Double tag car parking secure system based on RFID

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Abstract

Radio frequency identification system technology is employed in this proposed security system in order to create high level of accuracy as possible. Whereas the accuracy is considered as a heart of system because any simple error may lead to breach whole security system. Beside the accuracy we should close all the expected Illegals methods which could be exploited for illegal entry. Our solution represented by eight main stages, the first stage consists of embedding the ID into a tag and assigning the same to a car. The second stage is reading the IDs from the RFID tags in the reading range. The third stage is checking from the matched tags. The fourth stage involve take the decision about open the gate. In the fifth stage the camera capture a photo of the car and save it with the date of entry. The sixth stage involves opening gate and change the traffic light to green color. The seventh stage is checking the under gate arm area by using loop detector sensor. In the final stage change the traffic light to red and close the gate.

INTRODUCTION

Like bar code recognition, RFID relies on tagging in order to identify objects. RFID tags don't need to be visible to be read unlike bar codes. An RFID reader sends a radio signal, which is picked up by an RFID tag and then transmits back a string of data. Depending on the size and sensitivity of the strength of the transmission, and the reader's antenna the tag can be several feet away from the reader, enclosed in a book, box, or item of clothing. There are two types of RFID system: passive and active. Passive RFID tags are powered by the current that the reader's signal induces in their antennas. In an active RFID system, the tag has its own power supply. Active systems can transmit for a much longer range than passive systems, and are less error-prone. They are also much more expensive [1].

1.1 EXISTING SOLUTION

In last years some researchers proposed systems dealing with radio frequency technology to solve some problems. Some research studied shows the basic concepts behind RFID technology, and associate security issues and threats in using RFID technology [2]. The objective is to deliver a greater understanding of the security related aspects of this technology. Threats posed in this paper are bellow:

• Radio signals transmitted from the tag, and the reader, can be detected several meters away by other radio receivers. It is possible therefore for an unauthorized user to gain access to the data contained in RFID tags
• It is possible to perform tag spoofing. For instance, the intruder could fool an RFID system, and change the identity of tags to gain an undetected advantage. [2].

While Rishab Nithyanand in Paper [3] studies RFID tags that are capable of performing high level cryptographic operations (including public key operations) motivates new RFID applications, including electronic travel documents, and payment instruments [3].

While Xiaolong Li and Uma Kanth Ranga deals with digital vehicle management system using radio frequency identification (RFID) technology. The digital vehicle management system will enhance the utilization of parking space and help user check the availability of the parking space remotely since the system is connected to the Inter- net. There are four stages in [4], the first stage consists of embedding the code into a tag and assigning the same to a car. The second stage is reading the data from the RFID tag to the microcontroller. In the third stage, the data is uploaded from microcontroller to the Ethernet. The final stage is to keep a track of vacancies of the parking

spaces [4].
While Zeydin PALA and Nihat INAN proposes connection all parking of the city together by using same SQL data base to reduction in transaction costs with the use of Radio Frequency Identification (RFID) technology in automation. Where each parking make check about the car before give permission to pass [5].
Ron Weinstein studied the types of RFID systems and applications so offers an RFID tutorial that answers the following questions: What is RFID, and how does it work? What are some applications of RFID? What are some challenges and problems in RFID technology and implementation? How have some organizations implemented RFID? [6]
After reviewing the previous research and papers, there is a big different between the practical and theoretical sides were the theoretical side is mostly considered. While in this paper the practical side is strongly considered, especially in the field of security. Building a security system is characterized by high efficiency, accuracy and a lot of other features.

1.2 PROBLEM DEFINITION

In the last decade, Iraq has suffered a lot of problems, especially in security systems, because the primitive means are applied in Iraq Such as manual inspection or using the badges that can be easily forged leading to fool the security men, which cause's system disaster when entering the car illegally. At the University of Babylon, a badge is used in order to control access of cars, and every car has some information on it, before any car entrance the University of Babylon, a police man must check the car information. Although the probability of forgery there are a lot of side effects of this process, such as the delay in cars entry to the university, causing congestion for large number of cars and a large number policemen are needed to control this process. The better solution is by using an automatic security system where it has a very accurate and very fast functional act on the principle of RFID technology.

