

نظام أمني ذي مستويين للبيت الذكي Smart House Two Level Security System

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Abstract

Security systems used in smart houses are useful for keeping the safety of the house from the unwanted intrusions. Precision and ease of usage of these systems must be considered, also they must be considered to be a simple and inexpensive. In this research an Arduino Uno based ATmega328 microcontroller with Ethernet Shield are used to design a system that requires a password that trigger a digital camera to capture a car image to start car license plate localization and recognition process to open garage door when license plate is recognized.

Two security levels are used in this proposed system, when a house owner reaches with his car to the garage door, he connects to his own Local Network Area (LAN) through his mobile and login to the ethernet shield web page and enters a password (as a first security level), if this password matches the saved password, a signal is sent to the digital camera to capture a car image stopping in front of garage door, then this image is analysed to recognize the car license plate (as a second security level), when a license plate recognition success, a signal is sent to the garage door to be opened.

Keywords: Smart House, Security System, Two Factor Authentication, Car License Plate Recognition, Arduino Ethernet shield.

المستخلص:

الانظمة الامنية المستخدمة في البيوت الذكية مفيدة في الحفاظ على امن البيت من التداخلات الغير مرغوب بها. الدقة وسهولة الاستخدام لهذه الانظمة يجب ان تؤخذ بنظر الاعتبار، وكذلك يجب ان تكون هذه الانظمة بسيطة وغير مكلفة. في هذا البحث تم استخدام الاردوينو UNO المبني على اساس المعالج الدقيق Atmega ٣٢٨ مع غطاء الاثرنت Ethernet Shield في تصميم نظام يقوم بقدر كاميرا رقمية لألتقاط صورة والبدء بعملية تحليل وتمييز لوحة تسجيل السيارة لفتح باب المرآب عند نجاح عملية تمييز لوحة تسجيل السيارة.

تم استخدام مستويين للأمن في هذا النظام، عندما يصل مالك المنزل بالسيارة عند باب المرآب، يقوم بالاتصال بالشبكة المحلية الخاصة به عن طريق جهاز الهاتف الخلوي ويقوم بالولوج الى صفحة غطاء الاثرنت وادخال كلمة السر (كمرحلة اولى للأمن)، في حالة تطابق كلمة السر المدخلة مع كلمة السر المخزونة سيتم ارسال إشارة الى الكاميرا الرقمية لألتقاط صورة للسيارة الواقفة امام باب المرآب، ثم يتم تحليل الصورة لتمييز لوحة تسجيل السيارة (كمرحلة ثانية للأمن)، عندما تتم عملية تمييز لوحة تسجيل السيارة بنجاح سيتم ارسال إشارة الى باب المرآب لينتم فتحها.

الكلمات المفتاحية: البيت الذكي، نظام الأمن، مصادقة ذات عاملين، تمييز لوحة تسجيل السيارة، غطاء الاثرنت للاردوينو

١. Introduction

House security is becoming necessary these days as illegal intrusion increased. Safety from theft is the most important requirement of house security system for people. Alarm is the most used response as indication of an illegal intrusion to a house. Because of modern technologies, people can now protect and control their house security and house appliance remotely. Controlling house appliances is the best way to the owner to use technology, house appliances are not just the use of lighting systems, automatic window shutters, watering system, etc., but some of these appliances are used from outside even the owner is not available at its house.

There are two entry ways to a house, *authorized* and *unauthorized*. House invasion from windows is unauthorized entry and it can be monitored and controlled using different technologies, sensors and digital cameras are tools used to monitor a house intrusion areas. When an unauthorized entry is detected using sensors, such as IR sensor, a signal is sent to a buzzer (for example) to start an alarm; [1] Passive Infra-Red

(PIR) sensors are used to detect a motion and a signal is sent to trigger an alarm or to send an SMS via GSM to a mobile to inform the owner of an illegal intrusion; [2] Vibration sensor is mounted to windows or doors to detect any vibration and send an alarm as an indication to an illegal intrusion.[3]

