Secure Remote Access Fleet Entry Management System Using UHF Band RFID

N. Sathish and P. Ranjana

Abstract A Fleet management system based on UHF and RFID is proposed. This system is applied to a vehicle entering/leaving at the road gates. The system consists of a RFID tag present in the fleet, reader antenna, a reader controller, and the monitoring and the commanding software. The whole system sits on open source platform. The java code is used for controlling the platform. The band width of the UHF expands from 300 MHZ to 3 GHz which helps the system to detect the incoming fleet at distance of 30 m around the antenna even when the fleet travels at a speed of 45 km/h.

Keywords RFID · UHF

Introduction

Radio frequency identification (RFID) is an emerging technology with applications in several areas, from logistics to security. Usually, RFID cards have been used for people access control in office buildings, for public transportation billing, and even to store digital information in passports.

Active tags are normally used in cars, buses, and trucks because of their long reading range and reliability. However, the use of long range RFID for control access poses a serious problem: when the reader's detection range is difficult to control, it is very easy to make the reader presenting a wrong reading, and granting access without a valid request.

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This may happen when the tag enters an area next to the reading range. For instance, in a highway toll plaza, the toll reader can detect a car before it crosses the gate. So, if the car does not cross the gate for some reason, it will be anyway charged.

The same happens when a vehicle must get into premises, such as parking lots or garages. The vehicle can elude the system just by passing in front of the premises entrance and leaving. The reader has a high probability to detect the car tag in such a situation and make the system consider that the car is inside the garage. The objective of this work is to present and validate an approach to reduce the chance of a reader detecting a tag before it gets to a designated place.

Existing System

There is different type of vehicle entry management system available today. One of the existing vehicle entry systems uses security guards to manage the entry and exiting of the vehicles. This is an out dated system because it is literally inefficient for a large organization which could expect at least 1,000 vehicles per day. This system is does not provide conjunction control in the gate.

The other type of existing vehicle entry systems uses an IR sensor to detect the vehicles approaching the gate and open the door of. This is particularly effective if there is no security threat in the organization. The problem with this system is that it also allow attacker along with the other vehicles.

The latest existing vehicle entry system uses an RFID of lower frequency, which allow the system to sense a vehicle up to 9 meters from the base of the antenna. The system can detect vehicles that travel below the speed of 30 km/h. The existing system alerts the security personal to check with the unauthorized vehicle. The RFID tag can be detected by the antenna only when the RFID tag and antenna is placed in a precise position on the windshield.

Proposed Implementation

The proposed fleet entry management system uses ultra high frequency-based radio frequency identifier [1] that is more powerful, which will allow the system to sense the fleets arrival to a range of around 30 m, even with a speed of 45 km/h.

The proposed system also uses short range reader to find the fleets that are identified by the long range reader enter the premises. Only if the short range reader detects the fleets RFID, the gate will be opened.

The proposed system uses ethernet interface serial connection to communicate with the unauthorized person via vocal and video communication. This system can handle more number of vehicles that any existing vehicles management system

can't. This system automates the work of checking and registering the vehicles which enters and exits the premises.

This system uses a video camera to take picture of the unauthorized persons for future reference. This system can be easily fitted in any type of vehicles which are allowed to enter the premises. With this system in place we can make the segregate the parking facility for each type of authorization level and type of vehicles.

Proposed Design

System Overview

The software product can be used to secure the fleet entry. The application is divided into five phases and each module has its own functions. The central feature of this project is the automation provided which is not available in the existing system. The application basically consists of the following phases:

1. Client to server and server to client communication.
2. Communication between hardware and clients.
3. Microcontroller program for reading RFID reader.
4. Microcontroller program to control and open gates.
5. Microcontroller program to control in and out sensor.

The working of these phases depends on the type of database and other such requirements. Automation is achieved by the proper functioning of these phases. Thus, the project will save a lot of time during the synchronization process and emphasizes focus on the main thing – design and development – by taking the tiring routine upon itself.

