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Double Gate Security System Based on RFID Technology

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Abstract:

The most important things in any system are accuracy and security. So the Radio-Frequency Identification (RFID) technique in this proposed system is employed to achieve these purposes. The system is designed to control the entrance gate of a park. It consists of arduino, computer, tags, reader, two gates (main gate and underground gate), loop detector and software which is include the programs that control gates.

The proposed system treats some scenarios: When a car tries to enter the park illegally by hitting the main gate, the underground gate goes out from the ground. In addition, the thief cannot pass even he stalled a tag because the system deals with double matched tags.

The mixing between human ability and automatic system is provided by displaying all information (driver picture, car picture, car number, driver name, and phone number) on the computer screen to give human ability to take a decision at emergency. In addition, a connection via internet for monitoring, storage and control purposes also provided by programming a website page using ASP.NET language.

The security system is designed and implemented with high-precision security works automatically regulates the entry and exit of vehicles in a particular location. It documented pictures and names of the drivers for all vehicles entering the university and outflows, with the time of the entry and exit of each car. It saves daily, monthly and yearly reports for all vehicles entering and leaving the Ancient city of Babylon with access ability to this information at any time.

Key words: Security, RFID technology, Hit sensor, Reader, Base station, double gate, and double tags.

1- INTRODUCTION

The first Radio Frequency Identification transponder system is created in 1973 and then this technology evolved rapidly through the 1980s and 1990s. Huge progress has been made over the last 10 years. Recently and due to the development of integrated circuits, radios and increased commercial interest, the world moved widely toward this technology [1].

RFID principle of operation depends on tagging objects to identify them and the tags do not need to be visible. They are divided into three types: the first type was passive RFID tags that are powered by the energy that the reader's signal induces in their antennas; the second one was active tags that has its own power supply and finally semi-active tags in between [2].

RFID technology participated in markets such as access control, sensors and metering applications, payment systems, communication and transportation, parcel and document tracking, distribution logistics, automotive systems, livestock / pet tracking, and hospitals / pharmaceutical applications [3].

With the increased flexibility of being able to perform complete inventory tracking from manufacturer to warehouse to retailer, and with the economic influence of large retail chains, the cost of individual tags become affordable.

Because of the historical significance of the ancient city of Babylon, a secure system at the entrance door of City Park is needed. In addition, to avoid the delay in cars entry, the solution is to have a security system with accuracy and speed together.

A secure city park gate required many considerations like create a protocol that deals with double tags for both driver and car and combined these tags with the pictures of them to increase security, develop graphical user interface (GUI) to

record entering cars and logs system to record daily reports, also create a website page via-internet to help system at emergency, and finally a Hit sensor on the main gate must be programmed to transmit a signal to the underground gate to go out when the unlawful chauffeur hit the main gate forcibly.

2- MOTIVATIONS

At the ancient city of Babylon, many security men check the badge (a very primitive mean) to control the access of entrance cars. There are many side effects of this process, such as the delay in cars entry which causing congestion of many cars and many security man are needed to control this process.

The solution is to develop a secure car park barrier gate system using latest RFID technology which automates the whole security system, such as, develop a new protocol to deal with double RFID matched tags to both vehicle and driver, build a second gate (underground gate) that prevent illegal driver to hit the main gate and enter to the city, increase the accuracy and security alert by combined double RFID matched tags with the images of the vehicle and the driver, develop friendly graphical user interface (GUI) using C#.NET, Visual Basic, and ASP.NET which will be integrated with RFID monitoring system to capture and record cars, develop a logs system in order to record daily reports, create a website page to monitor and help system at emergency, save and display information on another site via internet by help of web page, protect web page and computer from hackers attack as possible.

3- LITERATURE REVIEW

Paper [4] studies RFID system technology and employed it proposed security system in order to create high level of security 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 illegal's methods, which could be exploited for illegal access. This 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.