1.3 PROPOSED SOLUTION

The preserved paper introduces an automatic security system of car entrance through the main gate of university using RFID technology which is well known one of the new technologies of the identification field. The proposed system mainly consists of two tags one for the car and the other for the driver. Ones the car entered the reading range, the reader reads information of tags under some criteria's, the system decided whether to open the gate or not. The system takes considerations of security features in order to the entrance of unlicensed prohibit cars. RFID system consists of two readers, number of tags, two cam- eras, microcontroller, gateway, ALFA, base station and terminal device (gate). Each car have a tag "car tag" and the car owner also have a tag known as "driver tag" Every car try to enter the university must contain two matched tags (car tag and driver tag), otherwise there is no possibility to enter. Figure 1 show the Proposed RFID security system.

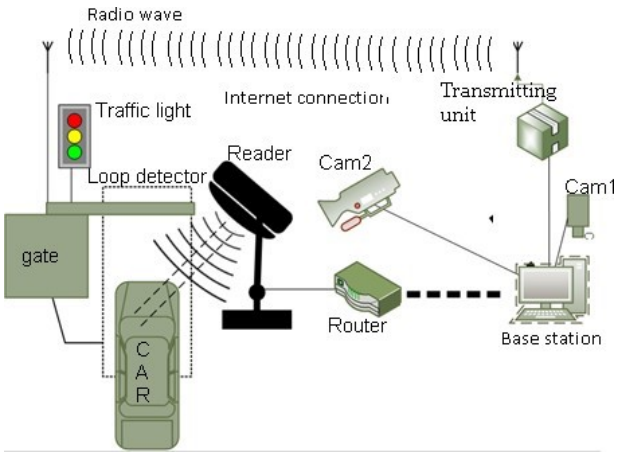

Fig. 1. Proposed RFID security system.

2 SYSTEM DESIGN AND IMPLEMENTATION

The designed system presentation is grouped functionally into four units namely (under observation unit, observing and data transmitting unit, main control unit and trans- mitting unit). The details of each unit (hardware and software) are presented in the following

2.1 UNDER OBSERVATION UNIT

It is the unit that's subjected for detection the car and the driver by means of observing and data transmitting unit by the tags that present on it. These units consist of two matched tags (car tag and driver tag) responsible for send IDs when receive the reader query.

2.2 OBSERVING AND DATA TRANSMITTING UNIT

The basic function of this unit is to provide interface environment among (tags, main control unit and the internet) as described in the following steps. The first step involves receiving the information about ID of each tag present within the reading range of the reader. The second step involves resending the information that's received previously in the first step to the main control unit. In the third step the observing and data transmitting unit will receive the processed information from the main control unit to share them with the internet for further processing. Figure 2 represent the interface environment that provides (Observing and data transmitting unit).

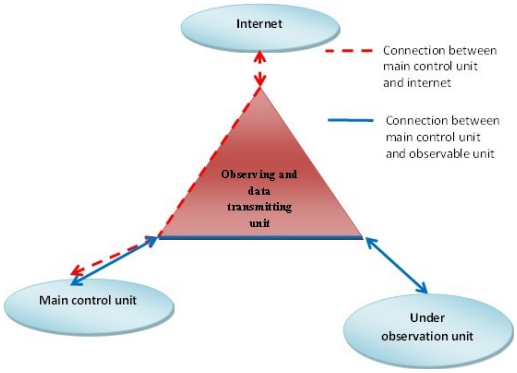

Fig. 2. Observing and data transmitting unit

This unit consists of two subunits which are Reader and Gateway (Router). Two UHF Long Range Integrated Readers are used, one of them is placed on the entrance gate and the other one placed on the exit gate. Each UHF Long Range Integrated Reader reads all identification numbers of tags and sent to the main control unit to complete the control processing. The MR6111E UHF long range integrated reader is used in this system. The reading range is tested according to the following criteria, height of antenna is 2.3m, and height of tag is 1m. The reading range for single tag is around 9 meter while two tags together is around 4.5 meter. This range enough for this proposed system. The tasks carried out by the reader, this system provides the link between the present's tags and the base station from main control unit, and the other task is to provide the ability to write the ID number for each (EPC, RESERVE and USER) memories on the tag. The communication between the base station and the reader is controlled by the base station. The base station sends commands to the reader then the reader will implement these orders and returns the response to the base station. Aims of the Gateway (Router) are provide wire- less control of the reader and Communicate with the reader through the created local area network LAN and at the same time communicate with the Internet through a global network WAN. The TL-WR940N router from TP-Link Company is used in this system because it has the suitable features. The Ethernet cables are used to connect the parts of observing and data transmitting unit. The first step is connecting the router to the Internet by the Ethernet connecting cable to the WAN slot Input, The second step connect the reader with the router

through the pin No.1 or other pin in the router.