As a security strategy, to avoid an illegal intrusion, a smart door locks are used, only an authorized person can open the door. In a high security system it uses an electronic locks. Electronic door lock is a locking device which operate with the means of electricity. Some electronic door locks have an access control as an advantages for key control, where keys can be added and removed without re-keying the mechanical part of the lock; accurate access control, where time and place are important. PIN codes, Passwords, Passphrase, Security Symbols, Finger Prints, Face Recognition, Tag Keys, RFID, Bluetooth, etc. are types of technologies used in electronic locks.[4] Smart garage doors have some types of lock/unlock wireless switches, focusing on unlock wireless switches; RFID technology garage door intrusion system is used as a door unlocking system without the use of a buttons, this technology deals with a reader (acts as a receiver) and a tag (acts as a transmitter) both are communicated wirelessly, when a valid communication is accomplished between the reader and the tag a signal is sent to the door to be opened;[5] Bluetooth technology is also used in smart garage door openers, where an application is installed on a smartphone and a communication to a mounted system to a garage door is accomplished via Bluetooth to send orders to unlock and open garage doors.[6] Another method to be used as a smart garage door opener is a system that employs two level of verification processes; a system with an image processing technique, when a car approaches to a garage door a car wheel touches a plate, a signal is sent to a camera to capture an image to the car and to start a license plate recognition process, when the license plate matched with the saved pattern of license plate image, the garage door is opened;[7] A license plate recognition and fingerprint verification system, where the garage door is not opened and the car is not passed until both LP and fingerprint are matched with the saved patterns.[8]

In this research a design of a two level authentication system is presented, where the *first authentication level* is that the user logs into a web server designed for Arduino

Ethernet Shield using his smartphone and enters a password, when the presented password matches the saved password, a signal is sent to a digital camera to capture an image and start a license plate recognition process which is the *second authentication level*, when the license plate is recognized a signal is sent to the garage door opener system to open it.

٢. Two-Factor Authentication (2FA)

In general, authentication is a comparison process between information presented and information stored (saved) in a data bank (database), where a user presents authorized information (password for example) on any authentication system or server to access a goal or perform any other process, when the (presented and saved) information are matched the user is authorized to access.^[9]

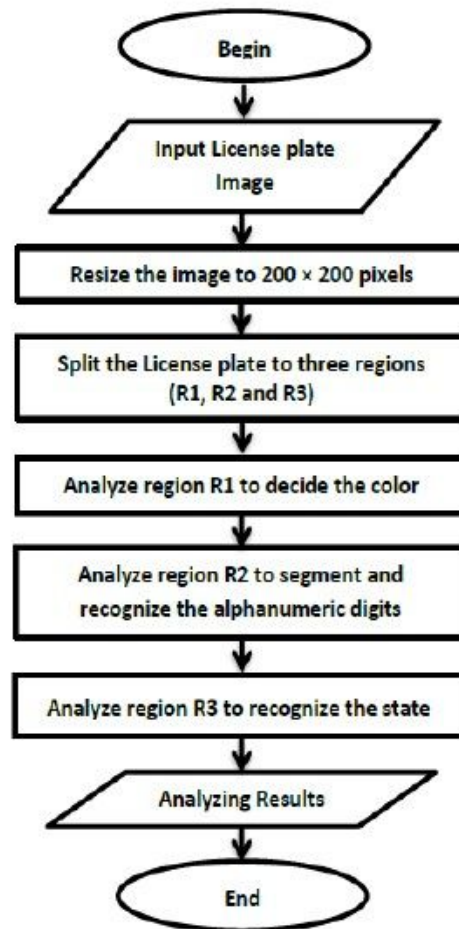
The use of a password only as an authentication information or identification information can be unsafe, because it can be an easy target to guess by attackers. So more stronger authentication methods are required, such as the use of multiple factors of authentication, or specifically, Two-Factor Authenticaion (2FA) method. Simply; the Two-Factor Authenticaion method reuires two factors to tell that you are the authenticated person. For example, the (2FA) method is widely used in banking field, where the user must use his bank card (something he have as a physical token) and a password or a PIN code (something he knows as a memorized information) to access a secured system.^[10]

In this research, the two-factor authentication (2FA) method is used in a way that it can be considered as (2FA) method, where; the first factor of authentication is that the user must present a memorized password, when this password is matched to the saved one, the second factor of authentication starts, which is represented by a car license plate recognition process, which is considered as a physical token.