Phases of the System

Figure 1 shows the system framework. The personal computer and RFID controller are placed in guard room and they are connected by AT89C51.

Two gates are for vehicle entering and leaving control, two reader antennas are placed at high positions for broader view angle, two optionally monitoring cameras could placed near road side for capturing the vehicle's images. The gates and the monitoring cameras are controlled by I/O interface of personal computer. The reader antennas are connected with RFID controller by coaxial cables for less attenuation transmission. The length of coaxial cables depends on the coaxial cable's attenuation value. Normally, at least 10 m is required for the implementation.

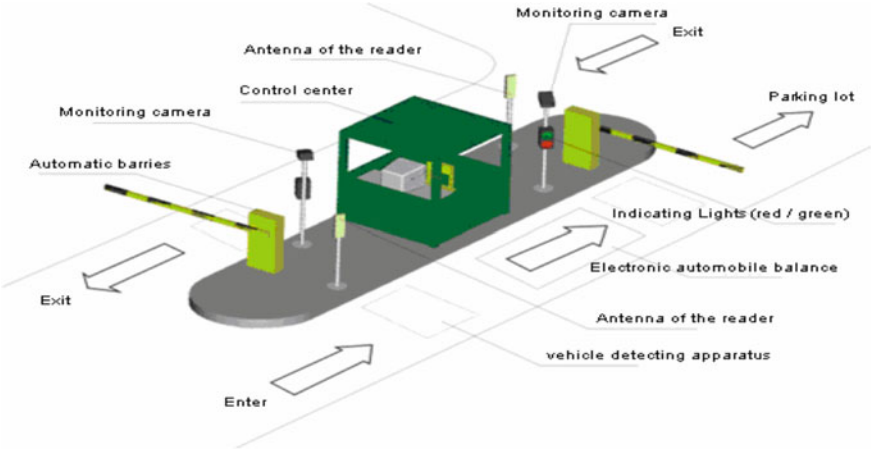

Fig. 1 System framework

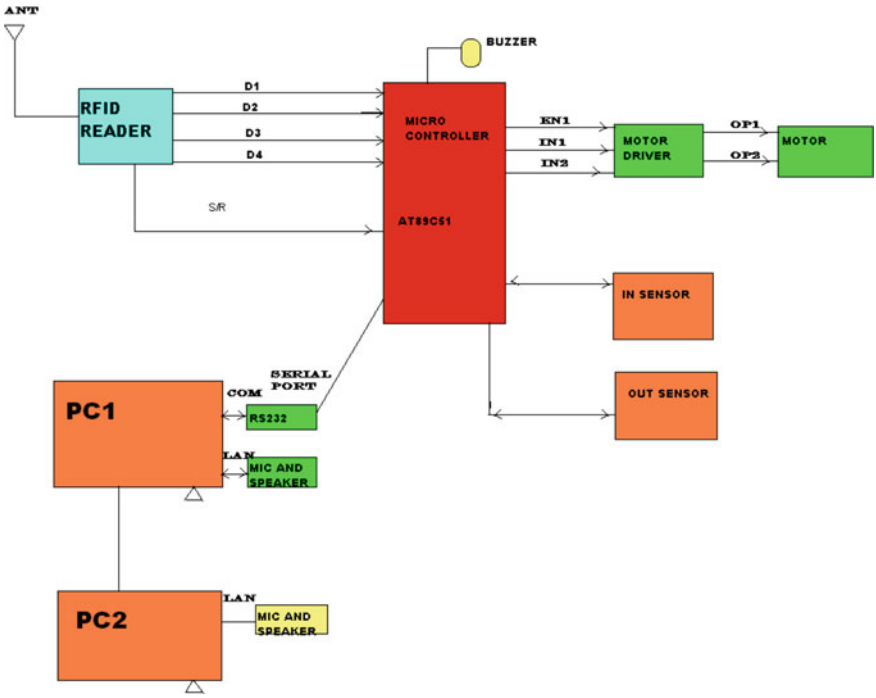

Fig. 2 Architecture of the system

Figure 2 shows the architecture of the system. The microcontroller "AT89C51" integrates the RFID reader with the computer. The microcontroller receives the signal from the RFID reader and sends the corresponding command to the software loaded in the computer.

