

Research Article

Control and Surveillance Secure System on Entrance Gate Based on Wireless Control and Internet

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Abstract: Recently, Iraq suffering a lot of security problem because the traditional methods are applied in security systems in Iraq such as using manual inspection. This method is easy to cheat and breach the security systems which lead to passing cars illegally. Radio frequency identification system technology is employed to increase the accuracy as possible. The proposed system involves two aspects which are hardware and software. The hardware consists of readers, tags, cameras, micro controller, router, four computers, loop detector, traffic light, transmitter and the barrier gate. The software consists of main station program, micro controller program, secondary storage program, secondary display program and website program. The codes are written using C#.NET. Hardware and software work together to support system features. Firstly to increase the security of the system we used double tags (one for driver and another for car). In addition the system is characterized by features like anti-hacker, achieve contact with the traffic police website, record daily reports about each car passing through the gate, monitoring ability via internet, storage all information via internet and mixing between human ability and automatic system by display all information on the computer screen to give human ability to take decision at emergency. The proposed system is implemented practically and tested; the presented results obtained demonstrate that the system has a high reliability.

Keywords: Barrier controller, car radio frequency identification, loop detector, passive tag, RFID security system, UHF reader

INTRODUCTION

Radio Frequency Identification (RFID) is one of important technologies that is used to detect and identify any thing depends on the using tags. The tag is used to transmit information over RFID reader inquiries. RFID tags provide a unique identifier to the reader query by transmit its fixed unique serial number. Each new tag carries only its ID in disguise to avoid eavesdropping and clandestine tracking. On the other hand, the program is responsible for protecting the database information (Cristina, 2009). There are two types of RFID tags: passive and active. Passive tags are powered by the current that the reader's signal induces in their antennas. In an active RFID, the tag has its own power supply. Active systems can transmit for a much longer range than passive and are less error-prone. They are also much more expensive (Tom, 2012).

Graphic operations (including public key operations) motivate new RFID applications, including payment instruments and electronic travel documents, (Rishab, 2010). Xiaolong and Uma (2009) write about digital vehicle management system using Radio Frequency Identification (RFID) technology. The digital vehicle management system enhance the utilization of parking space and help user check the availability of the parking space remotely since the

system connected with the Internet. There are four stages can describe paper, the first stage consists of embedding the code into a tag and assigning the same to a car. The second stage is reading the RFID tag ID 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. Pala and Inanc (2007) proposed connection of all parking of the city together by using SQL data base to reduce transaction costs by use of Radio Frequency Identification (RFID) technology in automation. Also each parking make check about the car before give permission to pass.

Weinstein (2005) studies 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 challenges and problems in RFID technology, How have some organizations implemented RFID.

After reviewing the previous papers and research, it is very clear there is a wide different between the theoretical and practical sides were the theoretical side is mostly considered. While in this study the practical side is strongly considered, especially in the field of security. Building a security system has a high efficiency, accuracy and a lot of features.

In our case study at the University of Babylon, badge checks the information about each car depend on the badge carried by the driver. But this method cause some disadvantage such as high probability of breach it and make crowd of cars because delay of processing also it need a large number policemen to control this process. So it's necessary to find out security system have to become secure, accuracy and fast in processing. Most of these features are existed in RFID technology.

The preserve paper introduces an automatic security system for control of car entrance through the main gate of University of Babylon main campus based on 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, barrier gate, loop detector, traffic light, Reader, router, base station (computer), two camera, microcontroller, transmitter unit, website page (msc-rfid.com) and three other computer for better service. Ones the car enter the reading range of reader, the reader send Inquire to the tags in order to read its information, the system decided whether to open the gate or not after check security aspect such as matching between driver tag and car tag. The system takes considerations of security features in order to the entrance of unlicensed prohibit cars.

SYSTEM DESIGN AND IMPLEMENTATION

Taking Fig. 1 in consideration, the designed system presentation is grouped functionally into five units which are (under observation unit, observing and data transmitting unit, main control unit, transmitting unit

and the barrier unit). The details of each unit in two aspects (hardware and software) are presented in the following.

