RFID Based Bus Tracking System

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Abstract-The innovation in technology today has made our lifestyle much easier and fun. This research work proposes and implements a solution for enhancing public transportation management services based on RFID and GSM. The system consists of three modules: Bus Module, Super station Module and Bus-Stop Module.

The microcontroller based Bus Module consisting mainly of a GSM modem and RFID Readers on the entry and exit gates. When driver press the INIT button, Bus module sends the bus number and license plate number to Super station and starts transmitting its location to Super station Module about a particular bus location out of Bus-Stops.

Super station Module equipped with a microcontroller unit and GSM modems interfaced to PCs is designed to keep track record of every bus, processes user request from Android mobile application about a particular bus location out of Bus-Stops and updates buses location on Bus-Stop’s LCD display.

Bus-Stop Module is installed at every Bus-Stop and consists of a GSM modem, RFID tags and LCD display all interfaced to a microcontroller. This module receives bus location information coming towards that stop from Super station module and displays the information on a LCD display.

Keywords- RFID Reader, GSM, RFID Tag, LCD

I. INTRODUCTION

Radio-frequency identification (RFID) is an automatic identification method, it is based on storing and remotely retrieving information using device called RFID tags or transponders. The technology works with RFID reader and an RFID tag.

An RFID tag is an object that can be deployed onto or into a animal, product or person for the purpose of tracking and identification using radio waves. RF tags can be read from large distance away and beyond the line of sight of the reader. [3]

The RFID has come up as emerging technology which started evolving in World War II. A RFID system has several components which include tags, antennas and readers. This set up can be used either in high frequency or ultra-high frequency. In 1946, Leon Theremin invented a toll for the Soviet Union which retransmitted radio waves with some audio information attached to it. Though it was not an identification device it can be considered a predecessor to the RFID technology. In 1939, the United Kingdom uses IFF transponder which was then used for identifying planes as an ally plane or enemy plane as early in 19th century in World War II. The transponder of this kind is still used in today’s aircrafts wherein the transmission and receiving of waves is used. The patent from Mario Cardullo’s in 1973 which talks about a passive radio transponder attached to a memory was the true ancestor of modern RFID. [6]

RFID

A RFID system uses three component:

a) An antenna
b) A transceiver (include decoder)
c) A transponder (RF passive tag)

Electronically programmed with unique information. There are different types of RFID components out in the market. Their categorization can be done with respect to frequency power. Some of the most commonly used RFID kits are as follows:

1) Low-frequency (30 KHz - 500 KHz)
2) Mid-Frequency (900 KHz - 1500MHz)
3) High Frequency (2.4GHz - 2.5GHz)

These frequency ranges mostly tell the RF ranges of the tags from low frequency tag ranging from about 3m to 5m, mid-frequency ranging from 5m to 17m and high frequency ranging from 5ft to 90ft. [3]

When designing this system, the following constraints have been considered:
Modularity and expandability constraints: the system must be modular in. Both hardware and software should be segregate into small components or modules to ensure easy scalability for further feature expansions. Each module must work independently and produce data, so that crash or changes of one module cannot affect the other ones.

Economic constraint: Performance vs Cost should be considered so as to design a cost-effective solution.

Environmental constraint: In our design and implementation, impact upon environment should be considered. We should use Low power consumption devices to keep system at low power. Optimization of energy should be involved in all the design’s steps.[3]

II LITERATURE REVIEW

Due to non-availability of prior information about the buses arrival schedule, in the morning people waits on bus stops. The buses are overloaded for most of the times which often results in some kind of fault occurrence in buses and people get late further. [1]

The time required to travel by bus is linked with some parameters like traffic, accidents and snow. In fact, buses are stuck in traffic and the scheduled of buses are hampered by such situations. Because of this the management of the bus schedule is a hard task. Most of the bus station used paperworks or fixed schedules. Supervisors are hired at super station to control the entrance and the exit of buses. They prepare the trip schedules and sheets containing the schedules manually which is inaccurate and time consuming. Subsequently, transport departments have no visibility on real time information about bus timings, which results in un-utilization of resources. So, all these results in dissatisfaction and inconvenience to millions of people. Therefore, accurate and timely transit travel time information is so important. This technology can be used to help the administrator to monitor the buses, the traffic while increasing the satisfaction of the users [1]

Well-known examples of identification technologies include Closed-Circuit Television (CCTV) and Global Positioning System (GPS). CCTV can be deployed at each entrance gate and image processing techniques can be utilized to identify the arrival of buses, where image recognition was performed to detect the bus in traffic. Output from these tests has shown poor performance in tracking based detection (~20% precision). During the past, GPS integrated to Geographic Information Systems (GIS) was used to monitor buses traffic. GPS receiver communicates with at least 4 satellites before giving the position of the bus. It gives very good results; however, line of sight between the receiver and the satellites is required otherwise the GPS signal is going to be weaker and attenuated. This is a main limitation of this technology especially when it comes to monitor bus traffic inside an underground bus station. [7]