Paper [5] provides details about RFID, its components, how it works, and its usage in different sectors i.e. retail sales and supply chains, livestock industry, courier services, military and prisons, automobiles and logistics, entertainment industry, publishing industry, wireless transaction, and, especially, in libraries, also presents an in depth analysis of RFID use in Libraries with implementation roadmap, its impacts on libraries, and a comparison of major vendors and their products. The large increase in the number of applications lead to increase the threat of breaching information, therefore database is protected of the hacker control by hiding and prevents hacker access to the main computer using special software.

Paper [6] deals with digital vehicle management system using RFID technology. This digital vehicle management system enhance the utilization of parking space and help user check the availability of the parking space remotely since the system is connected to the Internet. There are four stages in this 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 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.

Paper [7] proposes the connection of all parking of the city together using same SQL database to achieve reduction in transaction costs with the use of RFID technology in automation. Where each parking make check about the car before give permission to pass.

Paper [8] gives an overview of the current state of the art in the RFID technology. Aside from a brief introduction to the principles of the technology, a survey is given on major classes of RFID tags and readers, commonly used frequencies and identifier systems, current and envisaged fields of application, as well as advantages, concerns and limitations of use. This paper is introduced to increase knowledge about the RFID technology.

Paper [9] studies the evaluation of the reliability of RFID technology in tool tracking for the construction industry considering variables like speed through the portal and number of tools, over barcode technology. This paper identifies factors that might affect the reliability of RFID technology and tests are conducted to understand the influence of these factors on the readability of the RFID tags. Number of tools and the velocity with which tools are taken across the portal are two variables that are tested for reliability of RFID. Tests are conducted using the experiment setup that resembles a construction site tool management room entrance/exit. Also, the reliability of the RFID is tested of this system a similar manner somewhat.

4- PROPOSED SYSTEM

An automatic security system of car entrance through the main gate of the ancient city of Babylon is proposed using RFID technology. It used two tags one for the car and the other for the driver. Ones the car entered the reading range, the reader

reads the information of tags under some criteria then the system decide whether the gate will open or not. The system take into account general features of security systems and prevent any car access without license. If the main gate pushed by illegal driver, the Hit sensor will pushed and an underground gate will go out from the ground and prevent him from passing. Proposed system consists of two readers, number of tags, two cameras, base station, Arduino, transmitting subunit and terminal devices (gates) with Hit sensor on the main gate. Each car have a tag "car tag" and the car owner also have a tag known as "driver tag". Every car try to access the city must contain two matched tags (car tag and driver tag), otherwise there is no possibility to pass. The block diagram in figure 1 shows the units of the proposal RFID security system.

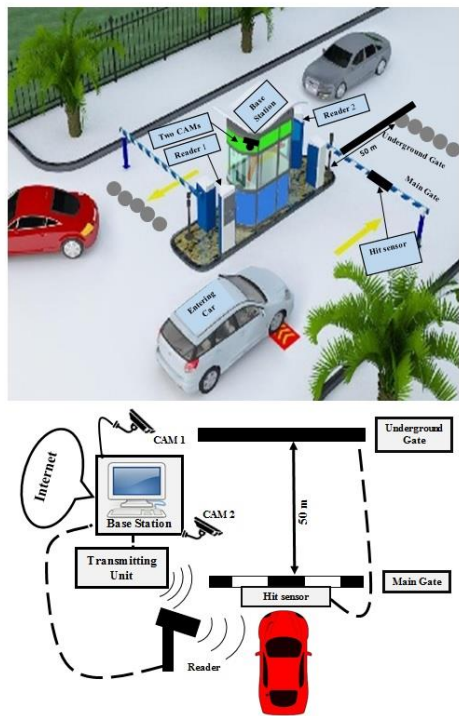


Figure 1: Proposed Two Gate Security RFID System for ancient city of Babylon.

