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Automation of Public Transportation Service Information

G. Rajesh
Mallineni Lakshmaiah Engineering college., Singarayakonda

N. Suresh
Assistant Professor Mallineni Lakshmaiah Engineering college., Singarayakonda

Abstract-

This project proposes and implements a solution for enhancing Advanced public transportation System(ATPS) services based on GPS and GSM in Vijayawada province of Andhra Pradesh. The system consists of four modules: RF-ID Module, In-BUS Module, BASE Station Module and BUS Stop Module. Equipped with ARM and GSM&GPS modem, BUS Station Module sends the initialization information containing the bus number and license plate number to In-BUS Module and BASE Station Module using SMS. The ARM based In-BUS Module consisting mainly of a GPS receiver and GSM modem then starts transmitting its location and number of passengers to BASE Station Module. BASE Station Module equipped with a ARM unit and GSM modems interfaced to PCs is designed to keep track record of every bus, processes user request about a particular bus location out of BUS Station and updates buses location on bus stops. BUS Stop Module is installed at every bus stop and consists of a GSM modem, memory unit and dot matrix display all interfaced to a microcontroller. This module receives buses location information coming towards that stop from BASE Station module and displays the information on a dot matrix display. A per stop statistical analysis is carried out based on the number of passengers and a recommendation report along with this analysis is sent to Andhra

Pradesh Government Transportation Department to have a check on the performance and services offered by transporters to common people. The results have shown that the developed system is useful for facilitating people using public transportation services.

Keywords-Embedded ARM, GPS, GSM, RF-ID Module.

I. Introduction

Travel time information is a vital component of many intelligent transportation systems (ITS) applications. In recent years, the number of vehicles in India has increased tremendously, leading to severe traffic congestion and pollution in urban areas, particularly during peak periods. A desirable strategy to deal with such issues is to shift more people from personal vehicles to public transport by providing better service (comfort, convenience and so on). In this proposed system we introduced advanced public

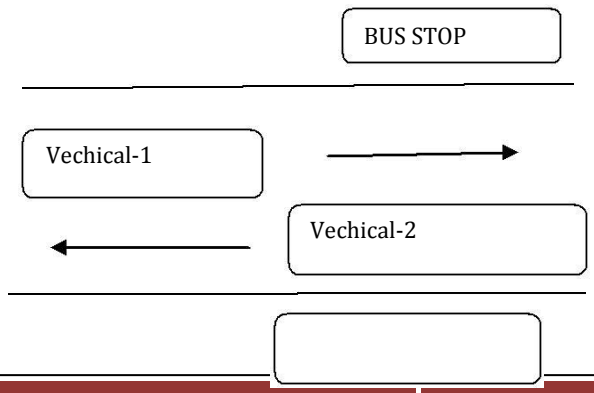
transportation systems (APTS) for public service. Advanced public transportation systems (APTS) are one of the most important ITS applications, which can significantly improve the traffic situation in India.

One such application will be to provide accurate information about bus arrivals to passengers, leading to reduced waiting times at bus stops. This needs a real-time data collection technique, a quick and reliable prediction technique to calculate the expected travel time based on real-time data and informing the passengers regarding the same. The scope of this proposed system is to use global positioning system data collected from public transportation buses plying on urban roadways in the city of Vijayawada, India, to predict travel times.

The performance of the proposed system is found to be promising and expected to be valuable in the development of advanced public transportation systems (APTS) in India. The work presented here is one of the first attempts at real-time short-term prediction of travel time for ITS applications in Indian traffic conditions.

II. Hardware Specification

There are some hardware components used to develop the system which are given bellow,



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BUS STATION

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A.GPS-This provides highly accurate position information and can be used for a variety of land, sea, and air applications. GPS was developed by the U.S. Department of Defense (DoD)[6]. The system consists of a constellation of 24 geostationary satellites, orbiting around 11,000 miles above the Earth‟s surface [9]. GPS was dedicated solely for military use and has recently been declassified for civilian use. To acquire GPS information, a wireless receiver capable of the civilian L1 frequency (1575.42 MHz) is required. The GPS receiver measures distances to four or more satellites simultaneously. Using triangulation [9] the receiver can determine its latitude, longitude, and altitude.

B.GSM- It has become the world‟s fastest growing mobile communication standard. It allows for seamless and secure connectivity between networks on a global scale. Digital encoding is used for voice communication, and time division multiple access (TDMA) transmission methods provide a very efficient data rate/information content ratio [10]. While GSM is becoming the standard for person-to-person communication, the circuit-switched network limits data transmission. General Packet Radio Service (GPRS) was developed to relieve this limitation.

C. ARM LPC 2148

The LPC2148 microcontrollers are based on a 32/16 bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, that combines the microcontroller with embedded high speed flash memory ranging from 32 Kbytes to 512 Kbytes.

