Structuring the Intelligent Transport Systems Based on Internet of Things (IoT)

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Abstract— With the emergence of the internet, a giant wide variety of data is generated by the communication network, generally induced with the aid of the human undertaking. Adding to this, emerging technology like internet-of-things (IoT) where a gigantic quantity of instruments have become connected to the web, thereby accelerating the cost of knowledge generation. There are also future predictions that the quantity of contraptions linked to the internet goes to exceed the number of humans related to the web. So there happens the need to harness this massive amount of data (typically sensor data), convert them into priceless know-how, make sensible predictions and use this knowl-side to build effective programs. On this paper we demonstrate the idea to build an Intelligent Transportation System (ITS) using the Internet of Things (IoT) platform. The system has three components ; the sensor system, monitoring system and the display system. The sensor system has Global Positioning System (GPS), Near Field Communication (NFC), Temperature and Humidity sensors, which might be constantly related with the internet by way of a GSM community to track the place, commuter and atmosphere within the bus. The monitoring system is used to extract the raw knowledge from the sensors database, convert it in to a significant context, triggers some activities with within the bus and provide expertise to the bus driver. The show method is used to show the context data (bus and journey associated expertise) to all of the commuters within the bus discontinue. We describe our prototype and show how this can be utilized as a predominant aspect to construct the ITS.

I. INTRODUCTION

Transportation of men and women, items and offerings is a multi million buck industry and varieties the spine of in these days’s global economic system. The customers of the transportation networks now not see transportation as motion from factor A to point B, but they're also count on a special nice of provider. Nice of provider interms of any transportation method is measured in phrases of the security assurance, journey time, facilities offered for the duration of journey. Vehicular tracking methods have proved to be as a priceless technology in offering a specified high-quality of service to its consumers, with the aid of successfully permitting them to monitor the region of their object of curiosity, along its journey. Many vehicular monitoring systems provide consumer purposes that run on shrewd phones that connect to the web for place monitoring [5][7].

Vehicular tracking method is an extraordinarily valuable technology for tracking public transportation (like bus) in establishing countries. Some of the main problems faced by means of the com-muters is that, the bus can arrive both previous or later than the anticipated time and may even be canceled. There are quite a lot of reasons for the above ranging from terrible climatic condition, unforeseen street stipulations, low availability of drivers and many others. So it'll be very useful if there's a technique to furnish the monitoring capability by means of usual GSM headquartered phones, as the smart phone proliferation is low in constructing nations (compared to function telephones)[15] and their need to be constantly connected to the internet is a undertaking via itself. This forces us to feel on learn how to provide automobile tracking process that can satisfy the wants of the normal humans in constructing nations.

Although there may be so much demand for such facets and choices, the vehicular monitoring methods have no longer advanced sufficient to meet this expectation. We're no longer restrained by utilizing the technology itself or entry to technology, alternatively, the closed box and rigid process in building science programs remains the bone of rivalry in taking the technological know-how to the
plenty. Vehicular monitoring packages are furnished by way of enormous companies which might be extra into quantity manufacturing and isn't feasible for them to customize the the HW and the auto monitoring infrastructure steady with the wants of the client. Quite a few the COTS auto monitoring methods have roughly the equal efficiency, low level of individual customization and a excessive fee in comparison with the offerings of fered. There's a establishing requirement for beginning auto monitoring process that perhaps used by all of the humans in every single place the sector irrespective of their handset and the supply of web. This provides a undertaking and an opportunity to have additional bendy, predictable, liable and find the money for- tant transportation methods for the rest transportation modes (like bus, vehicle, fleet management applications). Underneath is a definition of what these phrases mean and the way it may be executed.

<table>
<thead>
<tr>
<th>Features</th>
<th>Definition</th>
<th>How to achieve</th>
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<tbody>
<tr>
<td>Affordability</td>
<td>HW/SW cost should be low</td>
<td>Volume production</td>
</tr>
<tr>
<td>Accuracy</td>
<td>HW/SW precision</td>
<td>quality HW/SW modelling</td>
</tr>
<tr>
<td>Customization</td>
<td>add features to HW/SW</td>
<td>unified HW/SW standard</td>
</tr>
<tr>
<td>Flexibility</td>
<td>modify HW/SW features</td>
<td>provide the infrastructure</td>
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Table 1: - Features Expected and How To Achieve Them

As our design is open sourced, the user is provided entry to the whole source code, design files and we inspire person involvement in design approach. Scientific advances in material science, semiconductor processing, cautious designing and checking out will support the accuracy of the design. We have now sourced the nice components available in the market to illustrate our first prototype. Our next step will be fabricate them and go into quantity creation to carry the price down. We have made our design strong and feature rich, as a way to be discussed in the following sections.