4.1 Readers

Two UHF Long Range Integrated Readers are used, the first one is placed on the entrance gate and the second is 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.

4.2 Tags

Two types of tags introduced here to increase the level of the security system, which are MR6740A Glass Paper Tag (Windshield), and MR6700A UHF Passive Electronic Tag. The first type is selected due to the some features that it is suitable for frequency-hopping work mode, has possibility of writing and reading there many times, can be read from a distance up to eight meters, don't need battery, has frequency range from 860-960 MHz, Operation Mode Fixed Frequency or FHSS Software Programmable, has memory capacity 96 bits, has size 86*54*0.1 mm, has operating temperature of -20 °C to +80 °C and stick on the windshield for cars. The second type tag (shown in figure 2) different from the first one in two features that it has size of 86*54*0.84mm and carried by the person.

The idea behind using two types of tags is to provide best security. The first type stick to the front glass of the car and the second tag is carried by the driver. Each one of those tags has three sections of memory to write an identification number: The first section is known as EPC Memory. Each tag has the EPC ID composed of 28 salary differs from that's presents in the other tag but the two ID numbers are matched with each other relative to the base station. The second section is known as RESERVE memory. Each tag has RESERVE identical to the RESERVE of the other tag. The purpose of this process is to detect any trial of cheating. The final section is known as USER memory. The same secret number introduced in the USER memory of each tag.

The tag sends a specific ID number to the observing and data-transmitting unit according to the received order. If the tag carrier (anything carry the tag such as person or car) has the correct tags then he can pass the city otherwise the gate will never open.

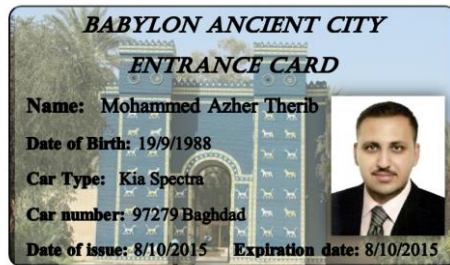


Figure 2: MR6700A UHF Passive Electronic Tag.

4.3 Cameras

Two cameras (shown in figure 3) 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 second 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, and seven work hours every day, then 26-day need to fill memory.

On the other hand, if the camera was only used to capture pictures when cars enters the gate. Suppose that everyday 1000 cars incoming the city over whole 24-day hours. 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, and then 37.28 years need to fill memory.

Clearly, it is better to take a photo rather than a video recording.



Figure 3: Webcams.

4.4 Base Station

It is the center of the main control unit so it controls other 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 provide the necessary solutions to prevent any expected breaches. This program is designed and implemented to achieve all the expected security aims. The "HOME" page shown in figure 4 and it is consists of the following contents: Reader IP, which represents the address of the reader on the network such as (192.168.1.200), Port number, which provides a path of communication between the computer and the reader, the password of the person who controls the system. The "connect" button which is responsible for connect the computer with the reader while the "disconnect" button is used to disconnect between them.

The first step in the connect button operation is to check whether the present reader has IP address and port similar to the entrance IP or not. The second step is to check the person who tries entering the system. If these tests succeed 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. In the other hand, the first step in the disconnect button operation is recording the name of the person and exit time. The second step is when the system separates itself from any control operation.

The short list also found in this page. It is 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, the HOME page consists from "clear" button, which is used to erase all the information from the list, "Start" button that is used to receive information 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. The first step is to give the command of reading to start the reading of the ID of each present 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. The fifth step is send the information to secondary display subunit and website. The sixth step is checking the car at the Iraqi official site of the General Traffic Directorate. 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 camera is put to monitoring the in charge person. The camera takes a picture of the person who uses this button and save image with the documented time. In addition no one can use this feature because password should be inserted first before opening the

gate. Typing the wrong password five times causes shut down system.

The button "OK" in the Edit Information is used to showing hidden page (Edit). At first the password must be entered correctly, if the password is entered incorrectly five consecutive times, the system will be shut down.