Observing and data transmitting unit: The basic function of this unit is to provide interface environment between internet and this security system as described in the following steps. In the first step the information (ID) of each tag exist in the reading rang of the reader is received. The second step involves retransmitting IDs that's received previously to the base station in main control unit. The third step involve share information with the internet for other processing, the information such as name of driver, date of entry, picture of car, picture of driver and other information about car number. Figure 2 represents the interface environment that provides (Observing and data transmitting unit). This unit contains two main part which are Gateway (Router) and Reader. UHF Long Range Integrated Reader was used, it placed on the entrance gate of University. UHF Long Range Integrated Reader reads all identification numbers of tags and sent it again to the base station in the main control unit to complete the sequence of processing. The MR6111E UHF long range integrated reader is used in this security system because it has suitable Features. The reading range was tested according to the specific criteria, height of tag around 1m and height of antenna around 2.3 m. The reading range of tag is around 9 m. This reading range is enough to communicate between tags and reader without need to hang tag outside the car window. So the reader is responsible for provides the link between the tags and the base station of main control unit. The

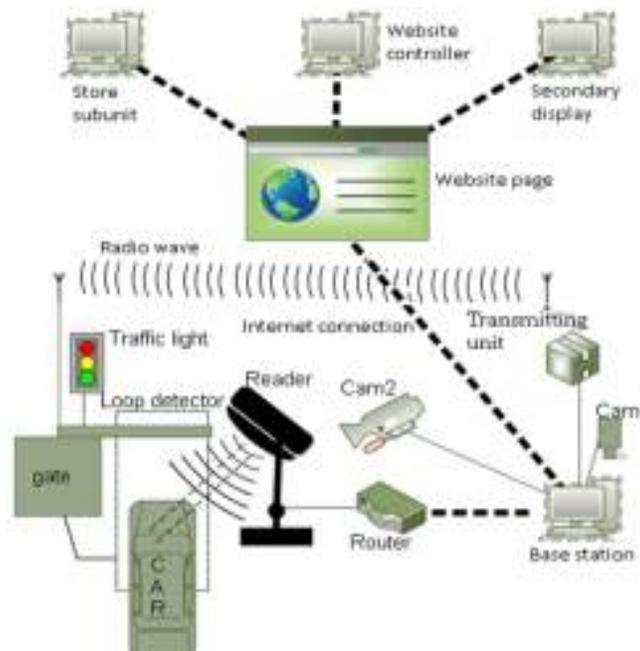


Fig. 1: Proposed RFID security system

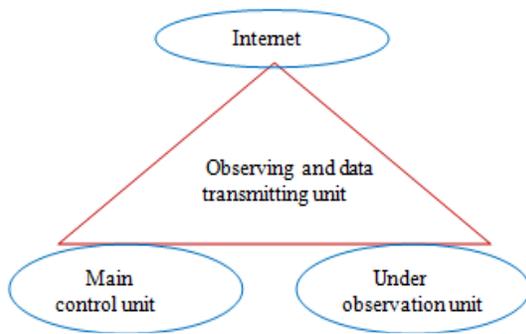


Fig. 2: Observing and data transmitting unit

communication between the reader and base station is fully controlled by the base station. The reader receives commands from base station and implements it then returns response to the base station. Aims of the Gateway (Router) are provide wireless connection between reader and base station also provide connection with the internet through the created 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. 2 or any other pins in the gateway (Fig. 2).

Main control unit: It is the main unit in this security system, it's responsible to control the other parts of system and make most processing that system need. The operation of this unit explained in the following steps, referring to Fig. 3. The first step is receiving the ID of each tag exist in the reading range of the reader, the second step involve make comparison among IDs of the tags and data base, The results of comparisons go to

data base in third step in order to fetch information of the car and the driver (such as name of driver, picture of car and picture of car) and fourth step displaying those information on the base station (computer screen). The fifth step involves storage of that information in another computer through internet and my website by using FTP protocol. The sixth step involves take a picture and open the gate. At seventh step that information are displayed on another computer (may be the head of security in university). 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 via internet) this operation is carried out by the subunit's that will be discussed in details.

Cameras: There are two cameras used in this system. The aim of the first one is to monitor the gate region and take a picture to each car passage through the gate. This method of monitoring save a large storage capacity, this lead to storage historical report about each car may reach to dozens of years. The second camera used in control room in order to monitor the in charge person when he decided to open the gate manually (without need tags) because this option is very important.

Base station (the computer): It is considered as the heart of the main control unit and all system. The program of base station designed 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 first page called HOME page is shown in Fig. 4.