Client-to-Server and Server-to-Client Communication

Java media framework is used to create a communication between client and server. The connectivity is done using ethernet interface serial communication [2]. To create a two-way communication media transmitter and simple audio player is used on both the client and the server.

Communication between Hardware and Clients

Java package helps to couple the hardware with the system. The microcontroller RS232 [3] converts the microcontroller data into voltage levels and vice versa. DB-9 or DB2 [4] pin connector is used to connect the hardware with system (Fig. 3).

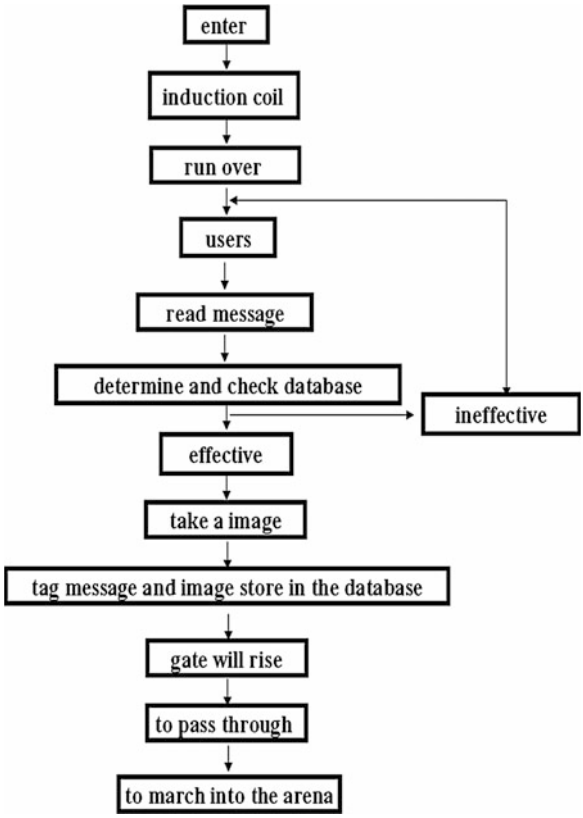

Fig. 3 Flow diagram for a vehicle entering the premises

Microcontroller Program for Reading RFID Reader

RFID [5] is a technology which uses tags as a component in an integrated supply chain. A tag is a transponder which receives a radio signal and in response to it sends out a radio signal. Tag contains an antenna, and a small chip that stores a small amount of data tag is powered by the high power electromagnetic field generated by the antennas. The microcontroller is programmed in such a way that it should respond to the inputs of the RFID.

Microcontroller Program to Control and Open Gates

The microcontroller used here is "AT89C51" which is an 8051 controller [5].The microcontroller issues a command to the motor that in turn open the gate. Authorized vehicles enter the premises. The security officer issues a command to open the gates. We use a RS232 to interface the motor and the microcontroller.

Figure 4 shows the alert to the security personal when an unauthorized fleets entering into the premises. The security personal can add the RFID tag to the database if available or can allow the fleet into the premises by sending open command through software to microcontroller.

Microcontroller Program to Control In and Out Sensor

IR proximity sensor built around the TSOP 1738 module which is simple and effective and used in the IN and OUT sensor which are placed on either side of the gates. The carrier frequency of this sensor is between 32 kHz to 42 kHz. It is used to detect the flux of the fleets Fig. 5.

