Implementation of logistics management system based on wireless technologies

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Abstract—This design, vehicle terminal system is proposed to obtain continuous monitoring of logistics. The integrated hardware and software design of the terminal system is based on RFID, GPS and GSM technologies. We use ultra-low power ARM7 32-bit RISC processor as the central control unit considering both small size and high efficiency. The intelligent vehicle terminal system can provide mainly the automatic identification of goods loaded, the real-time vehicle location, and remote centralized monitoring as well. Experimental results indicate that the integration of wireless technologies can enhance the reliability of the system, which further improve the accuracy and efficiency of logistics management.

Keywords: ARM7; RFID; GPS; GSM; vehicle terminal system; remote centralized monitoring

I. INTRODUCTION

An RFID (Radio Frequency Identification) is known as a ubiquitous technology used in real-time tracking [5]. Because of its accurate and fast identification, RFID is applied extensively to improve the logistics management, supply chain operation and asset tracking. The GPS (Global Positioning System) is the most promising technology to acquire the position information in outdoor environments. Always GPS is chosen for tracking of vehicles, assets and staff over a wide geographic area. With simultaneous data received from four satellites and ideal conditions and minimal ionosphere, users can calculate an object’s location including mainly latitude, longitude, and altitude. Global system for mobile communication (GSM) is a globally accepted standard for digital cellular communication, which has rapidly gained acceptance and market share worldwide. This technology is used to send and receive messages from vehicle and remote centralized monitoring sections in logistics management. GSM technology is very commonly used in any part of the world and it is economical to use. The powerful combination of information and intelligent technologies will advance the supply chain monitoring and management capabilities from the origin to final destination. There have been some related works that are focused on the integration of RFID, GPS, and GSM in certain fields.

The organization of this paper is as follows. Section II depicts an overall framework of the vehicle terminal system. Section III describes literature survey. In section IV the system architecture and prototype design are presented. Section V describes the prototype system test and evaluation. Finally, conclusive remarks are made in Section VI.

II. OVERALL SYSTEM FRAMEWORK

To solve accurate consignment and realize real-time monitoring service in the transport management, the overall monitoring service in the transport management [5], the overall framework of the digital logistics management system can be proposed as Fig.1. Working in coordination, the system can implement corresponding function to track goods and vehicle movement in real time. Once the position and the product ID information are captured through GPS and RFID, the vehicle terminal can send the messages to the logistics monitoring centre through GSM base stations.

The system operating procedures consist of three basic stages. Firstly, when the products leave the warehouse and are handed over to transport company, the product identification data can be found by the RFID reader. Meanwhile, the product's departure and arrival information can be automatically registered as well. The transporting information of goods is sent to transport company momentarily [5]. Then, the GPS module achieves the message (latitude, longitude, and altitude) of vehicle position; RFID reader detects whether a product data is changed; temperature sensor displays the
temperature [10]. All the product information and the combined GPS position information are sent in real time. Once the information is inconsistent with the present manifest, the vehicle terminal system raises the alarm to ask for help towards the logistics monitoring centre. Finally, when the vehicle gets to the destination and the goods are unloaded, the information database is updated immediately.

III. LITERATURE SURVEY

Cai-congwu, Xu-wan, ceiwen, H. liz, Z. Zhong describes, there is a spatial information technology like GSM, GPS and RS etc. These technologies are popularized and widely used in intelligent dispatching, but here it is used in agriculture to monitor the farms and also the intelligent dispatching. Because in large farms there are number of sub farms, so it is very difficult to manage them.[1] To solve this problem the farm vehicle monitoring and intelligent dispatching system is to be used. In this system the driver has to save the data into the IC card with personnel and vehicle identification from the monitoring centre. The IC card is inserted in the card reader. After dispatching is finished the task will be allocated for the driver and then it will be written into the IC card. When the IC card is inserted into the card reader it will automatically display the location in the monitoring screen and will be directly sent from the farm house to the desired location [1].