The "HOME" page is responsible for some action such as join the system by insert the port number, IP of reader and password. Also the reader start reading state

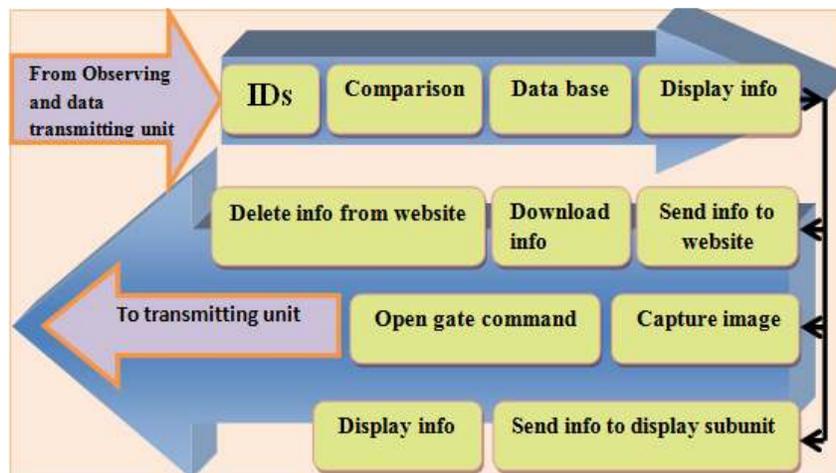


Fig. 3: The operation of main control unit

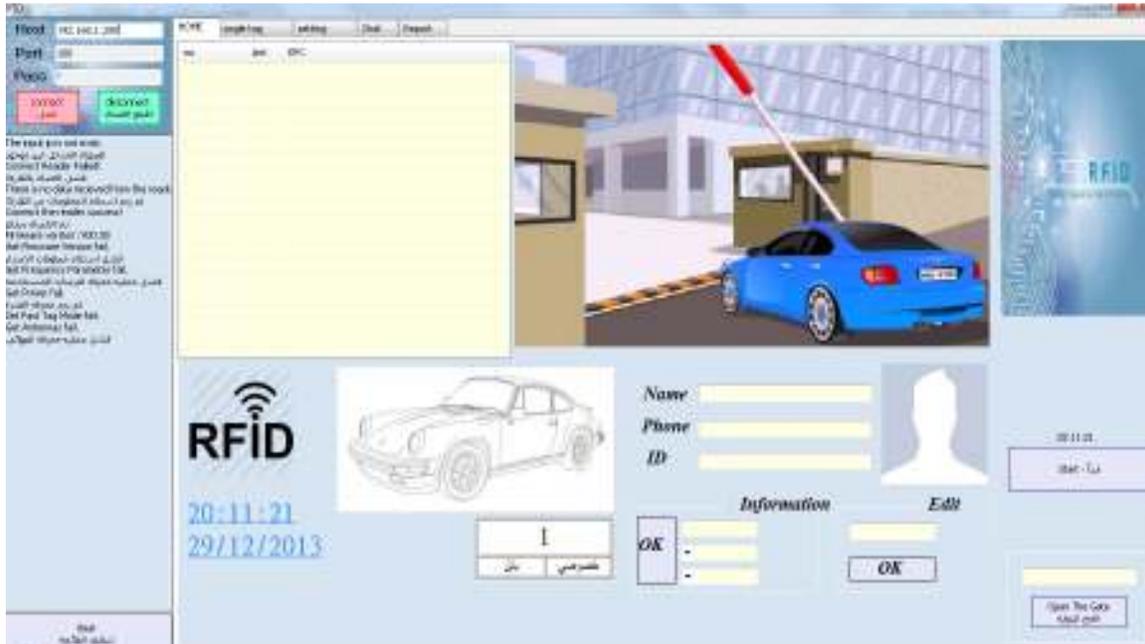


Fig. 4: Graphical interface of "HOME" page

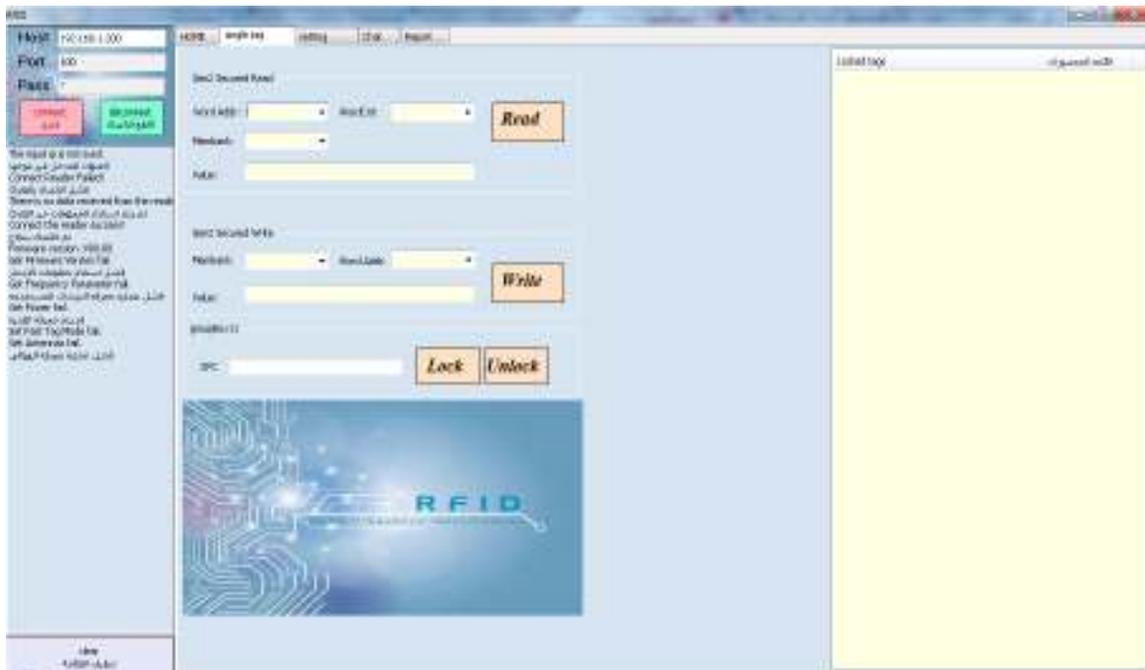


Fig. 5: View of "SINGLE" page

by click on "START" button belongs to this page. The list in the left side used to inform in charge person about what happen in the system (such as success or failure of the process or warning for penetration of the system). In addition to that, the in charge person can open the gate manually by click on "OPEN THE GATE" button after insert right password. "EDIT" button use to showing hidden page (Edit) that will be explained later. At first the password must be entered