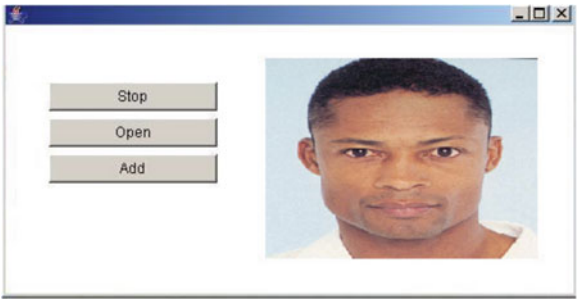

Fig. 4 The entering message displays window

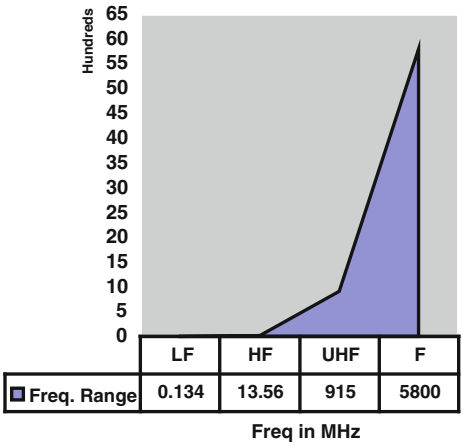

Fig. 5 Frequency graph

Dataflow Diagram

All the fleets entering the premises with the RFID tag will read by the antenna and the data will be compared with all the records from the database as shown in Fig. 3.

If the record is available in the database, then the information about the fleet and a image will be taken and stored in the entry table. Then the control will be sent to the microcontroller, which will control the open and close operations of the gate.

If the record is not available in the database, then the control will be sent to the security personal located anywhere in the premises.

Figure 6 describes the process for the fleets leaving the premises. When a RFID is received by the antenna, the tag will be read and checked in the database.

If the user is permanent, the fleet is allowed to move out from the premises. If not, then the parking pay will be deducted from the use, and then the fleet is allowed to leave the premises.

Experimental Analysis

The proposed system consists of both long range and short range readers. The long range reader detects the fleet about 30–40 m and sends to the system where the fleets unique RFID is matched with the data stored in the database.

If the RFID of the fleet is available in the database, then the system will wait for the short range RFID reader to detect the fleet. Only then the system will enter the details in the log file. Long range RFID has an accuracy rate of 80 %, whereas short range RFID has an accuracy rate of 100 %.

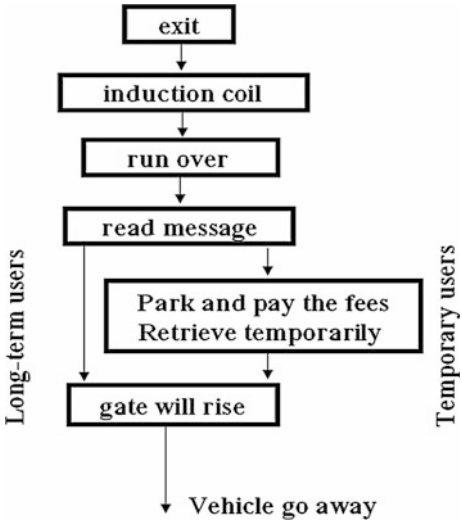

Fig. 6 Flow diagram for a vehicle leaving the premises

If the short range RFID reader did not detect the RFID tag that is detected by the long range reader, then the log will not be created for the fleet and the gate will not be opened.

Without using the short range RFID reader, the fleets that came near the entry gate may not be passed through will also be stored in the log file. Using the system, the log will be created for the vehicle that enters the gate.

The java platform has to be developed such a way that it can handle multiple requests at a time and also the request has to be in hold for some time till the short range reader detects the fleet.

Conclusion

Thus, we developed a web-based application which provides a common platform for several features. It mainly provides user to allow the vehicles IN or OUT without any security personal at the gate. It also provides the facility to chat with the unauthorized person who tries to enter the gate.

Security has been a bigger concern these days, in current scenario the security of the premises is handled by the security guards. The security guards can be easily corrupted which will make the premises vulnerable to attack like terrorist attack, data theft, and vehicle theft. Our system reduces the risk as the fleet entry is automated and the intervention of the security guards are kept minimal.

Future Work

Future enhancements are possible in this paper. Some of the possibilities are:

- Our project can be future improved by adding CCTV camera
- SMS alerts
- Video conferencing
- Crystal reports of the historical data

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