Intelligent Fleet Management System Using Active RFID

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Abstract-- Business needs to be agile, flexible and resilient to emerging technologies to keep abreast with the completion on Business Landscape. It has become very important to be receptive to modern technological tool for continuous process improvement. For existing large-scale RFID systems there are some fundamental problems, such as the accuracy, security, tag reading range of reader, most of them suffer from multiple-reading. Without resolving these problems, RFID systems cannot easily applicable for many applications in real time. In this paper we presented design of an active RFID tag for auto identification of fleet for digital fleet management. User interface is done using Graphical User Interface. This is useful in End to End fleet management. This aims at optimizing the usage of shared resources of transportation.

Index Terms – Digital fleet management, low cost, Active RFID, AutoID

I. INTRODUCTION

Being a lifeline of a country, transportation sector also needs to be more efficient and effective with its every increasing demand. Digital Fleet Management aims at optimizing the usage of shared resources of fleet in transport industry. This is useful in End to End fleet management. It empowers the fleet owners and operators with electronically driven system which helps in managing the fleet. It has functionality to store information about the vehicle in the tag for goods and personnel transportation by vehicles consequentially which saves time and paper for ecological aims. It automates manual processes with embedded enabled solutions which nullifies the use of physical maintenance of records thereby saves time and brings operational efficiency. It is an end-to-end solution of fleet management for fleet owners.

As a new kind of automatic identification technology, radio frequency identification (RFID) is the fundamental principle to realize the automatic recognition of the static or moving objects by radio frequency signal. Usually, RF system consists of RF tag, reader and host as shown in Figure.1. RFID tag can be roughly classified into passive and active types of tags. The passive tag does not incorporate a battery and responds with the energy provided by a reader/writer [4] [7]

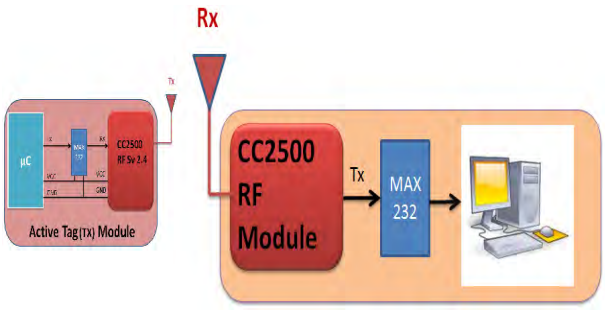

Figure.1. RF system using active tag

In passive tag system communication range is short, but the cost is low. This type of tags are expected to be applied to improve efficiencies in the area of the cash register, picking work at a delivery center, inventory control, and distribution / traceability. On the other hand active tag's communication range is long, but coverage of application is limited because of its cost. At present, most RFID systems adopt passive tags which get power from the reader by RF signal; it is beneficial to reduce the label size and cost, but the reading range and data storage capacity are limited. While the active tag with battery can provide larger range of reading ability and higher reliability. Now the breakthrough of low power consumed IC technology created favorable conditions for the development of small size and low power active tag. Active tag is designed using Single-chip MSP430F2012 and wireless data transmission chip CC1100 as presented in reference [1], The active tag always transmits ID at constant intervals, the design aimed to implement active tags based on 8051 µC and RF module having on chip antenna for wireless data transmission with the lowest possible hardware cost.

Applications

i. Customer Record Management

ii. Vehicle Billing Devices

iii. Web portal for booking and auto dispatch

II. DESIGN OF ACTIVE RFID TAG

The Active RFID tag is a transmitter designed using the 8051 µC and RF module which uses CC2500 chip for wireless data transmission. Since an active RFID tag uses the battery as power supply; we will look forward for low power consumption performance to prolong the service life of battery. Low-power design requires both the choice of components and optimized reasonable run timing.

A. Selection of Microcontroller

In this the µC performing following important functions i.e., (a) store the unique ID which is referred as tag ID (b) stores information like vehicle number, owner details, driver details etc. (c) transmit tag ID with information to the reader. Another name for a µC, therefore, is "embedded controller". For instance, a typical µC will have a built in clock generator and a small amount of RAM and ROM (or EPROM or EEPROM), to use it for required application we required crystal to generate frequency and control software. Micro-controller will also usually have a variety of input/output devices, UARTs or specialized serial communications interfaces like I^2C, Serial Peripheral Interface. Often these integrated devices can be controlled by specialized processor instructions. [9] µC's are dedicated to one task and run one specific program which is stored in ROM (Read Only Memory). The program is prepared in assembly/embedded c language for performing the above functions. Finally, it must be mentioned that some Micro-controller architectures are available from different vendors in various varieties that they could rightly belong to a category of their own. Chief among these are the 8051 family. Also 8051 series is a recognized as MCS51 in the industry. Taking into consideration of our present requirements and application of active RFID system we conclude 8 bit µC will suffice the application. 8051 µC is adopted in this paper. [9]

B. Selection of RF chip

Choosing RF chip is the most crucial part of the Active RFID card, it directly related to not only tags read range and reliability, but also the power consumption. As per rang requirement in selected application we can select the desired chip.