correctly, if the password is entered incorrectly five consecutive times, the system will be shut down to avoid the process of trial. finally when the car passing through the gate some information appear on this page such as driver's name, Image of car number, Image of car, Image of driver, Identification number of the driver, The phone number of the driver.

The second page called "SINGLE" page as shown in Fig. 5. This page responsible for some task which is:

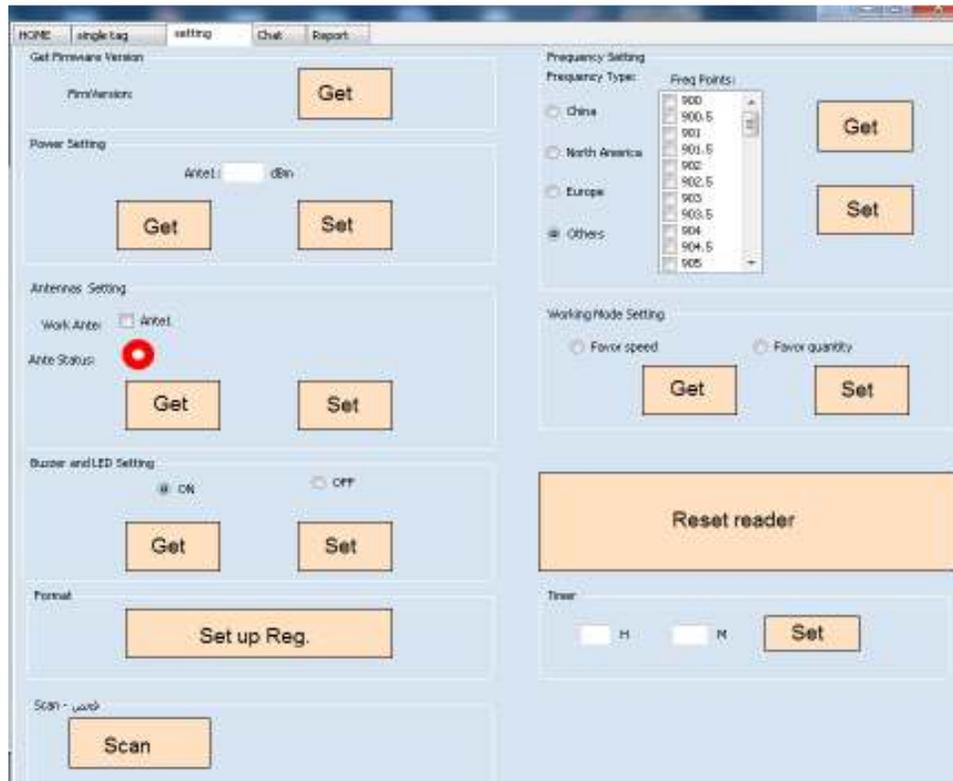


Fig. 6: GUI of "SETTING" page

read the ID from the single tag present in the reading range of the reader, write the ID to the single tag present in the reading range of the reader, lock any tag by inserts the EPC and unlock any tag by insert the EPC.

