# A cloud-based smart traffic management in the internet-of-things (iot) environmen...

Business, Management

Abstract—Road traffic on public roads around the world is a vital problem and is seemly a major pretend to conclusion makers. Urban region have a great stack of traffic jams. Cloud computing is turning a good engineering to provide a potent and scalable computing at low cost. This paper proposes a cloud-controlled smart traffic management system based on Internet-of-Things (IoT).

The proposed system collects vehicle count at various roads with the help of RFID receivers and uses this data to manage traffic efficiently. It will be capable of overcoming all the pain points observed with minimum cost and best-in-class quality of services.

Index Terms— Traffic Management, Cloud Computing, Internet of Things (IoT), Radio-frequency identification (RFID), Service Oriented Architecture (SOA)

# Introduction

The traffic on public roads around the world is a vital problem and is seemly a major pretend to conclusion makers. Urban region have a great stack of traffic jams. The existing methods are not accurate in terms of performance and cost for traffic management and its control. The thought to handle traffic in a feasible way motivates researchers to propose various traffic management systems. To efficiently intervene into such a system we need at first to create its model being able to simulate behaviour of its elements on various levels.

In our day-to-day life we all spend hours for travelling. In one way or another, we all are part of traffic system. Below are the pain points I observed in the current traffic system-

- Absence of central controlling
- Signal lights are pre-programmed and it will not consider the traffic density
- Vehicle location monitoring is lacking
- Issues related to fault finding and maintenance

The existing methods are not accurate in terms of performance and cost for traffic management and control. Typically, the traffic signals are managed by a controller inside a cabinet which is placed on a concrete grid. Some electro-mechanical controllers are still in use. As the number of road users increases, Traffic management will turn a highly significant topic. As time andtechnologyruns fast and we see advancement everywhere, the success of any implementation will be based on its smartness. And, it must be feasible too.

This paper proposes a cloud-controlled smart traffic management system based on Internet-of-Things (IoT). Cloud computing permits the systems and users to utilize Platform as a Service (PaaS) provider offer several environments to users for development of applications. The user can develop applications according to their requirements. Infrastructure as a Service (IaaS) that provides virtualized computing resources over the internet and Software as a Service (SaaS) provides software or application on the internet and customer used these, with no knowledge of development or maintenance.

Modern vehicles are increasingly equipped with a large amount of sensors, actuators, andcommunicationdevices (mobile devices, GPS devices, and embedded computers). In particular, numerous vehicles have possessed powerful sensing, networking, communication, and data processing capabilities, and can communicate with other vehicles or exchange information with the external environments. We are in an era of such technology advancements.

As we foresee a financially feasible yet smart traffic management, our proposed system uses RFID receivers to sense vehicle movement through roads. The placement of RFID receivers on roads by keeping certain distance from junction can help us to collect the vehicle count. RFID receivers sense the RFID tag each vehicle holds and passes this information to cloud with the help of a controller. As the data passes to cloud, the vehicle density at various roads can be processed effectively to provide proper signal on roads.

The advances in cloud computing and internet of things (IoT) have provided a promising opportunity to address the increasing transportation issues, such as heavy traffic, congestion, and vehicle safety. When combining Cloud with IoT, there are certain advantages withrespectto scalability, accessibility, money, time, data security, collaboration, etc. When IoT encourages communication between devices cloud makes it possible for handling all related processes on low cost. And acts as a global resource.

# Methodology

System Descriptions

The system consists of two major parts: electronic system, and software system. The electronic system consists of communication between microprocessor, traffic lights, and sensors, whereas software system includes Signal processing algorithm, cloud server, control system, and monitoring application for the intended authority.

The first part of the system is to track vehicle movement direction and count to calculate the density on each signal area. For that RFID receivers are to be placed on roads keeping a planned distance from the signal junction. Vehicles will be associated with RFID tag. RFID tags can be tracked with the help of RFID receivers. It senses the vehicle movement and count will be sent to cloud for processing further. The density details can be derived from the collected information and the processing related to traffic management will be carried at cloud. Based on the suggested algorithm, traffic signal on various roads can be handled with ease.

While cloud computing is currently a term without a single consensus meaning in the marketplace, it describes a broad movement toward the use of wide area networks, such as the Internet, to enable interaction between IT service providers of many types and consumers. Service providers are expanding their available offerings to include the entire traditional IT stack, from hardware and platforms to application components, soft ware services, and whole applications, as shown in

Figure 1. The common thread in cloud computing offerings across all levels of the stack is the consumer/provider relationship and a dependence on the network to connect the two parties.

