields like shopping, communication etc…, Since many devices are connected to the internet and share information over the cloud security of data and maintenance of large diverse network plays a key challenge to IoT. Even though there are few cons about IoT advantages have a cutting edge over disadvantages.

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