The third page called "SETTING" page as shown in Fig. 6. This page is responsible for some tasks which are: Identify the version of the reader (It's a way to test data transfer between reader and base station and Identify and set the used power of the antenna (0-31 dB). Whenever increases power the reading range of the reader will increase. Some of the registers in the computer is used for the purpose of in-creased speed in system performance. Using these registers increases 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 information stored in it causes the loss of stability of the security system. Since the main objective of this study is to implement an integrated security system must solve this problem. We proposed that the collection of all information from the computer and save them in a single file and then be redistributed after the format by click "SET UP REG" button. The security system must be strong in all aspects of security, including protection against hacking, hacking is a process carried out by a person unauthorized to enter into the system and the acts of surveillance and delete files. There is a large number of ways to the process of hacking but all these

methods do not work unless there is a file in a computer called hacking file. Hacking file is a file is hiding in certain areas of computer. The hacker can communicate with it for the purpose of control of the computer and control system. When click "SCAN" button, the program searches for a hacking file in the computer, found it and kill it. In case when system is unable to kill the hacking file, it will send sound alarm and text alarm to in charge person.

The fourth page called "CHAT" page as shown in Fig. 7. This page is the easiest way of communication between the user and the designer. Writes the problem or whatever he wants to say and then presses Send button, the message goes to the website, <http://msc-rfid.com>. This website is designed for the purpose of communicating with the user and helps to solve problems. Web designed by asp.net 2012 language. This website contains a high security features that distinguish it from other websites. asp.net 2012 is advanced language designed by the Microsoft Corporation. This language is used in the design of most of the global government websites at the present time, you can visit our website on the link mentioned above.

The fifth page called "REPORT" page as shown in Fig. 8. Here is a presented daily reports on all cars entering and leaving the university with a time of entry and exit of every car as well as provides reports about the person who control the system (the time of entry