Cloud Infrastructure —At the bottom of the cloud stack, Cloud Infrastructure provides the distributed multi-site physical components to support cloud computing, such as storage and processing resources. This layer allows the infrastructure provider to abstract away details such as which exact hardware an application is using and which data center the application is running in.

Cloud Storage —Storage as a service—Building upon the Cloud Infrastructure, this layer of the cloud stack is focused on the incremental renting of storage on the Internet, formerly called Utility Computing. Many offerings in this area are also enabled by underlying advances in server virtualization. Network-based large-scale storage on demand is an example of this layer of cloud computing. Some offerings go further and offer platforms for service providers, including storage, security, identity management, and other functions.

Cloud Platform— Platform as a service— Platform offerings provide an infrastructure for developing and operating web-based soft ware applications. Examples include facilities for application design, application development, testing, deployment, and hosting, as well as application services such as team collaboration, security, application versioning, and application instrumentation.

Cloud Services— Components as a service—This layer of the cloud computing stack includes the definition of soft ware components, run in a distributed fashion, across the commercial Internet. This definition is most like SOA, which is discussed below, with defined service interfaces as a basis for system-to-system integration.

Cloud Applications—Soft ware as a service (SaaS)—This definition relies on the cloud for access to what would traditionally be local desktop software. For example, Adobe's Photoshop, a program to manipulate images, was distributed to end users on disks for many years. Today, you still can install a version of Photoshop from an installation disk, or you can go to a completely online version of an analogous application, entitled Express.

In the online Express, you can upload your images into a hosted file area and work on the images with the same filters and capabilities that were found in the traditional soft ware version. Express is an example of SaaS, though this is not the only form SaaS can take.

Cloud Clients— Another application-related function of cloud computing focuses on the distribution of business and personal data across servers on the Internet. For example, an individual may have personal data in Facebook, digital photos in Flickr, banking data in bank servers, insurance data in insurance company servers, and on and on, all available in distributed servers and data centers around the world.

Multilayer approaches and SOA have been proposed as the main architecture to construct various vehicular cloud service platforms. Service-Oriented

Architecture (SOA) builds on computer engineering approaches of the past to offer an architectural approach for enterprise systems, oriented around the offering of services on a network of consumers. A focus of this service-oriented approach is on the definition of service interfaces and predictable service behaviors.

A set of industry standards, collectively labeled " Web Service" standards in this paper, provide and implement the general SOA concept and have become the predominant set of practical tools used by enterprise engineers for current SOA projects. Some Web Service standards have become foundational and more widely adopted, while many are still seeking broad industry or Government acceptance.

SOA offers positive benefits such as:

Component reuse: Given current Web Service technology, once an organization has built a soft ware component and offered it as a service, the rest of the organization can then utilize that service. With proper service governance, emphasizing topics such as service provider trust, service security, and reliability, Web Services offer the potential for aiding the more effective management of an enterprise portfolio, allowing a capability to be built well once and then shared. Multiple components can be combined to offer greater capabilities in what is oft en termed " orchestration."

Organizational agility: SOA defines building blocks of soft ware capability in terms of offered services that meet some portion of the organization's requirements. These building blocks, once defined and reliably operated, can be recombined and integrated rapidly.

Leveraging existing systems: One common use of SOA is to define elements or functions of existing application systems and make them available to the enterprise in a standard agreed-upon way, leveraging the substantial investment already made in existing applications. The most compelling business case for SOA is often made regarding leveraging this legacy investment, enabling integration between new and old systems components.

The Internet of Things (IoT) - is defined as a paradigm in which objects equipped with sensors, actuators, and processors communicate with each other to serve a meaningful purpose. More than 85% of systems are unconnected and do not share data with each other or the cloud. One such technology that facilitates the interconnection is the Internet of Things (IoT). IoT also means making devices smarter, by connecting them online to acquire and process data.

The integration of sensors and communication technologies provides a way for us to track the changing status of an object through the Internet. IoT explains a future in which a variety of physical objects and devices around us, such as various sensors, radio frequency identification (RFID) tags, GPS devices, and mobile devices, will be associated to the Internet and allows these objects and devices to connect, cooperate, and communicate within social, environmental, and user contexts to reach commongoals. IoT technologies make it possible to track each vehicle's existing location, monitor its movement, and predict its future location.