2.3 MAIN CONTROL UNIT

It is the main unit in RFID security system, while the basic function of this unit is to control of all parts of the system and give the order to open the gate, the operation steps of this unit are shown in figure 3

Suppose that everyday 1000 cars enter the university. The camera takes a picture of each car. That means 1000 pictures per day, as known an image of JPG Formula require 25KB as average, the time will be as follow:

Time= 320GB/ (1000*25KB) =13421.77Day =447.39 Month=37.28 Years Need to fill memory.

So it is very clear that it is better to take a photo rather than a video recording.

b. BASE STATION (PC)

It is the center of the main control unit for all parts of the system by using a special program has been programmed to control this security system, considered all the expected cases of security breaches and to provide the necessary solutions to prevent any expected breaches. This program is designed and implemented to achieve all the expected security aims. The final shape of the program consists of six tab page (five visible and one hidden). We will describe aim and operation of each page. The "HOME" page is shown in Figure 4

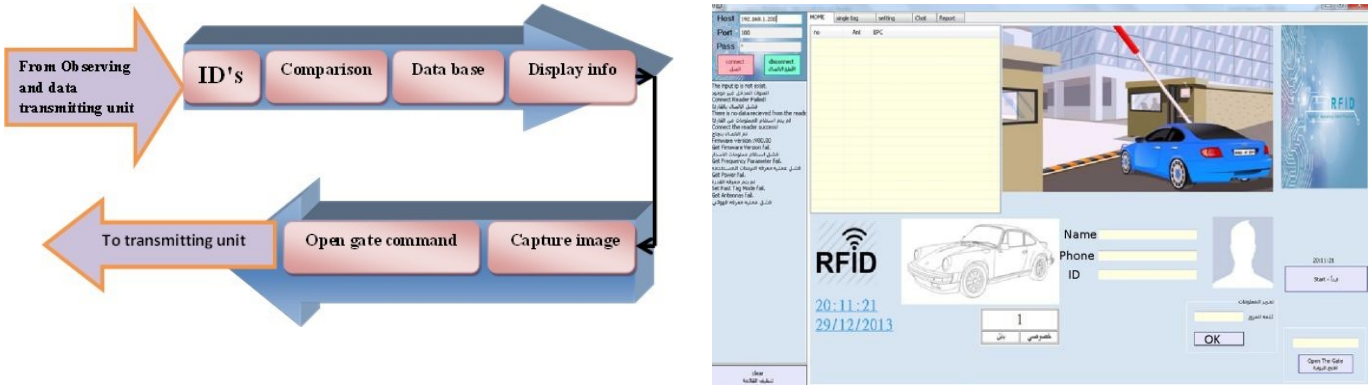

Fig. 3. The operation of main control unit

The first step is receiving the ID of each tag presence in the reading range of the reader and save it, then move to second step which involve comparison operation among IDs, The results of comparisons will go to data base in third step in order to fetch information of the car and the driver, and fourth step displaying those information on the computer screen. The fifth step involves pictures capturing and opening the gate. Generally the main control unit operate on transmit the information to the internet web site, receive information from the internet , transmit data to transmitting unit, process all this information and display the information on two screen (computer screen and other screen on the internet) this operation is carried out by the subunit's that will be discussed in details.

a. CAMERAS

Two cameras are used for monitoring the control room and gate area, where the first cam is responsible for observing the control room system and it can take a picture of each person who tries to open the gate manually. The other camera is responsible of monitoring the gate area. It can take a picture of every entering car through the gate. Owing to some reasons are considered, capturing pictures at sensitive times is used instead of video recording. The first reason is the memory storage. If we assume that the computer has 320 GB memory using video recording system. As known the minute at Video format AVI requires about 30 MB, to calculate

the time that can be stored in the memory of 320GB is:

Time=320GB/30MB
Time=10922.66 minute=182.04 Hours=7.58 Day Need to fill the memory. In the other hand, if the camera were only used to capture pictures when cars enters the gate.

Fig. 4. Graphical interface.