II. RELATED WORK

The web revolution has spread out new technologies such as ubiquitous computing, internet of matters (IoT), context-mindful computing and so on. Researchers validated nu-merous survey regarding context-aware computing for IoT and the market study on the huge development of sensor deployments over the last decade. There are various appli-cations developed with IoT infrastructure in field of edu-cation, amusement, healthcare, agriculture, transportation, real estates and many others. In particular, IoT has a gigantic have an effect on on transportation. Many researchers have explored ITS with respect to monitoring automobile programs.

Authors in [1][2] demonstrate an SMS situated vehicle track-ing procedure to transfer the latitude, longitude from GPS and auto information to finish systems and map their targeted place in Google Earth utilizing Keyhole Markup Language(KML). Researchers have additionally labored on SMS tracking process with theft identification and lock feature. In [3], SMS is used to trigger the microcontroller subsystem that generates the control sign for electronic relays, which in flip controls the car's engine and door locking mechanism. So once a theft is detected, the automobile will also be tracked and brought to halt by means of an SMS. A password based authentication is used to liberate the lock imposed on the door and the engine. A lot of study has also been done on internet-headquartered auto monitoring method[4], where the latitude and longitude are transmitted to the server by way of HTTP protocols (GET methods). Some researchers have additionally developed open source platform for GPS monitoring [5]. There are additionally efforts to tweet place information of vehicles within the Social media like twitter [6]. There are application where there's an in-car device with GPS, GSM and microcontroller, a server and a smartphone application are used for the car monitoring approach[7].

For public transportation approach, researchers designed and developed a monitoring process that tracks every bus's present vicinity . So that, passengers anticipating their buses in the bus stop will be aware of its vicinity information [8]. As technological know-how advances, researchers are exploring web-of-matters (IoT) for vehicle tracking, had been the method has a GPS and two RF-identity readers to verify the present place and passenger count within the bus. In a similar way, the station is also mounted with RFID readers that may observe the arrival info of buses. The understanding are transmitted by way of wireless conversation method
and will also be shared with the public [9]. There is study providing procedures in the direction of data handling and monitoring of car through SPSS (a statistical software) [10].

Our technique is to develop a flexible, cost amazing and consumer-pleasant public vehicle monitoring approach that may cater to the wants of each urban and rural community with minimal technology backing on the person finish. The user is furnished with the choice to prefer between:

- a sw application running on a smartphone or
- a SMS based tracking through a GSM enabled mobile handset.

By providing the above choices we are able to scale our application through different user base without any bias. This is especially very useful in developing countries like India where:

- the proliferation of GSM enabled mobile handsets is higher than smart phones [15].
- most of the people are connected to cellular networks than the wifi.

III. BUILDING BLOCKS

This section describes the components used to realize our PRIMO [16] architecture. The PRIMO consists of two subsystems called the Nautical and the Native.

A. Nautical prototype

The Nautical gadget consists of three modules shown in determine 1, the GPS module, GSM module and microcontroller. The essential purpose of the Nautical gadget is to capture the NMEA sentences, filter the sentences (like Latitude and longitude) and switch these parameters to the online server via the GSM module with the aid of microcontroller.

The Native prototype shown in figure 2, is similar to the Nautical nevertheless it does no longer has a GPS module. The Native is purposely designed to provide the present vicinity information from the web server to the GSM module with the help of the microcontroller.

IV. HARDWARE

The Nautical apparatus consist of three most important modules which might be the GPS (international Positioning approach), GSM (world method for cellular Communications) and the Microcontroller. Similar to Nautical, Native apparatus also consist handiest two modules (GSM and microcontroller). The duties of each modules are very exact.

V. SOFTWARE

This section provides a brief overview of the software application used by PRIMO.

A. Web server

We designed a web web page with personal home page code that will acquire GPS knowledge from the Nautical gadget and uploads to the server database. In the server, we use MySQL database and to connect with the database, we use mysqli join command. Once the connection is effectually centered, we have got to insert the values with the aid of utilizing MySQL question.

Once the table is competent in the database, we will software the Nautical gadget to redirect the GPS values bought from the satellite tv for pc to this php file.
VI. PRIMO ARCHITECTURE

The structure represented in figure 3, describes the constitution and blocks reward in PRIMO. The Nautical device begins with the aid of sending the present region packets captured from GPS receiver through the GSM guard to the web server. The foremost operate of the web server is to store, approach, retrieve and display the understanding gift/given in/to the database. The web server encompass more than one databases, where each car represents one database. Each and every database has two tables known as the Tracer and the Spotter (Spotter is presently applied as file). For each 5 minutes (will also be configurable), the Tracer table helps in storing all the expertise like date, time, latitude, longitude, altitude and speed sent from GSM module.

On the other hand, the Spotter is used to seize the present latitude and present longitude values from the Tracer table and identifies the region name. That is, when there's a new stimulus in the Tracer desk, then the Spotter updates the current vicinity name robotically. Now, to identify the certain area and the earlier navigated course, we use the Tracker. The tracker is a digital interface integrated with Google API, that represents the area of the auto via maps. All smartphones and different personal gadgets linked with internet can view these maps. However, now not all of the folks are prepared with smartphones. Thus, to make this utility serve for the other half of, we built the Native prototype. Here, the top consumer, with a common handset offers a request by calling to the Native. The Native will response to the call by using sending the present auto region information from the Spotter to the end consumer through an SMS.