Danyu, Z. And G.A.O. Hongfeng depicts communication is very important for vehicle monitoring to improve the communication service system in vehicle. This study mainly focuses on performance reliability and reusability of communication server. For achieving this, GPRS and GSM are used. One can also apply the non blocking I/O technique to optimize this process. The J2EE design scheme and open source technique is used for the compatibility and reusability [2]. Container logistics plays a vital role in logistics management.

Ming, Y., W. Xuefeng and Z. Renyi addresses to improve the logistics information like unreasonable usage of equipments and also improve the reliability. For that the Topology structure is followed in the basics of EBXML. All the goods details are collected and maintained in the database. The web base application is used to monitor the vehicle and the information is sent to the concerned persons [3].

The existing systems had a disadvantage of internet facility, every time system cannot be connected to internet because logistic vehicle passes through remote areas cannot provide internet. Every time system cannot be connected to servers. So tracking of vehicle is impossible in this aspect.

The above disadvantage can be resolved in my model by using GSM technology. GSM don’t need any complex circuitry; GSM networks are available in any part of the world. GSM technology is cost effective and can be easily installed and operation is simple.

IV. SYSTEM STRUCTURE AND PROTOTYPE DESIGN

A. Analysis of hardware Structure

1) Microprocessor: The microprocessor ARM7 TDMI performs signal analysis, command execution, and logical judgment. One of the most important logical judgments is determination of a theft event. ARM7 TDMI first records the original manifest and original GPS coordinates and then updates them every preset time. Once an invalid unloaded authorization is detected, the monitoring system raises the alarm. Then the system will report the detailed product description and current location to the monitoring centre.

2) RFID reader Module: This is used to automatically identify the products tagged within the communication range of the reader, which will be able to provide the accurate consignments and real-time automatically manifest, and improve movable asset management accuracy and efficiency.

3) GPS Module: It is used to provide satellite localization information to trace and locate the vehicle of transportation, such as WGS84 coordinates (latitude, longitude and altitude).

4) Temperature Sensor: It is used to check the temperature of vehicle container.

5) GSM Module: It provides a communication channel to transmit product tag messages, temperature, geography location messages or emergency rescue messages, and receives commands from the transport company or the remote monitor centre.
Prototype model is shown in the Fig. 4. "VEHICLE SECTION" and Temperature continuously. tracking is completed all the data read is send to control values, later GPS tracking is started, as soon as the GPS detection is completed, system reads temperature sensor is valid or invalid and start.

Power supply produces two different voltages 3.3V and 5.0V. When kit is switched ON vehicle section LCD displays "VEHICLE SECTION" and send as acknowledgement to remote centralized monitoring section, message is displayed on the LCD screen for 5sec and vehicle system will track GPS values and send as acknowledgement to remote centralized monitoring section.

Remote centralized monitoring section receives SMS from vehicle section; received SMS is displayed on the PC hyper text terminal window. As soon as SMS is received, buzzer rings to indicate arrival of SMS. If we want to send emergency message to vehicle section, we can send by typing message on hyper text terminal on the personal computer. SMS is send through GSM technology. Prototype model is shown in the figure 4.

The integration of the GPS and RFID helps in identifying the things or goods in the transportation as well as in the mobile vehicles. By designing the terminal at the PC section the location of the transport vehicle is located and then information is accessed through internet for the further evaluation.

C. System operation flow

i) Vehicle section

The vehicle terminal system in Fig.2 consists of ARM7, GSM module, GPS module, RFID reader Module, temperature sensor and the power block. When the transport vehicle is going to be started, and the company manufacture gives the identification numbers of the goods to the transport department of that company. The transport personalities store the identification numbers of each and every good in the transport vehicle (radio identification number of the good). Power supply produces two different voltages 3.3V and 5.0V. 3.3V is applied to ARM7 and 5.0V is applied to LCD, GPS module, Buzzer, Temperature sensor and RFID module. 9V is applied to GSM module through external adapter.