In order to enable the interface program the address of reader, port number and password should be entered after that the following steps become already under processing. The first step is check the present reader have IP address similar to the entrance IP. The second step is check of the person who tries entering the system. If these tests are succeeded then the reader is connected with the base station and allows the person the entire control of the system. In other side there socket timer began to operate, this timer is responsible of connection in real time between base station and secondary display subunit, by checking the connection every minute. The re-connect in the event of any type of connection error. In other hand when the person incharge want to disconnect the connection by push the disconnection button the following steps happens, the first step is recording the name of the person and exit time. The second step is separates the system itself from any control operation. The START button works on identifying operations of tags and makes necessary comparisons to identify the cars and their owners and connect with the internet to send and receive information from other computer or website. Work is done as the following, The first step is to give the command of reading to start the reading of the ID of all presented tags in the reading range of the reader , the second step is the creation of the list to put ID's in it , the third step is checking each ID before adding it to the list to prevent the IDs frequently input , the fourth step is making comparisons between IDs in the list according to specific protocol to prevent any overlap between IDs and extract information correctly. In the other hand the system is checking the connection between base station and readers and repairs any error may occur, but if the system cannot repair this error, it will make a sound alarm and shuts down the program. The system provides the possibility to open the gate manually by click on OPEN THE GATE button which belong to HOME page. But because of the importance of this feature and the possibility of illegal exploitation the cam is put to monitoring the user. The CAM works and takes a picture of the person who uses this button and saves the image with the documented time. In addition no one can use this feature because password must be entered first before opening the gate. Typing the wrong password five times causes system shut down. Work is done. Some of the registers in the computer is used as a temporary memory for the purpose of increased speed in system performance. Using these registers in- creases the processing speed of the data which leads to increase the efficiency of the system but the problem is when formatting computer system and removes all in- formation stored in it causes the loss of stability of the security system. Since it is the main objective of this thesis is to implement an integrated security system must solve this problem .We proposed to collect all the information from the computer and save them in a single file and then be redistributed after the format by pressing this button. To get and Set frequencies that used in frequency hop- ping separate spectrum (FHSS). (FHSS) Is a way to transmit radio wave's encrypted manner by rapidly switching a carrier. Using a pseudorandom sequence known to both transmitter and receiver. Here you can choose the frequencies that will be used in Frequency- hopping spread spectrum. China Frequency (920-925 MHz), North America Frequency (902-928 MHz), European frequency (865-868MHz), and others frequency configurable. As shown in figure 5

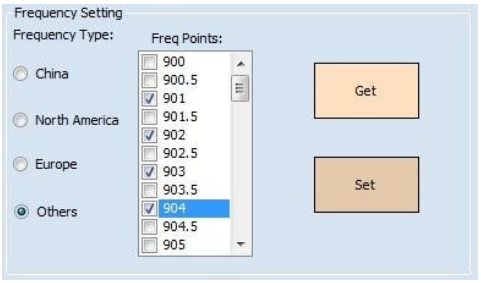

Fig. 5. Frequency setting.

There are two working mode, Favor speed and Favor quantity for the query and setting as shown in figure 6. Favor speed used for few tags reading with the high speed tag reading rate. Favor quantity is used for high number of tags reading

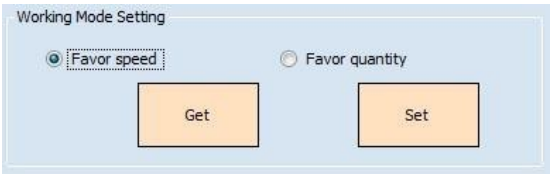

Fig. 6. Working modes setting

2.4 TRANSMITTING UNIT

The aim of this unit is transmit order to open the gate according to the order from the main control unit. The transmitting unit consists of two subunit which are processor (MCU) and transmitter subunit. The MCU is used to process the data coming from the serial port of the computer. The processor subunit used in this system is the Atmel MCU (ATmega328), we used the Arduino plat- form that contains the ATmega328 MCU and this plat- form is the open source platform which is easy to use in terms of software and hardware. MCU is programmed through the Arduino programming language which is integrated development environment (IDE). This language based on C / C + + language. We programmed the MCU to control the node tasks receives data from the serial port of the computer, processing and sending orders to relay shield for the purpose of control of the gate. Command transmitting subunit is used for transmit the command of open gate from the main control unit to gate control unit after making some procedures by the processor. 418MHZ is used for remote control with distance about 30m. Figure 7 shows the Transmitting unit.

Fig. 7. Transmitting unit.

3 SYSTEM OPERATION

At beginning must open the program and enter the Reader IP, port and password then click on CONNECT button. Notes the enable of other buttons and pages then click on START button which belong to HOME page to start the reading operation and let the program to take decision about opening the gate or not. The abnormal cases are Case one: when visitors comes to the University of Babylon, the user must open the gate manually by enter the password and click on OPEN THE GATE button which belong to HOME page.