A 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at the maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30 % with minimal performance penalty. Due to their tiny size and low power consumption, LPC2141/2/4/6/8 are ideal for applications

where miniaturization is a key requirement, such as access control and point-of-sale.

A blend of serial communications interfaces ranging from a USB 2.0 Full Speed device, multiple UARTS, SPI, SSP to I2Cs and on-chip SRAM of 8 Kbytes up to 40 Kbytes, make these devices very well suited for communication gateways and protocol converters, soft modems, voice recognition and low end imaging, providing both large buffer size and high processing power.

Various 32-bit timers, single or dual 10-bit ADC(s), 10-bit DAC, PWM channels and 45 fast GPIO lines with up to nine edge or level sensitive external interrupt pins make these microcontrollers particularly suitable for industrial control and medical systems

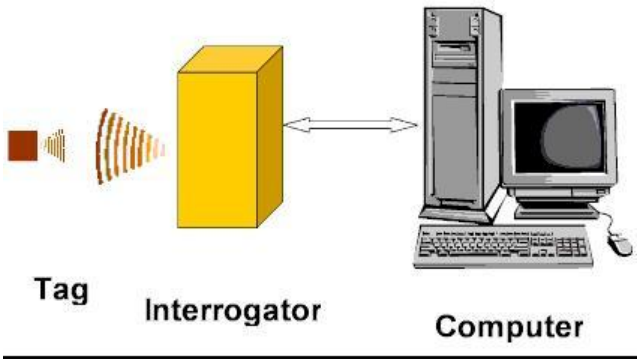
D.Microcontroller:-A Micro controller consists of a powerful CPU tightly coupled with memory, various I/O interfaces such as serial port, parallel port timer or counter, interrupt controller, data acquisition interfaces-Analog to Digital converter, Digital to Analog converter, integrated on

to a single silicon chip. If a system is developed with a microprocessor, the designer has to go for external memory such as RAM, ROM, EPROM and peripherals. But controller is provided all these facilities on a single chip. Development of a Micro controller reduces PCB size and cost of design.

RFID (RADIO FREQUENCY IDENTIFIER)

Introduction:

Radio-frequency identification (RFID) is an automatic identification method, relying on storing and remotely retrieving data using devices called RFID tags or transponders. An RFID tag is an object that can be applied to or incorporated into a product, animal, or person for the purpose of identification using radio waves. Some tags can be read from several meters away and beyond the line of sight of the reader. Most RFID tags contain at least two parts. One is an integrated circuit for storing and processing information, modulating and demodulating a (RF) signal, and other specialized functions. The second is an antenna for receiving and transmitting the signal. Chip less RFID allows for discrete identification of tags without an integrated circuit, thereby allowing tags to be printed directly onto assets at a lower cost than traditional tags.



Primarily, the two main components involved in a Radio Frequency Identification system are the

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Transponder (tags that are attached to the object) and the Interrogator (RFID reader). Communication between the RFID reader and tags occurs wirelessly and generally does not require a line of sight between the devices.

RFID transponder / tag:

An RFID transponder, considered as a next generation barcode, is a miniscule microchip that is attached to an antenna. They come in a wide variety of sizes, shapes, and forms and can be read through most materials with the exception of conductive materials like water and metal, but with modifications and positioning even these can be overcome.

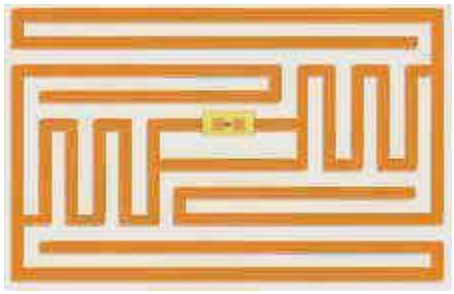


Fig: RFID Tag

Passive tags

Passive tags are generally smaller, lighter and less expensive than those that are active and can be applied to objects in harsh environments, are maintenance free and will last for years. These transponders are only activated when within the response range of a reader. The RFID reader emits a low-power radio wave field which is used to power up the tag so as to pass on any information that is contained on the chip.

Active tags

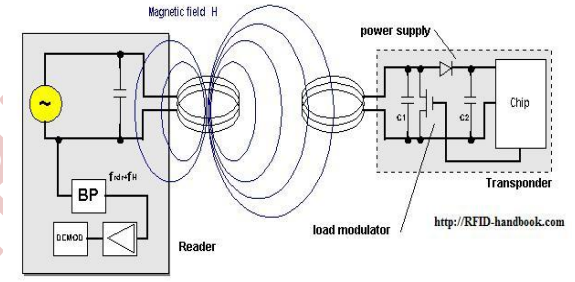
Active tags differ in that they incorporate their own power source, where as the tag is a transmitter rather than a reflector of radio frequency signals which enables a broader range of functionality like programmable and read/write capabilities.