In addition to that, the HOME page shown in figure 4 also contains the information and image of car number, the name, image, identification number and phone number of the driver, image of car, access to the home page, access to the single tag page, access to the setting page, access to the chat page and access to the report page.

The second page is the "SINGLE" page that shown in figure 5. It consists from the following buttons: Read which is used to read the ID from the single tag present in the reading range of the reader, Write which is used to write the ID to the single tag present in the reading range of the reader, Lock is used to lock any tag by inserts the ECC, Unlock is used to unlock any tag by insert the ECC, and the list contains the locked list of ECC.

Some of the registers in the computer is used for the purpose of increasing 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.

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. Hacking file is a file 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 this button, the program search for a hacking file in the computer, found it and kill it. In case

when the system is unable to kill the hacking file, it will send sound alarm and text alarm to in charge person.

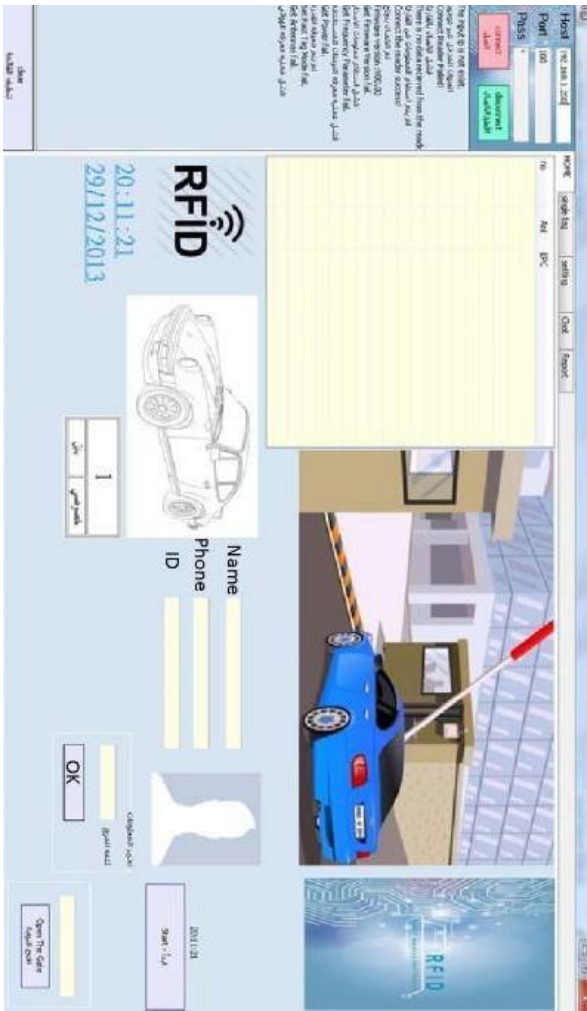


Figure 4: HOME Page.

