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EVALUATION OF GNSS FOR TRAIN LOCALIZATION USING RFID

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Abstract: Global Navigation Satellite Systems (GNSS) are applicable to deliver train locations in real time. This train localization function should comply with railway functional safety standards; thus, the GNSS performance needs to be evaluated in consistent with railway EN 50126 standard [Reliability, Availability, Maintainability, and Safety (RAMS)]. This paper demonstrates the performance of the GNSS receiver for train localization. First, the GNSS performance and railway RAMS properties are compared by definitions. Second, the GNSS receiver measurements are categorized into three states (i.e., up, degraded, and faulty states). The relations between the states are illustrated in a stochastic Petri net model. Finally, the performance properties are evaluated using real data collected on the railway track in High Tatra Mountains in Slovakia. The property evaluation is based on the definitions represented by the modeled states.

Keywords: *RFID, Reflection sensor, GPS, GPRS, Smoke Sensor.*

I. INTRODUCTION

In recent years the existing methods for tracing the location of train is not accurately providing information. It is leading to a large number of train accidents and loss of lives. In existing system driver or its assistant needs to inform to nearby railway control unit when it is entering nearby area to railway station. The driver will send information through walky-talkies or some wireless unit of small range. Hence there is a must situation for persons presence at all times in the driver unit for taking some timely needed control actions and providing information to control unit. The proposed system approach provides a good solution to this problem. The proposed system describes the development of a wireless train tracking system. GPS (Global Positioning System) will be used to trace the location of train in terms of latitude and longitude. RFID Readers will be used to trace the location in case of forest areas where GPS may fail to receive network. The tracked location will be compared with a digital track map and through communication unit it will be transmitted to Railway control room.

II. HARDWARE SYSTEM

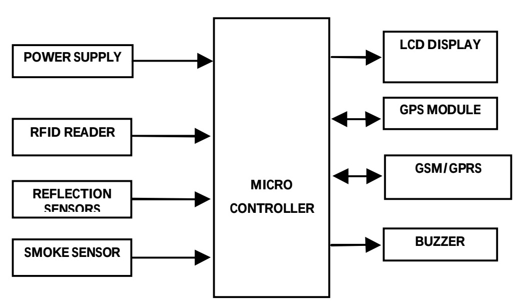

Fig 1: Block Diagram

III. METHODOLOGY

Micro controller: This section forms the control unit of the whole project. This section basically consists of a Microcontroller with its associated circuitry like

Crystal with capacitors, Reset circuitry, Pull up resistors (if needed) and so on. The Microcontroller forms the heart of the project because it controls the devices being interfaced and communicates with the devices according to the program being written.

ARM7TDMI: ARM is the abbreviation of Advanced RISC Machines, it is the name of a class of processors, and is the name of a kind technology too. The RISC instruction set, and related decode mechanism are much simpler than those of Complex Instruction Set Computer (CISC) designs.

Liquid-crystal display (**LCD**) is a flat panel display, electronic visual display that uses the light modulation properties of liquid crystals. Liquid crystals do not emit light directly. LCDs are available to display arbitrary images or fixed images which can be displayed or hidden, such as preset words, digits, and 7-segment displays as in a digital clock.

Smoke Sensor:

They are used in gas leakage detecting equipments in family and industry, are suitable for detecting of LPG, i-butane, propane, methane, alcohol, Hydrogen, smoke. The surface resistance of the sensor Rs is obtained through effected voltage signal output of the load resistance RL which series-wound. The relationship between them is described: Rs\RL = (Vc-VRL) / VRL

Fig 2: Smoke sensor

Reflection Sensor:

Transmitter and receiver are incorporated in a single housing. The modulated infrared light of the transmitter strikes the object to be detected and is reflected in a diffuse way. Part of the reflected light strikes the receiver and starts the switching operation. The two states – i.e. reflection received or no reflection – are used to determine the presence or absence of an object in the sensing range. This system safely detects all objects that have sufficient reflection. For objects with a very bad degree of reflection (matt black rough surfaces) the use of diffuse reflection sensors for short ranges or with background suppression is recommended.

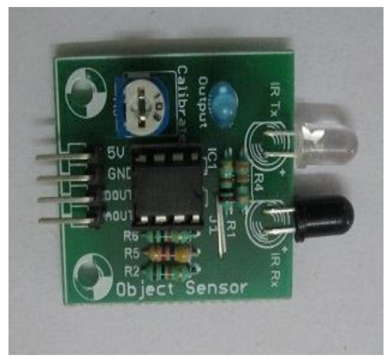

Fig 3: Reflection sensor

GPS:

Global Positioning System (GPS) technology is changing the way we work and play. You can use GPS technology when you are driving, flying, fishing, sailing, hiking, running, biking, working, or exploring. With a GPS receiver, you have an amazing amount of information at your fingertips. Here are just a few examples of how you can use GPS technology.

GPS technology requires the following three segments.