Wireless transmitter CC2500 [8] with small size, low power consumption, supports programmable control; with internal address decoder, modulate processor and so on, is very easy to use. In our design we have selected CC2500 with on chip antenna and 2.4GHz operating frequency. [5]

C. Battery supply

Battery is used as power supply directly. It saves quiescent current brought from voltage regulator circuit, prolongs the service life of battery. To adopt battery as power supply, the key point is to solve the random wrong operation because of incomplete reset, caused by mechanical contact with the wires.

III. HARDWARE DESIGN OF ACTIVE TAG

The active tag should have the following characteristics: miniaturization, low cost, high reliability, adjustable reading, distance battery-powered, and so on. The block diagram of the tag is shown in Figure. 2.

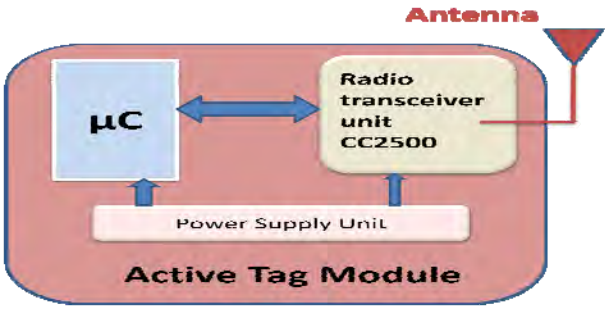

Figure.2 Block diagram of active tag module

A. System Structure of Tag

RFID tag consists of µC unit, radio transceiver unit and power supply unit, out of these, the µC unit with its own memory is responsible for the operation of RFID tag, data deposition and processing. The radio transceiver unit contains RF chip with on chip antenna, to achieve information transmission between active tag and reader. The power supply unit supply power for tag.

B. Serial Communication

µC supports four modes of serial Communication. The diagram of active tag is shown in Figure.1 Here we are using µC in continuous Transmission mode with 8-bit UART (Universal asynchronous receiver transmitter), variable baud rate.

IV. SOFTWARE DESIGN OF TAG

A. Design of Workflow

Recent µC's integrated with on-chip debug circuit accessed by In-circuit Emulator enables a programmer to debug the software of an embedded system with a debugger. The software development of system uses C language on Embedded Workbench keil to program. The intercommunication between µC and RF module is done by using RS232 cable.

B. Realization of Driver

(a) Microcontroller communicates with RF module by standard Serial Peripheral Interface (SPI), which includes two data lines.

(b) USB to DB9 serial adapter is needed for the pc or laptop without serial port. For that it is necessary to install USB TO RS232 Driver Installer

V. HARDWARE TEST

To verify the proposed method, we made a prototype model of 2 active tags having ID 74 and 104. We are able to see ID in ASCII equivalent of the same tag ID number. The ID's are given through programming µC. Used radio frequency band is 2.4 GHz which is same for transmitter and receiver. Receiver has only one on chip antenna and it works as transceiver. It receives the tag ID so it is as good as RFID reader. We tested tag read system using HyperTerminal and terminal. The results obtained for Sending two active tags ID are shown in Figure. 3 (a) and Figure 3 (b); and for receiving tag ID in Figure.3(c) and Figure 3(d)