By integrating with cloud computing, wireless sensor network, RFID sensor networks, satellite network, and other intelligent transportation technologies, a new generation of IoT-based vehicular data clouds can be developed and deployed to bring many business benefits, such as predicting increasing road safety, reducing road congestion, managing traffic, and recommending car maintenance or repair.

## Proposed System

Consider a junction where three roads – A, B, C are joining. Each road has dividers shown by dotted line. In each road, two RFID detectors are fixed to count traffic in and out of the junction. Here, total six RFID detectors are used. Direction of vehicle movement is also shown in the figure.

RFID receivers to sense the traffic towards the junction and out from the junction are shown separately. Consider, car 'X' moving towards junction through Road C. Then, 'X' will be sensed by C-in sensor. If 5 more cars are approaching the junction through Road C then, the total cars count in C-in sensor will be 6 (including 'X'). These 6 cars must go out of the junction and it will be sensed by A-out, B-out or C-out (if 'U-Turn').

In cloud,

- Create a new junction
- Edit the properties of junction such as,
- Junction name

- Number of roads meeting
- Road names
- Road priority
- Number of sensors used
- Density
- Time out
- Location of each sensor

After setting properties, a table as shown below will be formed in the database. Let the table name be the Junction name

Road No Road Name In Sensor Out Sensor Priority Density Max Density Min Time out

1. A A-in A-out 1 25 7 60
2. B B-in B-out 2 30 12 40
3. C C-in C-out 3 45 15 30

Table 1 – Sample database table

The database will have enough information to handle the traffic in a smart way. The proposed working is as follows-

- Step 1: Start
- Step 2: The number of roads meeting at a junction (says the junction of interest) can be retrieved from the database and it needs to be assigned to a variable 'n'.
- Step 3: A memory location 'x' to be created to hold 'n' characters.

- Step 4: Set Most Significant Byte of 'x' as 1 and all remaining bytes as 0.
- Step 5: Start timer
- Step 6: From database, retrieve the number of vehicles moving towards a junction through each roads.
- Step 7: Check if traffic density on highest priority road is less than its planned minimum density. If yes, goto step 8. Otherwise, goto step 9.
- Step 8: Clear MSB of 'x' and restart timer. Goto step 10.
- Step 9: Check if time out of highest priority road less than or equal to timer. If yes, goto step 8. Otherwise goto step 6.
- Step 10: Check if traffic density on second highest priority road is less than its planned minimum density. If yes, goto step 11. Otherwise, goto step 12.
- Step 11: Clear second MSB of 'x' and restart timer. Goto step 15.
- Step 12: Set second Most Significant Byte of 'x'.
- Step 13: Check if time out of second highest priority road less than or equal to timer. If yes, goto step 11. Otherwise goto step 14.
- Step 14: Retrieve the number of vehicles moving towards a junction through each roads. Goto step 10.
- Step 15: Check if traffic density on nth highest priority road is less than its planned minimum density. If yes, goto step 16. Otherwise, goto step 17.
- Step 16: Clear LSByte of 'x' and restart timer. Goto step 6.
- Step 17: Set LSByte of 'x'.

- Step 18: Check if time out of nth highest priority road less than or equal to timer. If yes, goto step 16. Otherwise goto step 19.
- Step 19: Retrieve the number of vehicles moving towards a junction through each roads. Goto step 15.
- Step 20: Stop

The above flow will be continued throughout traffic management.

Flowchart

1. Flowchart for Cloud computing

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2. Flowchart to handle light signal

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## Conclusions

IoT-based vehicular data clouds are expected to be the backbone of future ITSs with the ultimate goal of making driving safer and more enjoyable. However, research on integrating IoT with the vehicular data clouds is still in its infancy and existing study on this topic is highly insufficient. To make vehicular data clouds useful, numerous services, such as road navigation, traffic management, remote monitoring, urban surveillance, information and entertainment, and business intelligence, need to be developed and deployed on vehicular data clouds.

A number of challenges such as security, privacy, scalability, reliability, quality of service, and lack of global standards still exist. Due to the complexity involved in implementing vehicular clouds and integrating various devices and systems with vehicular clouds, a systematic approach and collaboration among academia, the automobile companies, law enforcement, government authorities, standardization groups, and cloud service providers are needed to address these challenges.

FUTURE ENHANCEMENTS

In future, the system can be improved to handle emergency vehicles and their easy movement. Also, there is scope for enhancement with respect to pedestrian

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