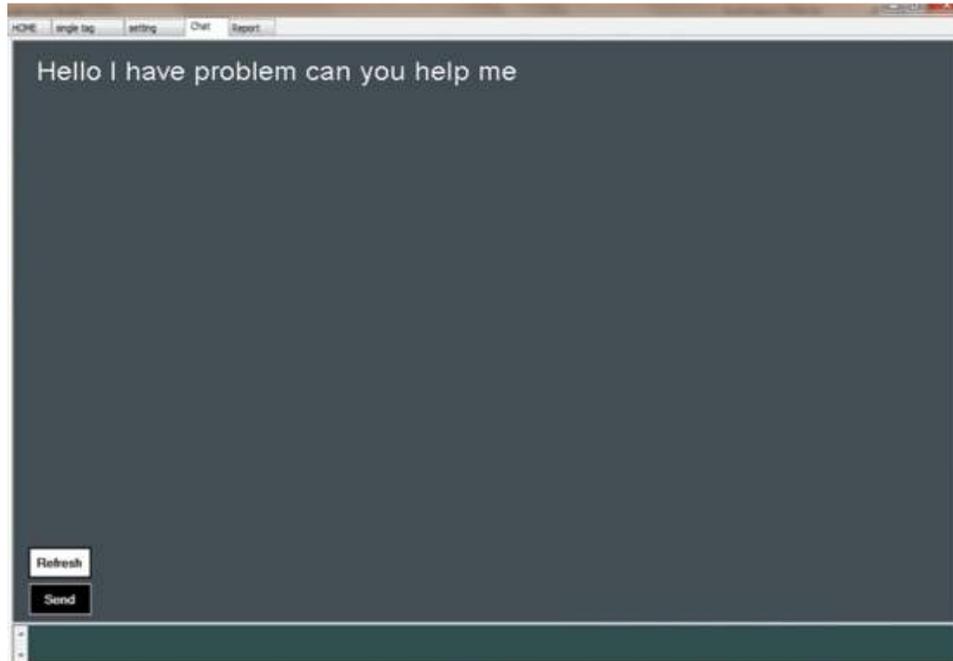


Fig. 7: Screen of "CHAT" page

HOME	single tag	setting	Chat	Report
2013-10-20			2013/11/20 11:11:32	control input name : admin1
2013-10-21			2013/11/20 16:8:59	control input name : admin1
2013-10-23			2013/11/20 16:10:37	control input name : admin1
2013-11-1			2013/11/20 16:12:7	control out name : admin1
2013-11-10			2013/11/20 16:12:11	control input name : admin1
2013-11-11			2013/11/20 16:14:55	control input name : admin1
2013-11-12			2013/11/20 16:15:21	control out name : admin1
2013-11-13			2013/11/20 16:15:56	control input name : admin1
2013-11-14			2013/11/20 16:16:55	control input name : admin1
2013-11-19			2013/11/20 16:28:49	control input name : admin1
2013-11-2			2013/11/20 16:30:24	control out name : admin1
2013-11-20			2013/11/20 16:30:31	control input name : admin1
2013-11-21			2013/11/20 16:32:1	control input name : admin1
2013-11-22			2013/11/20 16:33:14	control input name : admin1
2013-11-24			2013/11/20 16:33:40	control input name : admin1
2013-11-27			2013/11/20 16:35:20	control input name : admin2
2013-11-28			2013/11/20 16:40:22	control input name : admin1
2013-11-30			2013/11/20 17:7:21	control input name : admin1
2013-11-5			2013/11/20 17:19:38	control input name : admin1
2013-11-7			2013/11/20 17:21:31	control out name : admin1
2013-11-8			2013/11/20 17:21:34	control input name : admin2
			2013/11/20 17:59:32	control input name : admin5
			2013/11/20 18:42:20	control input name : admin2
			2013/11/20 18:46:14	control input name : admin2
			2013/11/20 18:56:22	control input name : admin5
			2013/11/20 18:59:16	control out name : admin5
			2013/11/20 18:59:25	control input name : admin1
			2013/11/20 19:2:24	control out name : admin1
			2013/11/20 19:2:26	control input name : admin4
			2013/11/20 19:31:39	control input name : admin4
			Print - طباعة Refrsh - تحديث	

Fig. 8: View of "REPOTR" page

and exit time). All reports are sent to the Website at every change in them. Preview of reports for days of the previous months and years by clicking on the desired date. These reports provide a number of services, security and administrative such as known

time entry and exit of each employee. These reports can be printed by clicking the Print button.

Page Six is "EDIT" page as shown in Fig. 9. This page appears only if the correct password is entered. Password protected from any operation lead to detect it.

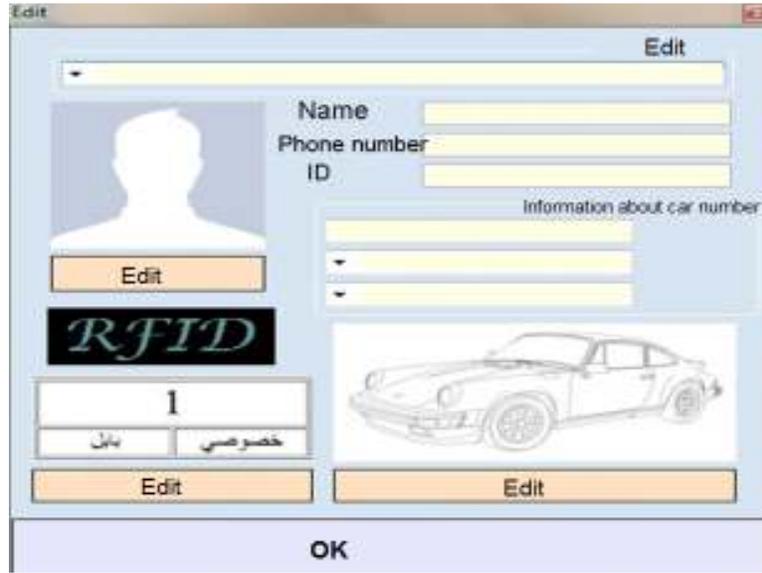


Fig. 9: Shows the "EDIT" page



Fig. 10: Screen of running the surveillance program

Entering the password for five consecutive times cause shut down the system. There are three steps to join a new car with the system. At first chooses the sequence of the car; the second step is insert personal information and car information, the third step Click on "OK". By repeating these three steps, unlimited number of cars can be added.

Secondary display subunit: This subunit provides the ability to watch each car passing through the gate and watch daily reports of all cars entering the university. This unit connects with base station via internet so it can works anywhere in the world. The display unit is programmed using c#. Net language as shown in Fig. 10. This program receives images and reports and update automatically in real time and displays it on the screen. The aims of this unit are to monitor the events by the head of security at the university over the Internet.

Website: There are three goals of this subunit which make a chat with the base station and receive the reports and pictures to save it for the purpose of storage subunit and control on several systems in same time by lock and unlock the EPC of any car quickly, this point is very important spicily in sensitive time when somebody try to enter University by illegal case. The link of website is <http://msc-rfid.com/>. User name, password and captcha are needed to open this page as demonstrated in Fig. 11.