- Space segment.
- Control segment.
- User segment

Space Segment

At least 24 GPS satellites orbit the earth twice a day in a specific pattern. They travel at approximately 7,000 miles per hour about 12,000 miles above the earth's surface. These satellites are spaced so that a GPS receiver anywhere in the world can receive signals from at least four of them.

Control Segment

The control segment is responsible for constantly monitoring satellite health, signal integrity, and orbital configuration from the ground control segment includes the following sections: Master control station, Monitor stations, and Ground antennas.

User Segment

The GPS user segment consists of your GPS receiver. Your receiver collects and processes signals from the GPS satellites that are in view and then uses that information to determine and display your location, speed, time, and so forth. Your GPS receiver does not transmit any information back to the satellites.

The following points provide a summary of the technology at work:

- The control segment constantly monitors the GPS constellation and uploads information to satellites to provide maximum user accuracy
- Your GPS receiver collects information from the GPS satellites that are in view.
- Your GPS receiver accounts for errors. For more information, refer to the Sources of Errors.
- Your GPS receiver determines your current location, velocity, and time.
- Your GPS receiver can calculate other information, such as bearing, track, trip distance, and distance to destination, sunrise and sunset time so forth.
- Your GPS receiver displays the applicable information on the screen.

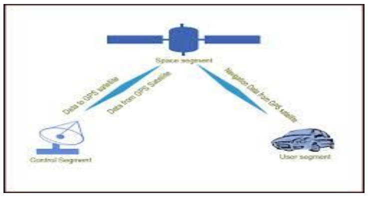

Fig 4: GPS Working

GPRS:

GPRS (general packet radio service) is a packet-based data bearer service for wireless communication services that is delivered as a network overlay for GSM, CDMA and TDMA (ANSI-I36) networks. GPRS applies a packet radio principle to transfer user data packets in an efficient way between GSM mobile stations and external packet data networks. Packet switching is where data is split into packets that are transmitted separately and then reassembled at the receiving end. GPRS supports the world's leading packet-based Internet communication protocols, Internet protocol (IP) and X.25, a protocol that is used mainly in Europe. GPRS enables any existing IP or X.25 application to operate over a GSM cellular connection. Cellular networks with GPRS capabilities are wireless extensions of the Internet and X.25 networks.

Fig 5: GPRS module

RFID:

Radio Frequency Identification (RFID) is a silicon chip-based transponder that communicates via radio waves. Radio Frequency Identification is a technology which uses tags as a component in an integrated supply chain solution set that will evolve over the next several years. RFID tags contain a chip which holds an electronic product code (EPC) number that points to additional data detailing the contents of the package. Readers identify the EPC numbers at a distance, without line-of-sight scanning or involving physical contact. Middleware can perform initial filtering on data from the readers. Applications are evolving to comply with shipping products to automatically processing transactions based on RFID technology RFID Reader Module, are also called as interrogators. They convert radio waves returned from the RFID tag into a form that can be passed on to Controllers, which can make use of it. RFID tags and readers have to be tuned to the same frequency in order to Communicate. RFID systems use many different frequencies, but the most common and widely used & supported by our Reader is 125 KHz.

Fig 6: RFID Reader

Tags are classified into two types based on operating power supply fed to it.

1. Active Tags
2. Passive Tags

Active Tags: These tags have integrated batteries for powering the chip. Active Tags are powered by batteries and either have to be recharged, have their batteries replaced or be disposed of when the batteries fail.

Passive Tags: Passive tags are the tags that do not have batteries and have indefinite life expectancies.

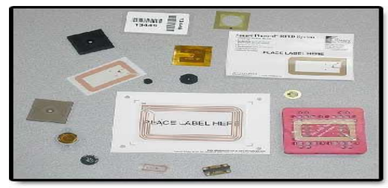

Fig 7: Different types of tags

Buzzer:

A buzzer or beeper is a signaling device, usually electronic, typically used in automobiles, household appliances such as a microwave ovens, & game shows. The word "buzzer" comes from the rasping noise that buzzers made when they were electromechanical devices, operated from stepped-down AC line voltage at 50 or 60 cycles. Other sounds commonly used to indicate that a button has been pressed are a ring or a beep.

The "Piezoelectric sound components" introduced herein operate on an innovative principle utilizing natural oscillation of piezoelectric ceramics. These buzzers are offered in lightweight compact sizes from the smallest diameter of 12mm to large Piezo electric sounders. Today, piezoelectric sound components are used in many ways such as home appliances, OA equipment, audio equipment telephones, etc. And they are applied widely, for example, in alarms, speakers, telephone ringers, receivers, transmitters, beep sounds, etc.

Fig 8: Types of Buzzers

IV. CONCLUSION

The results indicate that GNSS is suitable for railway localization, but the performance of GNSS in different railway environmental scenarios varies a lot. The overall reliability and availability are evaluated as the basis for safety analysis. In open area, GNSS is shown as a good instance for stand-alone localization and fits the railway RAMS requirements quite well. However, in the forest, the GNSS performance cannot meet the requirements; other onboard localization sensors, together with GNSS receiver to provide sensor fusion structure, are required.

V. REFERENCES

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