Smart Vehicle Tracking System through IoT

ABSTRACT

This study evaluates the importance of connecting objects through the concept of Internet of things (IoT). There has been an increasing trend in the topic of Internet of Things in various sectors. Almost all, such as area, devices, software are connected to each other which all can be accessed remotely or virtually through smart devices. The most typical invention is smart phone which acts like a computer some time even smarter, connected with web & internet. But the new term smart homes where all the devices and machineries are connected together to ensure all smart process. This can be extended to smart village, smart city and smart industry. Here we introduce vehicle tracking system by using the concept IoT. MQTT is a protocol commonly used in the IoT platform to share information. It can be used for both publish and subscribe data from one end to another. Here we have used the same technique to design a simulation to track the exact location of a given vehicle. IOT broker and the smart devices were integrated with the middleware (ESB) architecture and the simulation run with numerous geolocations.

Keywords: {IoT, ESB}

1. INTRODUCTION

The tremendous invention of transformation of technology in this century is Internet. It is created for people, by people and about people which plays a prominent role in all fields such as education, commerce, politics and marketing. Internet is already connected the people and the new era of internet is connecting the things. In the comparison of both, first one change the communication styles and the other one change the activities of entire world. Precisely, things you can add ability to communicate, sense touch and control so that it provides the opportunity to collaborate and interconnect things with others. Generally, five senses such as hearing, tasting, seeing, smelling and touching are used for the collaboration among people. Likewise, things get the ability to sense, touch and communicate. This is how internet of people and internet of things intersect.

A typical IoT concept would be illustrated by the perfect morning, for instance a smart belt placed in the wrist gives a small vibration to awake a person while monitoring his/her sleeping cycle. Moreover, it alerts other devices to do their process, such as thermostat gets the message to switch off fans and lights and coffee maker starts to make the coffee. The actual integration of IoT handle by IPV6 and MQTT protocols. Message queue telemetry transport (MQTT) plays the major role in communication of devices due it’s light weight, the efficient of bandwidth usage and the minimum consumption of power. It uses publish – subscribe mechanism as the technique of communication.

MQTT-Broker is the main communication center of the MQTT scenario. Sender can publish data with a topic. Then Topic contains the routing information for the broker. Receiver subscribes the topic to receive messages. The entire idea of MQTT is to keeps senders and receivers independently.
2. MQTT PUBLISH/SUBSCRIBE

The mechanism is bit differ from other technologies of communication. Fig(1) explains the typical concept of IOT. It refers that pulling data from MQTT broker to Client is unnecessary. Therefore, receiver only subscribes the topics and the broker pushes the data, which exactly matches with the topic. Publisher has the authentication to publish data for the relevant topic, but broker only maintains the information regarding the topic which are in the form of strings. Moreover, client can subscribe more than one topic using characters # and +.

Publish
Client can publish messages, once the MQTT broker connects. Publisher can decide the format of the data (binary, text, XML, JSON). PUBLISH message contains following attributes

- **Topic name**: Designed with simple string followed by slashes. Home/Bedroom/Temperature
- **Qos**: Three levels of service level as 0, 1, 2 ensures the delivery of messages
- **Retain Flag**: Flag defines whether the last message is saved by the broker for a particular topic
- **Payload**: Contains the actual message or commands
- **Packet Identifier**: Identifies the messages uniquely. It is applicable only for the levels greater than 0.
- **DUP Flag**: Indicates the duplication of messages which are needed to be sent.

Subscribe
Receiving Clients should subscribe topics to receive a relevant message. Subscriber message is very simple, and it contains the following attributes.