Storage subunit: The operation of this proposed subunit involves down-loading information from a website, saves it and deletes the data from the Website. The "START" button uses to start the operation of this unit while "STOP" button uses to stop the operation of this unit. The aims of this subunit is to save all the information, images and reports in other computers for

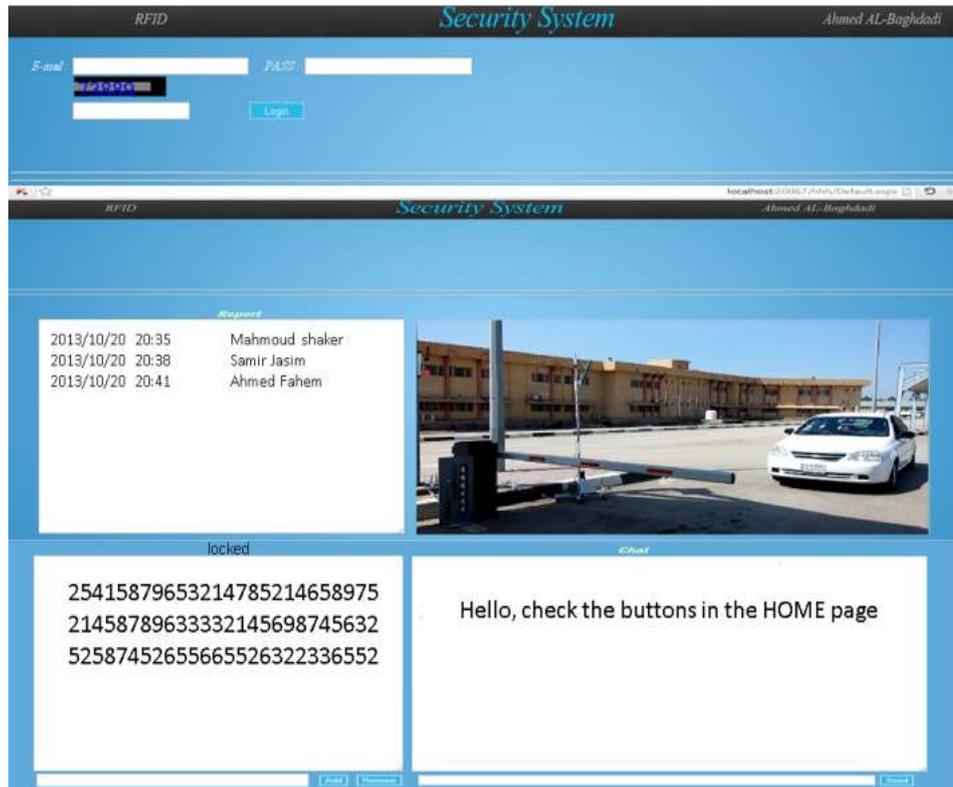


Fig. 11: Shows website page



Fig. 12: Transmitting unit



Fig. 13: Photo of the barrier

the purpose of uses it instead of the original information in case of cleared or falsify or destroy the main computer information, also prevent fill the storage capacity of the website.

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

parts which are processor (MCU) and transmitter subunit. The processor subunit used in this system is the Atmel MCU (ATmega328), 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. 418 MHZ is used for remote control with distance about 30 m. Figure 12 shows the Transmitting unit. The aim of using coil Loop sensor is to prevent any hit-ting accident between car and barrier arm. If the Coil Loop sensor detects any vehicle under the gate, the barrier arm will go back to vertical position immediately.

The barrier and loop detector: The barrier used in this proposed system as shown in Fig. 13. We use this type because it has suitable feathers which are rail lifting time is three second, rail length is three meter, working temperature from $-40\sim 70^{\circ}\text{C}$, relative humidity $\leq 90\%$, dimension: $350*300*1050$ mm and rail material is aluminum alloy. The loop detector put under the street in the gate area to detect the cars and prevent any hitting accident between barrier and car.

SYSTEM OPERATION

Once the car enters the reading range of the reader, some reaction will activate by the system. The system operation can be summarized by the following steps:

- Reading the information of each tag by the reader and sends this information to the base station (PC).
- The information about car and its driver appear on the computer screen.
- Send that information to our website "msc-rfid.com" via internet.
- Display that information on the website page and another computer connected with website.
- Take a photo of the car and save it with the date of capture.
- Open the gate and change the color of traffic light to green.
- Closing the gate after passing the car immediately and change the color of traffic light to red.