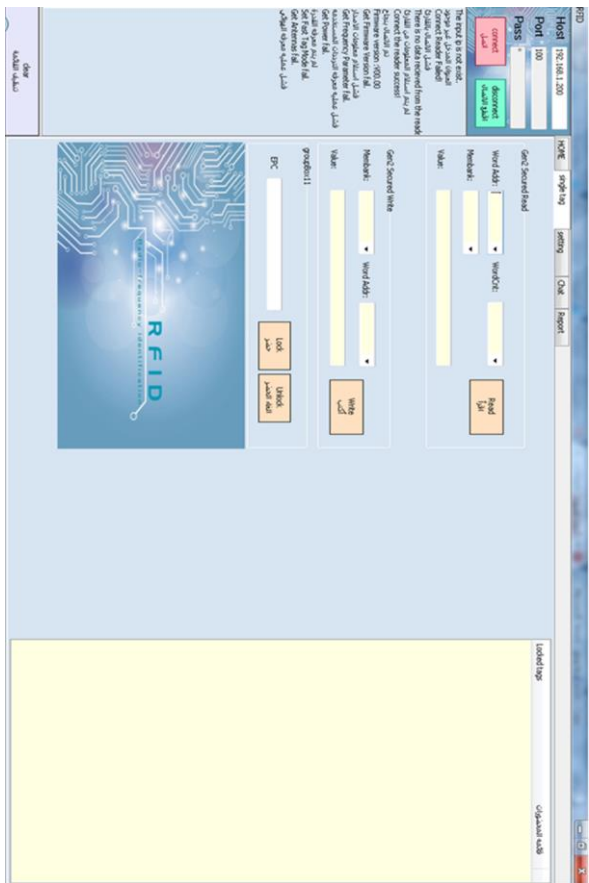


Figure 5: "SINGLE" page.

To get or set frequencies that used in frequency hopping 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 can choose the frequencies that will be used in Frequency-hopping spread spectrum. China Frequency (920-925MHz), North America Frequency (902-928MHz), European frequency (865-868MHz), and others frequency configurable. As shown in figure 6.

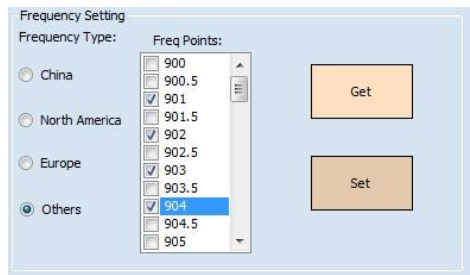


Figure 6: Frequency setting.

The "CHAT" page shown in figure 7 is the easiest way of communication between the user and the designer. Writing the problem or whatever he wants to say and then presses Send button, the message goes to the website. This website is designed for 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 the thesis website on the link mentioned above. Website as in figure 8.

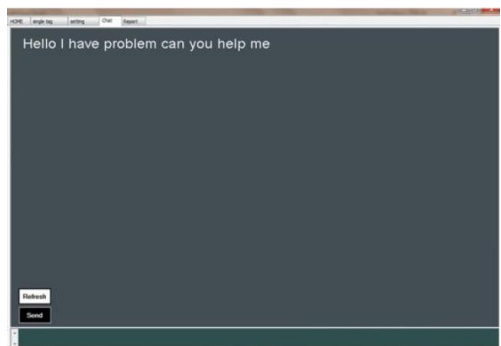


Figure 7: "CHAT" page

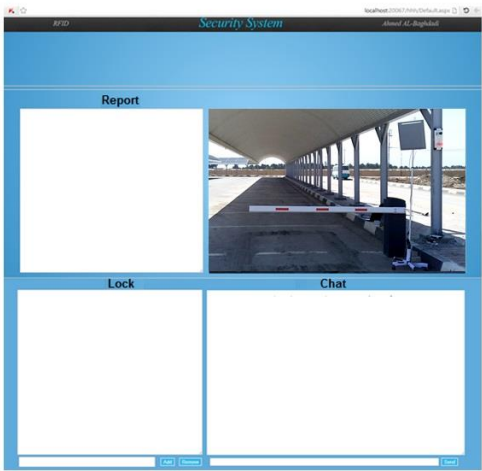


Figure 8: Website.

The "REPORT" page is shown in figure 9. Here is a presented daily report on all cars entering and leaving the university with a time of entry and exit of every car as well as providing reports about the person who control the system (the time of entry 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.

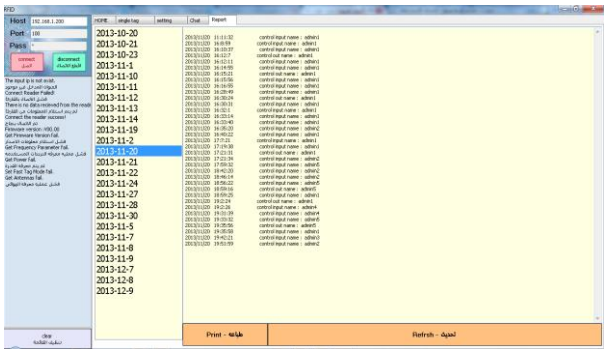


Figure 9: "REPORT" page.

