Smart Public Transport using IoT Technology

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Abstract- *Reliability in public transport is of great importance today. Millions of people travelling by public buses waste a lot of time waiting at bus stops. This paper focuses on presenting a solution to tackle the said problem by harnessing IoT technology stack. If the people travelling get accurate real time location of the buses along with estimate time for arrival at bus stop based on the real time traffic conditions, it will facilitate an overall increase in reliability on the public buses. The solution proposed in this paper involves using the existing internet enabled devices on the bus (like the e-ticketing system) or a simple android tablet to capture the real time location and send to the servers. Accessing this location data from servers will be facilitated by Representational State Transfer (REST) APIs which users can access through android application, SMS or web-portals. The system proposed will have distributed architecture in order to tackle high number of requests from users. Although there are existing solutions which harness the use of Global Positioning System (GPS) for bus tracking, they aren't ready to handle high demand on the backend which will exist in the near future. We have addressed this problem. The primary contribution of this paper is that it shows that a backend based on Message Queue Telemetry Transport (MQTT) instead of the traditionally used Hypertext transfer protocol (HTTP) based REST will be light weight, data efficient and scalable. We have proposed and implemented the backend as well as the front end required for the tracking system and presented the improvements.*

I. INTRODUCTION

Transportation is a major pain area for cities today. With the ever increasing load on public transport systems, it is really necessary to increase efficiency in these systems. Due to extreme traffic condi- tions, over-crowding and many other similar issues, public buses lack punctuality and reliability. There is a dire need to tackle this issue. The required solution should not only facilitate improvement in the services, but should also be a driving factor for increase in trust on the public bus transport systems. Reliability in public transport will be facilitated when the traveller accurately knows when a bus will arrive to the bus stop or when will the bus reach the destination.

The solution proposed in this paper harnesses the real time lo- cation of the buses to calculate the estimated time for reaching a particular position. By saving location data on the server along with corresponding timestamps, we can estimate the time for the bus to arrive as a bus stop, or time to reach a destina- tion, using services like Google maps.

II. IDENTIFY, RESEARCH AND COLLECT IDEA

Many passengers are usually late to work as a result of they decide to anticipate the bus rather than simply merely using another alternate transportation. A variable message shown on the web which will be real time info regarding the bus showing the time of arrival at a particular bus stop might scale back the anxiety of passengers expecting the bus. With the advent of GPS and also the ubiquitous cellular network, real time vehicle tracking for higher transport management has become attainable. These technologies can be applied to conveyance systems particularly public buses, those are not ready to adhere to predefined timetables owing to reasons like traffic jams, breakdowns etc. The increased waiting time and the uncertainty in bus arrival build conveyance system unattractive for passengers. The time observance and real-time bus position system uses GPS technology alongside totally different application to fetch knowledge and with code that displays the information online on with different buses on a special route to the user. When this info is conferred to the traveler by wired or wireless media or online internet media, they can use their time with efficiency and reach the stop simply before the public bus arrives, or if the bus is delayed. They can even arrange their journeys long before they really undertake them.This will build the general public transport system competitive and passenger friendly. The use of personal vehicles is reduced when additional individuals use transit vehicles, which in turn reduces traffic and pollution.

III. GOAL AND OBJECTIVES

- E-ticketing systems
- Android tablet phones
- Crowd sourcing location data
- IOT BACKEND ARCHITECTURE

IV. PROPOSED SYSTEM

The data collected from a source needs to be sent to servers efficiently and reliably. It should be stored in a way such that users can query it and should be available even when there is a heavy load on the servers due to huge number of people querying it.The solution involves light weight protocol to send the collected data to databases. There are many protocols that can be used to achieve this. However, MQTT will best serve this use-case due to its low bandwidth usage and support scalability. MQTT backend can be easily scaled up by clustering of its brokers. Once the server gets the data, it will store it in NoSQL database like MongoDB which will be distributed and have multiple instances to enable load balancing. Users can then query bus locations from these databases. In MQTT protocol, there is a broker(server) that contains 'topics'.Topics are the way to determine who receives the data generated by a sender. A receiver has to 'subscribe' to a topic to receive data 'published' with that topic by any senderThe location data published over MQTT from the buses will have the route number as topic. Location data comprising of the current latitude and longitude of a bus will be published at a frequency of 5 seconds and will still consume less bandwidth because of the use of MQTT. To make the system scalable, the MQTT brokers will be clustered as shown in Fig. 3. The clustered MQTT brokers act together as one broker. Every broker in the cluster will maintain the topics list. When one broker is unavailable, another broker handles the request. This way, the brokers balance within themselves. This clustering ensures that the system is highly available. Even if one server goes down, other servers will be there in its place to handle the requests and data.The server will receive the location data through MQTT and will store it in a database collection for that particular route number.

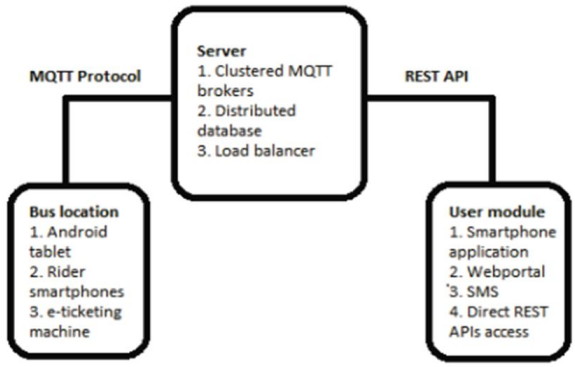

Fig. 1. Overview of the proposed solution

Figure 1.

This can be done by directly modifying the MQTT broker to write to database when data is received or by creating a MQTT client to do so.

The solution proposed will enable users to easily fetch the live locations of the buses and thus know the estimated time for arrival and also the time to reach the destination.

System also providing crowd sense mechanism so that user will be aware of place available. By knowing this time, users will benefit as they can now plan their travel very accurately. The public bus service will become more efficient and reliable due to availability of real time data.

- **To calculate shortest Distance**

La1: User latitude
Lo1: User longitude La2: Bus stop latitude Lo2: Bus stop longitude
Dlon: Lo2 – Lo1
Dlat: La2 – La1
R: Radius of earth

A=(sin(Dlat/2))^2+cos(La1)*cos(La2)*(sin(DLon/2))^2 C
= 2 * tan-1(sqrt(A),sqrt(1-A))

Distance = R * C

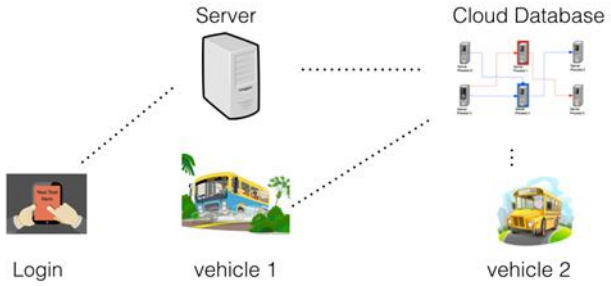

Figure 2.

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