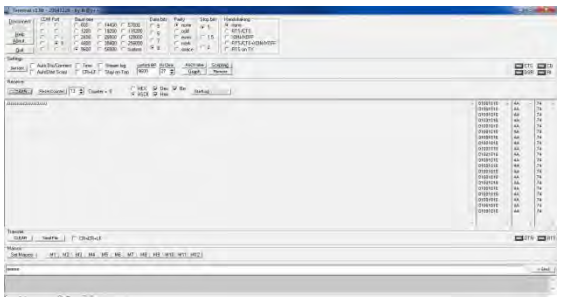

Figure (a) For Sending active tag ID 74

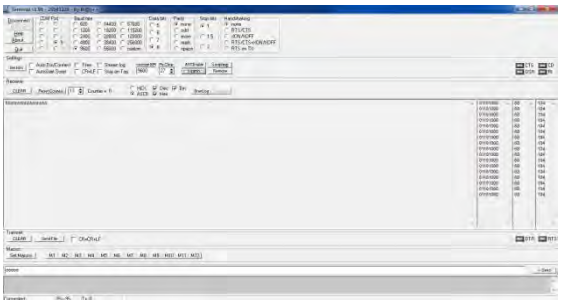

Figure (b) For Sending active tag ID 104

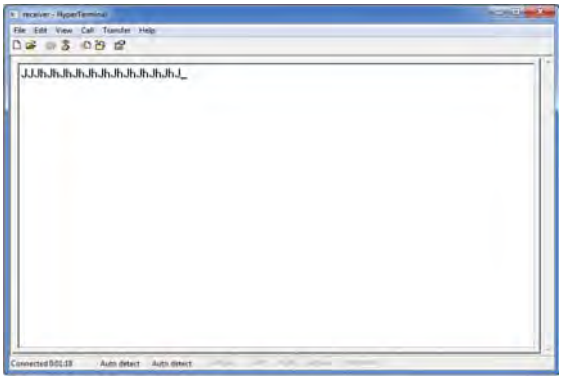

Figure (c) For receiving tag ID's on hyperterminal

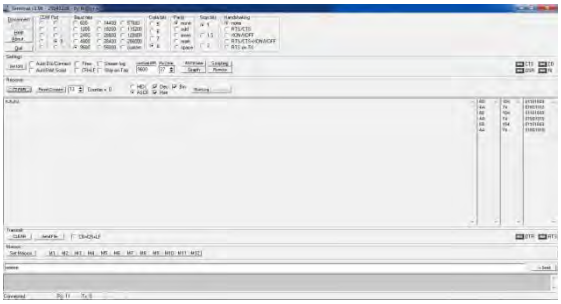

Figure (d) for receiving tag ID's on

Figure.3 Result of Hardware Test for Prototype Active Tag Read System Using Hyperterminal

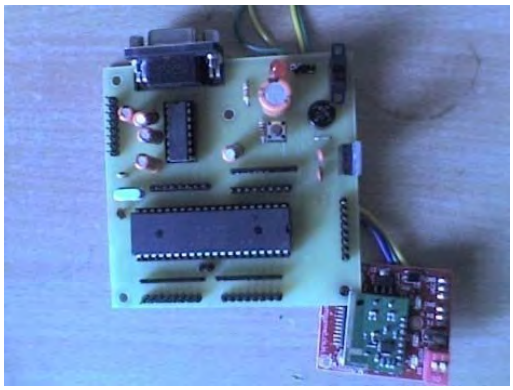

Figure.4 Photo image of working prototype model of active RFID tag

We observe that active tag is transmitting the Tag ID continuously to reader. The reader is interfaced to host computer by RS232 interface and displays Tag ID on HyperTerminal or Terminal of PC. In the Figure 3 (a) (b) result is received when two active tags sending their Tag ID; and Figure. 3 (c) (d) for receiving the Tag ID the simulation and debug results proved the feasibility of RFID design.

VI. PROTOTYPE MODEL TEST

In this system tag is issued to each vehicle so that each vehicle has its unique Tag identification number. Reader is installed at each base station which reads tag ID of the vehicle. The tag id along with the required information is stored in the database, so by entering tag id of the vehicle all the information will be available to the user on single click. The admin can keep record of the vehicle by clicking generate report button. Report includes the tag ID with base station Number, time of arrival and departure in excel. This excel file is shared with all the base station, and is updated by authentic person on arrival on respective vehicle. GUI for Intelligent Fleet Management System Using Active RFID is as shown in Figure 5.

Future Scope

This system can be used for security, automation and monitoring systems like multistoried car parking system, Mining, Logistics, Artwork Presentation, Construction Site Safety etc. We can develop application based GUI as per user requirement.

Figure 5 GUI for Intelligent Fleet Management Systems Using Active RFID

VII. CONCLUSIONS

In this paper Intelligent Fleet Management System Using Active RFID is presented successfully. Results of hardware test for prototype active tag read system are presented. The tag solved identification problems as long-distance, big flow, anti-interference, high-speed and at the low cost RFID tags. Tags can be used for persons or goods recognition, Management and location system, which is widely used in industrial production, national defense security and so on.

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