VII. ITS ARCHITECTURE

The ITS system architecture is labeled with respect to sensing, monitoring, and exhibiting systems. All operations are carried out by means of keeping web as the backbone. There are one of a kind sensors used in this process. All these sensors produce uncooked data so they can be stored in a vital database as proven in figure 4. This raw expertise have to be care-completely monitored, analysed after which made right into a significant context. If any disorders, movements are taken robotically by using the method. At final, the meaningful context are displayed to the public.

VIII. APPLICATION FLOW

The operation begins when the Nautical is placed in the bus and powered with 5V. Then the Nautical device will start to sense the raw GPS NMEA sentences. Once the data is received from GPS as shown in Figure 5, the microcontroller will introduce these information to GSM module. The GSM module will then initiate a GPRS wireless connection. Once the GPRS network is connected, all these data will be transmitted to the database through a web server(Nautical Server) with the help of IP address, path and the port number of the web server.

```c
char server[] = "IP address/domain.com"; char path[] = "/tracegps.php";
```
int port = 80; // default port for HTTP

Fig. 5. Nautical flow

The Native acts as an intermediate between the web server and the elemental handset. The commuters who use the elemental handset are on the whole concerned with understanding in regards to the present place where the bus is travelling. So that you can make this viable, we created a separate file/table within the Database known as the Spotter or popularity DB. Right here the Spotter just continues updating every time there's a new stimulus within the trace table.

So, the work waft is explained as in the figure 6. The operation for the Native starts with the aid of dialing a number(Native’s cellphone number) from normal handset. When the Native receives the decision from end person, it simply captures the phone quantity and rejects the call. As the Native is invariably linked with the web, it connects to net server and looks the Spotter within the database and supplies the present area name to the GSM module. Then the GSM module will reply to the top person by sending the current area details through an SMS.

IX. OTHER APPLICATIONS

The PRIMO project can be harnessed with minimal changes to suit different applications as well:

- Parents send their kids to school or college through bus which can get delayed or turn up much early. With the aid of our application we can identify the exact location of the bus and travel our journey accordingly.
- Our applications can help parents who are worried about their children traveling long distances from work location to their home.

By exploiting the minimal HW requirements of the mobile phones, our design is not only available for the user who travels in the bus, but also for people who can track the expected arrival time of the user.

X. RESULT

On this section, we speak about the results bought for the period of one in every of our area trials. The HW prototype used to be allowed to duvet a distance of round 15km from Ooty city to Nundhala village. Throughout the direction of the journey, the area
updates of the HW prototype used to be send to the Nautical server by means of the GPS in Nautical.

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**Fig. 7. Database imprint showing the parameters provided by the HW**

**Fig. 8. Satellite coverage Vs Altitude**

Probably the most most important features of our prototype is the accuracy of the HW, which relates to the co-ordinates offered by means of the GPS. In our trial, we determined the quantity of satellites included as we moved by way of exclusive altitude. Figure 9 shows the number of satellite included (along X-axis) against the altitude in meters (along Y-axis). When you consider that the geographical area chosen for the area trial is high altitude hilly vicinity covered with forest, there were some slight deviation within the number of satellite tv for pc discovered. One such sign deviation may also be located for the altitude of 2261.7m where the quantity of satellites observed is dropped to 6 as a result of the signal interruption when passing via the forest. For the remaining a part of the graph, the satellite tv for pc insurance policy is just right.

**Fig. 9. Dynamic speed Vs Time**

Figure 9, indicates the plot for the dynamic variation of the bus velocity (in km/hr alongside Y-axis) against the time (along X-axis). The initial value is zero km/hr when the bus is in the halt state for the period of the primary 10 minutes. Because the bus starts and move along its vacation spot, we can see a gentle exponential curve extending by means of as a rule. Because the bus didn’t discontinue within the middle, there aren’t any unexpected dips located. As we attain closer to our destination, there’s a linear curb within the velocity and grounds to halt (0 km/hr) when the destination is reached. By way of this selection, we will monitor the region of an object of curiosity as good as estimate the arrival/estimated arrival time. In future, we’re also planning to increase algorithms that can interpret the appearance time of the bus established on the site visitors and climatic conditions.

**XI. CONCLUSIONS**

On this work we have now developed PRIMO - an open source Vehicular tracking system that’s bendy, cheap, customizable and accurate. We have described our complete resolution containing a HW prototype and user pleasant SW utility. Via this technology, we also furnish architecture for sensible transportation system. There may also be quite a lot of different utility that may be built over our existing platform. We have now additionally demonstrated the credibility of the design through field trials and the preliminary outcome acquired by means of our prototype is very promising.
REFERENCES