<table>
<thead>
<tr>
<th>Features</th>
<th>RFID, GPRS</th>
<th>GPS, GPRS</th>
<th>RFID, GPRS</th>
<th>RFID, GPRS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Transmission</td>
<td>Slow within range</td>
<td>Moderate delay due to satellites blocking</td>
<td>Moderate</td>
<td>Faster</td>
</tr>
<tr>
<td>Data Informatio n</td>
<td>Only RFID</td>
<td>Only coordinates</td>
<td>RFID data and coordinates</td>
<td>Position, picture and vehicle information</td>
</tr>
<tr>
<td>Control centre</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Hardware Cost</td>
<td>Low</td>
<td>Moderate</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Hardware Implement ation</td>
<td>Simple</td>
<td>Simple</td>
<td>Complex</td>
<td>Complex</td>
</tr>
<tr>
<td>Reliability</td>
<td>Less</td>
<td>Less</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>Application</td>
<td>Specific</td>
<td>Specific</td>
<td>Limited</td>
<td>Limited</td>
</tr>
<tr>
<td>GUI</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Figure 1: Study & comparison of existing systems

Due to the limitation of these technologies, RFID can be used to track public transport service. This technology can
be effectively applied for real-time tracking and identification. RFID was developed in the 1940s by the US department of defence (DoD) which used transponders to differentiate between friendly and enemy aircrafts. Since this time, RFID technology has been evolving to change the way people live and work. Use of RFID in different areas is been explored in many previous researches, from toll collection, agriculture, access control, supply chain, logistics, healthcare, and library. RFID technology can response to our tracking needs that’s why we used RFID in our design to identify buses entering and leaving the bus station.[1]

III PROPOSED METHODOLOGY

The proposed system architecture for the bus monitoring and management system is shown in Figure 2. A black box containing RFID reader, GSM modem is equipped in the moving bus. As the bus approaches a bus station with an RFID tag, the distance between the reader and the tag decreases and causes them to interact with each other. This network communication results in data and the data obtained is sent to the Super station via GSM. [1]

The data circulation of the RFID and integrated communication technologies in the constructed system are shown in Figure 3. The system is automatically turned on once the bus is ignited. When the bus nears a tagged Bus-Stop, RFID devices interact with each other. The reader then reads and retrieves the information saved inside the tag once it recognizes the tag. If the communication is successful, the information of the bus and the respective Bus-Stop is saved in the database; with the condition that GSM is ON. The data retrieved are then sent to the Super station via GSM, and this action initializes the data utilization. These data are stored in the database. Filtered, clean information is sent to the Bus-Stop module, which shows the data received from Super station i.e. bus positions on the LCD display.

Bus Module is installed inside every bus and consists of a RFID reader, a GSM modem and an emergency button; all interfaced to AT89S52 microcontroller. After sending the initialization signal to Super station Module, this module starts transmitting bus location to the Super station. At each stop, RFID reader reads the RFID tag on Bus-Stop and sends data to Super station. In case of an emergency situation (e.g., when fault occurs in bus), driver can press the emergency button to inform Super station units about

![Diagram](image-url)
the location of bus. The BUS station operator can then adjust the schedule accordingly and send an additional bus for facilitating the passengers. The block diagram for this module is shown in Figure 4. [1]

Super station module is the central part of the network. It accepts current location of buses through respective GSM. The PC after processing the data sends desired location information in form of Bus-Stop name to microcontroller at Bus-Stop module. Super station also monitors the emergency situations transmitted from Bus Module. The block diagram of the module is shown in Figure 5.

Bus-Stop module is installed at every Bus-Stop to let the passenger know about the location of buses coming towards that stop. It comprises of a GSM modem, LCD display; all interfaced to AT89S52 microcontroller. Microcontroller after retrieving the stored information displays it on LCD display. [4]

IV CONCLUSION

In this research work, design and development of a low cost transportation management system based on integration of RFID and GSM data is described. The system makes use of various modules which are wirelessly linked with GSM modems. SMS service of GSM network very cost effective so it is used for the transfer of data between the modules. This service provides the user with the information about location of desired buses so that the user can adjust his schedule accordingly. This technology outdates the need of waiting at the Bus-Stop thus saving a lot of time. Displays are used at Bus-Stop to let passengers know the expected time to arrive and bus locations coming towards that stop. The system made such that it can also handle the emergency situations e.g., tire of bus is punctured, in case some kind of technical or non-technical fault in bus, the operator at bus terminal is informed and the departure time between the buses is reduced.[5]
It is believed that by the implementation of this system, problems such as un-utilization of buses and waiting time at the bus station will be reduced. So, both bus station administrators and passenger will benefit from the system as real time information is provided.

V FUTURE SCOPE

An automatic route guider display can be installed in buses to better update the alternative route in case of serious road congestions. We can connect RFID reader wirelessly to the host application. There are many wireless technologies that can be used such as Bluetooth (802.15.3) and ZigBee (802.15.4) to extend the range of an RFID reader. Fare collecting system can also be automated by providing another mobile service to which all the passengers using public transport are subscribed.

REFERENCES

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