Semi-passive tags

Semi-passive tags are similar to active tags in that they have their own power source, but the battery only powers the microchip and does not power the broadcasting of a signal. The response is usually powered by means of backscattering the RF energy from the reader, where energy is reflected back to the reader as with passive tags. An additional application for the battery is to power data storage. Semi-passive tags leads to greater sensitivity than passive tags, typically 100 times more. The enhanced sensitivity can be leveraged as Semi-passive tags have three main advantages: greater sensitivity than passive tags; longer battery powered life cycle than active tags; they can perform active functions (such as temperature logging) under their own power, even when no reader is present for powering the circuitry.

RFID reader/ Interrogator:

An RFID reader typically contains a module (transmitter and receiver), a control unit and a coupling element (antenna). The reader has three main functions: energizing, demodulating and decoding. In addition, readers can be fitted with an additional interface that converts the radio waves returned from the RFID tag into a form that can then be passed on to another system, like a computer or any programmable logic controller. Anti-Collision algorithms permit the simultaneous reading of large numbers of tagged objects, while ensuring that each tag is read only once.



RFID operates in several frequency bands. The exact frequency is controlled by the Radio Regulatory body in each country.

III System Modules

The whole system consist of Three modules: BUS Station Module, In-BUS Module, BASE Stop Module and BUS Stop Module.

A.Bus station module- BUS Station Module is installed at bus terminals from where the bus will depart. It consist of a LASER and a GSM modem connected to a PC. At the time

of entrance of a bus in to the terminal a LASER sensor detects it. The operator sitting at the terminal enters the license

plate number in database. A count number is then generates accordingly and assigned to the bus e.g., bus leaving the terminal first will be assigned a number 1. The route number of bus along with the direction information, assigned count number and license plate

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number is sent to the BASE Station via GSM. An example of the transmitted header is of the form

"99U01LZR7240" where „99" is the bus route number issued by Transportation Department, „U" is upward direction of bus

(„D" will be downward direction), „01" is the count number assigned to the bus and

„LZR7240" is license plate number of bus. An „ON" signal is also transmitted to the In-BUS Module installed in the bus for initialization.

B.In-BUS Module

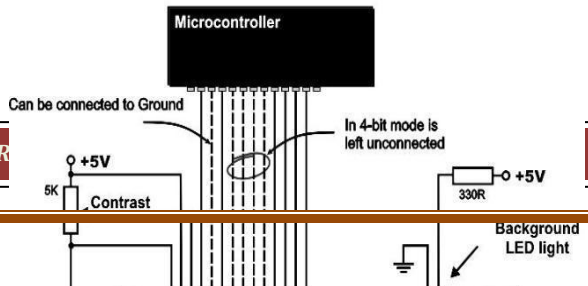
In-BUS Module is installed inside every bus andconsists of a GPS receiver, a GSM modem, a NVRAM,infrared object counting sensors, dooropening/closing sensors and an emergency button; allinterfaced to ARM microcontroller. This module starts transmitting bus location to the BASE Station After receiving the initialization signal form BUS Station Module,. At each stop, when the driver opens the door, an interrupt is generated and microcontroller starts counting the numbers of passengers entering and leaving the bus with the help

of infrared sensors. This count value on per stop basis is transmitted to the BASE Station. In case of an emergency situation (e.g., when fault occurs in bus), driver can press the emergency button to inform BUS and BASE Station units about the location of bus. The BUS station operator can then adjust the schedule accordingly and send an additional bus for facilitating the passengers.

C. BUS Stop Module

This 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, a NV-RAM and dot matrix display; all interfaced to 89C52 microcontroller. After receiving the bus location data in the form of stop names from BASE station, microcontroller stores it in nonvolatile RAM. Microcontroller after retrieving the stored information displays it on a 3x15 dot matrix display. The microcontroller refreshes the information with am rate of 10 seconds. In case of an emergency situation, the location of next incoming bus is displayed shown

in fig, explains the lcd displaying at the bus station.



IV. Conclusion

In this paper, we design and developed a low cost transportation management system based on integration of GPS and GSM data. The system consist of various modules which are wirelessly linked with GSM modems. Cost effective SMS service of GSM network is used for the transfer of data between the modules. A new service, to facilitate the people who use public transport for traveling, is introduced inside the city. The service provides the user with current location information of desired buses based in which the user can adjust his schedule accordingly. The service therefore reduce the waiting time at the bus stop. For the passengers not utilizing the service, displays are installed at bus stop to let them know the buses location coming towards that stop. This system provides a user friendly environment to the people of a city to overcome the difficulty in finding bus route as well.

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AUTHOR'S PROFILE

Mr. G. Rajesh

has completed B.Tech. from S.V.V.S.N Engg. Colllege,Ongole. He was worked as a Lecture in Bapatla Polytechnic College till 2011 and currently studying M.Tech.

Mr. N. Suresh

Has completed his M.Tech. from V.R.S. & Y.R.N Engg. College,Chirala and currently he working as an Assistant Professor in Mallineni Lakshmaiah Engineering college, Singarayakonda.

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