ILLEGAL EXPECTED SCENARIOS

Some of expected illegal scenarios may happen. We will display it in the following and the reaction of our system:

- If any visitor coming to the university without tags so the in charge person can open the gate manually.
- If someone stole the tag from the car and try passing through the gate by using the stolen tag, the gate will never open. In other hand when someone stole the two tags one from car and another from the car owner and try to passing, the gate never open because these tags inserted in the black list when the car owner inform the in charge of the system. In special case when the car owner doesn't inform in charge person so the in charge person can notice the information and pictures on the computer screen so he can prevent the gate opening easily. The friendly GUI provides all information to detect any illegal case and give some option to stop that case.
- If someone try to hacking the computer in order to open the gate illegally. The anti-hacker of our system will work and prevent any external control on the system.
- In the case when some people get in same car and each one of them have a tag, the protocol programmed in the system can detect which of them is the car owner and record him in the daily report.
- If someone try to detect the signal connection between the tags and reader and try to make cheat to open the gate. He will never succeed because we are used frequency hopping separate spectrum technology. This technology considered one of the most difficult methods to make communication also it is very secure.

SYSTEM FEATURES

The proposed system is characterized by the following features:

- High precision and security. The solution of all illegal expected case was developed
- Work in real time
- Friendly GUI system
- Unlimited number of cars can join the system
- Using the internet service in the monitoring, control and storage
- Alert system in the event of an attempt to penetrate the system
- Storage information about each car passing through the gate
- The system safe from Hacker attack
- Check the validity of the car documentation by connection online with the police office via the internet
- Double tag (one for driver and another for car)
- System allows five people to control it through five passwords, but watching the periods of entry and exit of every person to the system is to determine the responsibility of each person during the period of his stay

RESULTS

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 study.

Normal operation test results: When legal car (which carry two matched tags) become near the reader as shown in Fig. 14a, The information on car is showing on the computer screen as shown in Fig. 14b then the gate was opened and the traffic light become green as shown in Fig. 14c, 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 Fig. 14d.

Illegal cases results: There are two technical reasons to prevent a car from passing through the gate. In relation two cases are presented.

Case one (car without tag): When the car doesn't have any tag on it or it has two tags but does not match, the system will not open the gate as shown in Fig. 15.

Case two (car in the black list): In this case the car is prevented from passing through the gate because its ID exists in the black list (for example because of security reasons, tag expired, or other reasons). In this case, sound alarm and text alarm appear to alert the in charge person like the test in Fig. 16.

Daily report result: Figure 17 shows a photo of the obtained result for the daily report in which all the information of the events in the gate are listed.



(a)

(b)



(c)

(d)

Fig. 14: Normal operation tests (a) legal car, (b) information of car, (c) opened gate, (d) closed gate and red traffic light



Fig. 15: Illegal case result for a car without tag



Fig. 16: Illegal case result because of locked ID car (black list)

HOME	single tag	setting	Chat	Report
2013-11-21			2014/3/26 11:14:35	control input name : admin2
2013-11-22			2014/3/26 11:19:16	control out name : admin2
2013-11-24			2014/3/26 11:19:20	control input name : admin2
2013-11-27			2014/3/26 11:19:52	control out name : admin2
2013-11-28			2014/3/26 11:19:58	control input name : admin3
2013-11-30			2014/3/26 11:20:51	control out name : admin3
2013-11-5			2014/3/26 11:20:56	control input name : admin5
2013-11-7			2014/3/26 11:24:47	control out name : admin5
2013-11-8			2014/3/26 11:25:6	control input name : admin1
2013-11-9			2014/3/26 11:26:2	control input name : admin2
2013-12-29			2014/3/26 11:29:9	control out name : admin2
2013-12-7			2014/3/26 11:29:13	control input name : admin2
2013-12-8			2014/3/26 11:31:40	name : سمير جاسم
2013-12-9			2014/3/26 11:33:32	name : عبد الكريم مخيف
			2014/3/26 12:23:36	name : سمير جاسم
			2014/3/26 12:26:25	name : محمود شاكر
			2014/3/26 12:27:23	name : سمير جاسم
			2014/3/26 12:29:8	name : محمود شاكر
			2014/3/26 12:35:8	name : سمير جاسم
			2014/3/26 12:35:31	name : محمود شاكر
			2014/3/26 12:35:44	name : سمير جاسم
			2014/3/26 12:47:45	name : محمود شاكر

Fig. 17: Daily reports

CONCLUSION

The presented secure system uses two matched tags which increase the security and reliability of the system, while in other systems one tag is used.

The proposed system is flexible for any new requirements such as adding new readers, changing the network topology, or updating the GUI.

The presented system provides a connection with police office website which adds another level of security to increase overall protection. Also the university head of security can monitor online all the events at gate via the internet. The system provides the necessary reports for security requirements such as a list of the entry cars for the selected date.

According to the obtained results, the presented security system is very useful and applicable for the University or other site.

The system is implemented practically for the gate in the University of Babylon and tested for different cases. The obtained results demonstrate that the system operates with high reliability.

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