- **Packet Identifier**: Identifies the messages uniquely.
- **List of Subscriptions**: Subscribe message can have plenty of subscriptions. Each subscription identifies by a topic and QoS level

Protocol features
- TCP/IP protocol is used to establishing the connection between node
- One- to – many message distribution is achieved by the publish/subscribe mechanism
- Message delivery worked under three qualities(QOS)
  - “At most once” where messages are delivered through the best qualities (Message loss can occur. Because recipient does not acknowledge to the sender and sender does not have the mechanism to save and resend the message.
  - “At least once” where the messages are delivered at least once. Sender saves the message until gets the acknowledgment from the receiver. It allows multiple sent of messages.
  - “Exactly once” where each message is delivered only once to the intended recipients. It is the highest level of service by the MQTT. It allows the safest delivery in a slow mode. It establishes four-part handshake between receiver and sender to ensure the high quality of services.

![Publish and Subscribe mechanism of IOT broker](image-url)
3. MQTT CONNECTING WITH THE OUTSIDE WORLD

Every protocol needs another, that is the basis behind all technologies. MQTT also need other protocols such as HTTP, HL7, FIX, SMTP to meet the requirement of send/retrieve phenomena. So, it is a need for a component, which in cooperates all protocols as a combined solution. In the enterprise software application, this component plays a major role to connect multiple architecture and services, which is known as Enterprise Service Bus (ESB). There can be plenty of ESBs available in the IT market. But here we use WSO2 ESB, because it provides an open source and light weight middleware. It allows the users from different platforms and enable the combined architecture. Apart from the ESB, Mosquitto broker can be also used as a MQTT Broker.

4. ENTERPRISE SERVICE BUS (ESB)

An Enterprise Service Bus (ESB) [1] is an architecture. According to Fig2, It integrates various application and services together through a set of rules. In another word, it is called as middleware. The major duty of an ESB is to work with different kind of applications and platforms by having a communication bus in the middle which has a variety of point to point connections like client - server model. And also, it offers the flexibility to talk to each other. Generally, it meets all the challenges in service-oriented architecture (SOA). It provides high – level protocol communication as well. The concept of ESB is to avoid spaghetti integration between the applications. It placed in middle and monitor every node and allows a flexible path to troubleshoot through creates loose coupling among the services

![Fig. 2. Architecture of ESB, connected with various platforms](image)

5. METHODOLOGY

Here we propose a smart vehicle tracking system which helps to identify the exact location of a vehicle. We extended the idea of weather tracking system, introduced by WSO2 using MQTT protocol. For the first step we can fix a tracker which able to emits GPS information (longitude and latitude) about a place where the vehicle stands or travels. Emitted location details will be published to MQTT Broker. Mobile phone which is placed apart is subscribed with topic of MQTT Broker to receive information about the vehicle. In between ESB calls Google map API and gets the detail of the exact given location. Fig (3) explained the whole idea of the scenario.
6. RESULTS AND DISCUSSION
We run the simulation over 1000 randomly selected geolocations with six different smart devices including apple, windows and android operating systems. We found that more than, 85% of correct locations were published by MQTT broker to the smart devices. Compare to other devices android platform subscribed the topics more precisely.

Table 1. Number of data published

<table>
<thead>
<tr>
<th>Devices</th>
<th>Number of Geolocations</th>
<th>Number of Subscriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Android smart phone</td>
<td>200</td>
<td>192</td>
</tr>
<tr>
<td>Apple smart phone</td>
<td>200</td>
<td>178</td>
</tr>
<tr>
<td>Windows smart phone</td>
<td>200</td>
<td>189</td>
</tr>
<tr>
<td>Android tablet</td>
<td>200</td>
<td>190</td>
</tr>
<tr>
<td>Apple I pad</td>
<td>200</td>
<td>182</td>
</tr>
<tr>
<td>Windows tablet</td>
<td>200</td>
<td>193</td>
</tr>
</tbody>
</table>

7. CONCLUSION
This study analyses the importance of connecting objects under the concept of Internet of Things (IOT) [2]. ESB plays as a bridge between objects and web services to bring data from one end to another. Here it is obviously proven that ESB can connect independent objects together and MQTT used as an IOT protocol to publish and subscribe data.
REFERENCES