Case two: If the tag is stolen or lost, the user can attend this tag in order to prevent breach by this tag, just insert the EPC of this tag and click on LOCK button which be- long to SINGLE TAG page.

Case Three: When some persons become already under the reading range, the system deal with all Cases, every two tags are compared with each other to know the identity of the person allowed him to pass.

4 SYSTEM FEATURES

1. High-precision security system works automatically regulates the entry and exit of vehicles in a particular location.
2. When any car is going through the gate, the system displays the following information on the computer screen (The name of the driver of the car, Phone number of the person, ID number of the person, ID number of the person, Image of the person, A picture of the car, Image of the car and information)
3. The system provides the possibility to open the gate manually
4. The system can be controlled from a distance of more than 20 meters wirelessly.
5. The age of the system is too long.
6. Easy to use and control it.
7. Speed performance.
8. There cam for direct imaging of the gate and display the image on the screen. It also captures every car entering the designated location with the recording and saves the image with the time of entry.

5 RESULTS AND DISCUSSION

In this section the results which have been collected from several tests will offered also these results to be discussed from a different aspect in order to explain the advantages of this work

a. LOGIN AND LOGOUT OF THE SYSTEM

The system is protected, and password, IP and port number are required to precede the connection process successfully. After insert this information and click the "CONNECT" but- ton, The system gives a report to the user about the connection state and explain if the connection is successful or not. To logout of the system click the "DISCONNECT" button. This operation is shown in figure 8

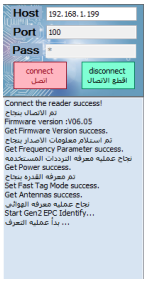

Fig. 8. Login & logout

b. NORMAL OPERATION TEST RESULTS

When legal car (which carry two matched tags) become near the reader as shown in figure 9a, The information on car is showing on the computer screen as shown in figure 9b then the gate was opened and the traffic light become green as shown in figure 9c, after the car passes completely over the vehicle sensor the gate was closed automatically and the traffic light become red, waiting for another car as shown in figure 9d.

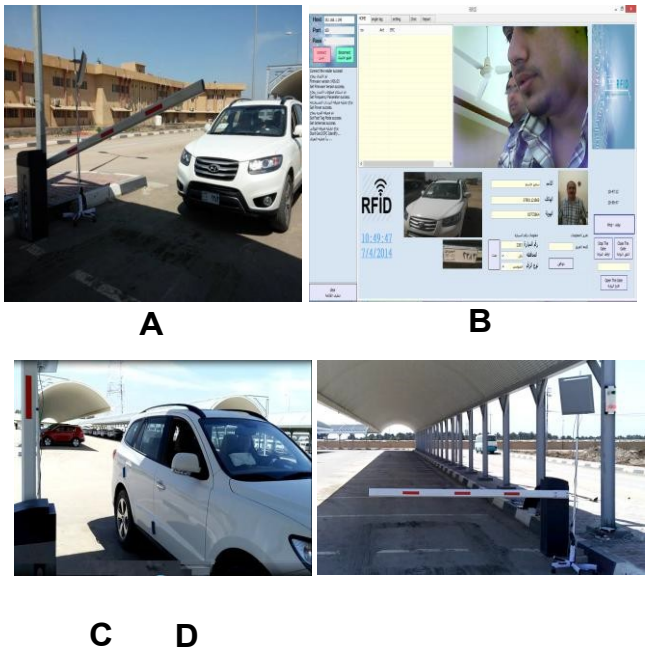

Fig. 9. Figure 9 Normal operation tests (A- legal car, B- information of car, C- opened gate, D- closed gate and red traffic light).

c. SUSPECT CASE

When the car hasn't any tag on it or has two tags but it's not matched, the system will not open the gate as shown in fig-ure10

Fig. 10. Illegal case.

6 CONCLUSIONS

- Used two tags cause increase of security against theft and fraud and increase the accuracy of the gate state (will open or not).
- The system is flexible for any new requirements such as adding new readers, changing the network topology, or updating the GUI.
- The coverage of the reader is about 4.5 meters in diameter and that is enough for receive information from the tags in the car.
- According to the obtained results, the presented security system is very useful and applicable

for the University or other site.

- Wireless connection between the control room and gate give flexibility to build the control room far from the gate about 20 meters.

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