Page "EDIT" page is shown in Figure 10. This page appears only if the correct password is entered. Password protected from any operation lead to detecting it. Entering the password for five consecutive times causes shut down the system.

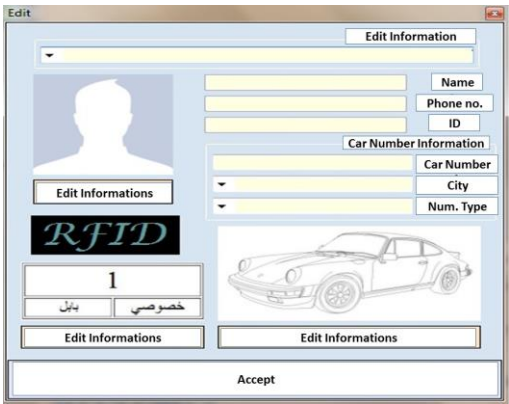


Figure 10: "EDIT" page.

4.5 Arduino

The Arduino is used to process the data coming from the serial port of the computer. It is programmed to control the unit tasks receives data from the serial port of the computer, processing and sending orders to relay shield for the purpose of control of the main gate. This subunit receives the control data from the main control unit then processes this data to give the order about the main gate state. The processor subunit used in this system is the Atmel MCU (ATmega328), we used the Arduino platform that contains the ATmega328 MCU and this platform is the open source platform, which is easy to use in terms of software and hardware as shown in figure 11. The most important specifications of the MCU are.

Digital I/O	14 Pin
Analog Input	6 Pin (10-bits ADC)
DC Current per I/O	40 mA
Flash Memory	32 KB (ATmega328)
Clock Speed	16 MHz



4.6 Gates Control Unit

The automatic gates are used to provide smooth movement of cars entering and leaving the ancient city of Babylon. The main gate receives orders from two places. The first from the Transmitting unit for the purpose of opening the gate while the second from sensor for the purpose of closing the gate as well as protect the cars under it. While the underground gate (which is made by concrete) receives orders from the Hit sensor on the main gate to go up and stop any illegal attempt to enter the city. The control unit consists from receiver to receive command for opening the gate from transmitting unit and two sensors: coil loop sensor to prevent any hitting accident between the car and barrier arm. In addition, it consists of the Hit sensor, which controls the underground gate in the case of illegal attempt for entrance, and two DC motors to control the main gate arm and the underground gate.

5- SYSTEM OPERATION

At beginning in charge person must open the program and insert 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 system to take decision about opening the gate or not. Some abnormal cases may happen which are:

- **Case one:** When visitors come to the Ancient city of Babylon, the in charge person can open the gate manually by insert the password and click on Open the Gate button which belong to HOME page.
- **Case two:** If the tag is stolen or lost, the in charge person can lock this tag in order to prevent breach by this tag, just insert the ECC of this tag and click on LOCK button which belong to SINGLE TAG page.

- **Case three:** If any default is happened in the system, the in charge person can chat with the designer by using the CHAT page.
- **Case four:** When a new person wants to join the system, the in charge person can add this driver and his car according to EDIT page treatment.
- **Case five:** If any illegal driver hit the main gate, the Hit sensor on this gate will order the underground gate to going up and prevent him from entrance.

6- CONCLUSION

- Using two tags cause increase of security against theft and fraud and increase the accuracy of the gate state (will open or not).
- Using two gates prevent any illegal attempts to enter the ancient city of Babylon by using Hit sensor on the main gate and underground gate made from concrete for example.
- 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 9 meters 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 Ancient city of Babylon and any site.

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