Initially LCD screen displays “VEHICLE SECTION” RFID reader reads the RFID tag it recognizes whether the tag is valid or invalid and status is displayed on the LCD. After detection is completed, system reads temperature sensor values, later GPS tracking is started, as soon as the GPS tracking is completed all the data read is send to control system via GSM technology. After SMS is sent LCD displays “VEHICLE SECTION” and Temperature continuously. Prototype model is shown in the Fig.4.

If temperature increases above 50°C in vehicle then buzzer rings and automatically SMS is sent to remote centralized monitoring section. If any message received from remote central control is to be intimated to vehicle section, we can send by typing message on hyper text terminal on the personal computer. SMS is send through GSM technology. Prototype model is shown in the figure 4.

The vehicle terminal system operation flow is depicted as Fig.6. When kit is switched ON vehicle section LCD displays
message as “Vehicle Section”. When tag is shown to RFID reader, reader reads the tag value and shows whether the tag is valid or invalid, if tag is valid then, temperature value taken and GPS tracking is started as soon as tracking is completed. These three values are sent to the remote centralized monitoring section through GSM technology. After SMS is sent LCD displays message as “Vehicle section” with temperature value. If the card is invalid then the LCD displays “Invalid Good” and collects temperature value and GPS data then sends to the control section through GSM technology. If temperature increases above 50°C then a long beep is given and temperature value and GPS data are sent to the remote centralized monitoring section.

ii) Remote centralized monitoring section

![Diagram](image)

Figure 7. The operation flow of the remote centralized monitoring section.

The control system operation flow is depicted as Fig.7. At the remote centralized monitoring section initially LCD displays message as “Remote centralized monitoring section”, as soon as SMS is received to remote centralized monitoring section a long beep is given to notify that SMS is received. Received data is displayed on the hyper terminal window of the Personal Computer.

If a company want to sent an emergency message to driver at vehicle section, switch on the slider switch on the remote centralized monitoring section board and type message on the hyper terminal window and press enter, as soon as enter is pressed SMS is sent to the vehicle section.

At the vehicle section when SMS is received from the remote centralized monitoring section a long buzzer is given until the Acknowledgement is sent to the remote centralized monitoring section. Acknowledgement is received by the remote centralized monitoring section with a buzzer; the acknowledgement consists of temperature value and GPS data of the vehicle.

V. EXPERIMENTS AND RELATED RESULTS

We have conducted related experiments and evaluations in a simulation transportation scene. Each of products was affixed a RFID tag working at 125 KHz band, which provides 9600bps communication link. When the products tagged enter the operational zone of the RFID reader, each of unique ID is acquired. Meanwhile, the system gets the temperature of the product tagged.

During the experiment run, the GPS module receives the real-time location message from different satellites. All this three information's are transmitted to control station via GSM technology. The vehicle terminal system and the remote centralized monitoring section communicate with each other via GSM short messages. Utilizing “At + CMGS” command to send a message [7].

Figure 8. Messages from Vehicle terminal.

Figure 8 shows Details of goods loaded into the vehicle. It displays good number, temperature of the container, and GPS values. GPS value: 1725.6635,N,07830.7722. From this received GPS data we have to extract original data as “17 25.6635N, 78 30.7722E” then exact location is shown on Google maps as shown in figure 9.

RESULTS

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<th>Values</th>
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<td>1</td>
</tr>
<tr>
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<td>Temperature</td>
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</tr>
<tr>
<td>3</td>
<td>GPS Value</td>
<td>1725.6635,N,07830.7722</td>
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VI. CONCLUSIONS

This implementation proves to be very effective in providing security for the goods and also ensures the safety and delivery of goods to respective enterprises. Tracking of vehicle is also effectively done using GPS and GSM technologies. In future drunk and drive may be prevented by embedding alcoholic sensor with the existing structure.

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