Figure 1: Two-Factor Authentication Concept**٣. License Plate Recognition**

License plate localization, color verification, number segmentation and then recognition are steps of license plate analyzing. In this work, license plate recognition process is not discussed widely, because the main discussion is ^{١٩}therne on a garage door authentication system design. A new license plate style of Iraqi vehicles is considered in this work as a license plate recognition level (as a second authentication level). Figure (2) shows the flowchart of the license plate recognition.^[11]

**Figure 2:** Car License Plate Analyzing Flowchart

٤. Proposed System

The proposed system in this research is designed to control a house garage door for a security requirements. This system depends on two main parameters (factors), the first parameter is related with a password presented by the house owner, and the second parameter is related with house owner's car license plate. Figure (3) shows the block diagram of the proposed system.

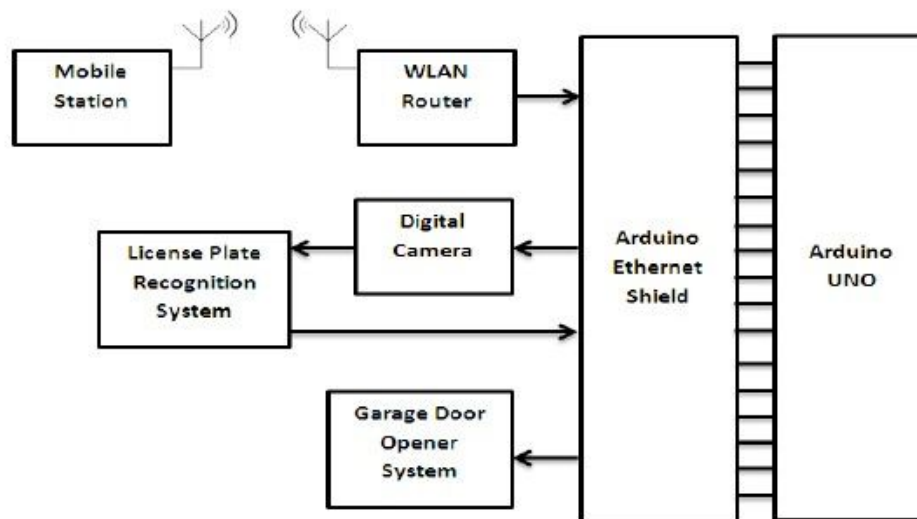


Figure 3: The Block Diagram of The Proposed System

The house owner reaches with his car to the garage door, and connects to his own Wireless Local Area Network (WLAN) using his mobile cellphone, and logs into a simple web page designed for this work through an Arduino Ethernet Shield.

The web page server is designed in a simple form to accept a password, and when the user presents the correct password, a signal triggers a digital camera which is connected to the Arduino board through a digital relay to capture an image to the car from the front side, and then a license plate localization and recognition process is started. When the license plate recognition succeeded, another web page is opened to inform that, and a signal is sent to the garage door opener system to open the door.

The construction of the proposed system is shown in Figure (4) with the following parts:

١. Arduino UNO based (Atmega328 microcontroller)
٢. Arduino Ethernet Shield
٣. Arduino Relay Module

٤. Servo Motor
٥. Digital Camera
٦. Wireless Router

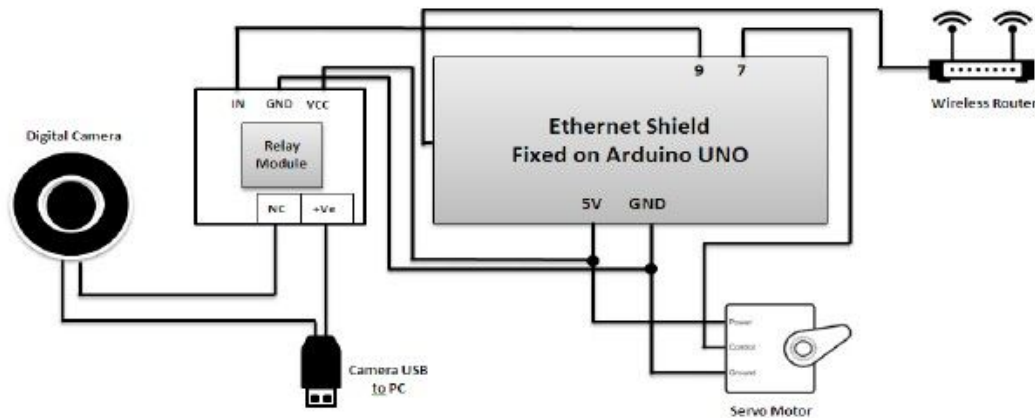


Figure 4: The Construction of The Proposed System

The digital camera, which is connected to the Ethernet shield through the Normal Close (NC) pin on a relay, is triggered by a signal to capture an image to the car after a password verification process, then for a specified time delay another trigger signal is sent to the digital camera to set it again to the Normal Close (NC) state.

The servo motor, which represents the garage door opener system, is controlled after a car license plate recognition is succeeded. The license plate recognition process is accomplished on a stand alone personal computer using MATLAB technical language, which is connected to the digital camera through USB port.

The flowchart of the proposed system is shown in Figure (5) which explains the steps of the proposed system.

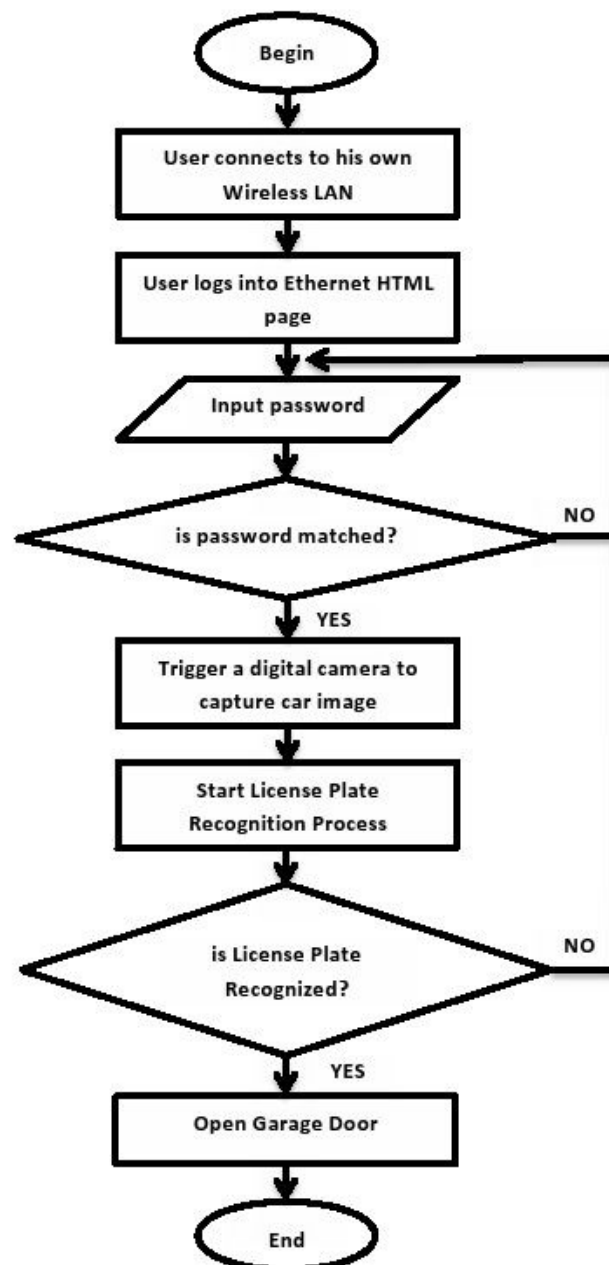


Figure 5: Flowchart of The Proposed System

The steps of garage door security system web page logging and password presenting is shown in Figure (6).



Figure 6: Steps of Garage Door Web Page Logging; (a) security page shortcut icon on mobile background. (b) main security page. (c) password writing. (d) wait informing page. I license plate recognition success informing page.

Figure (7) shows the implementation of the represented system.

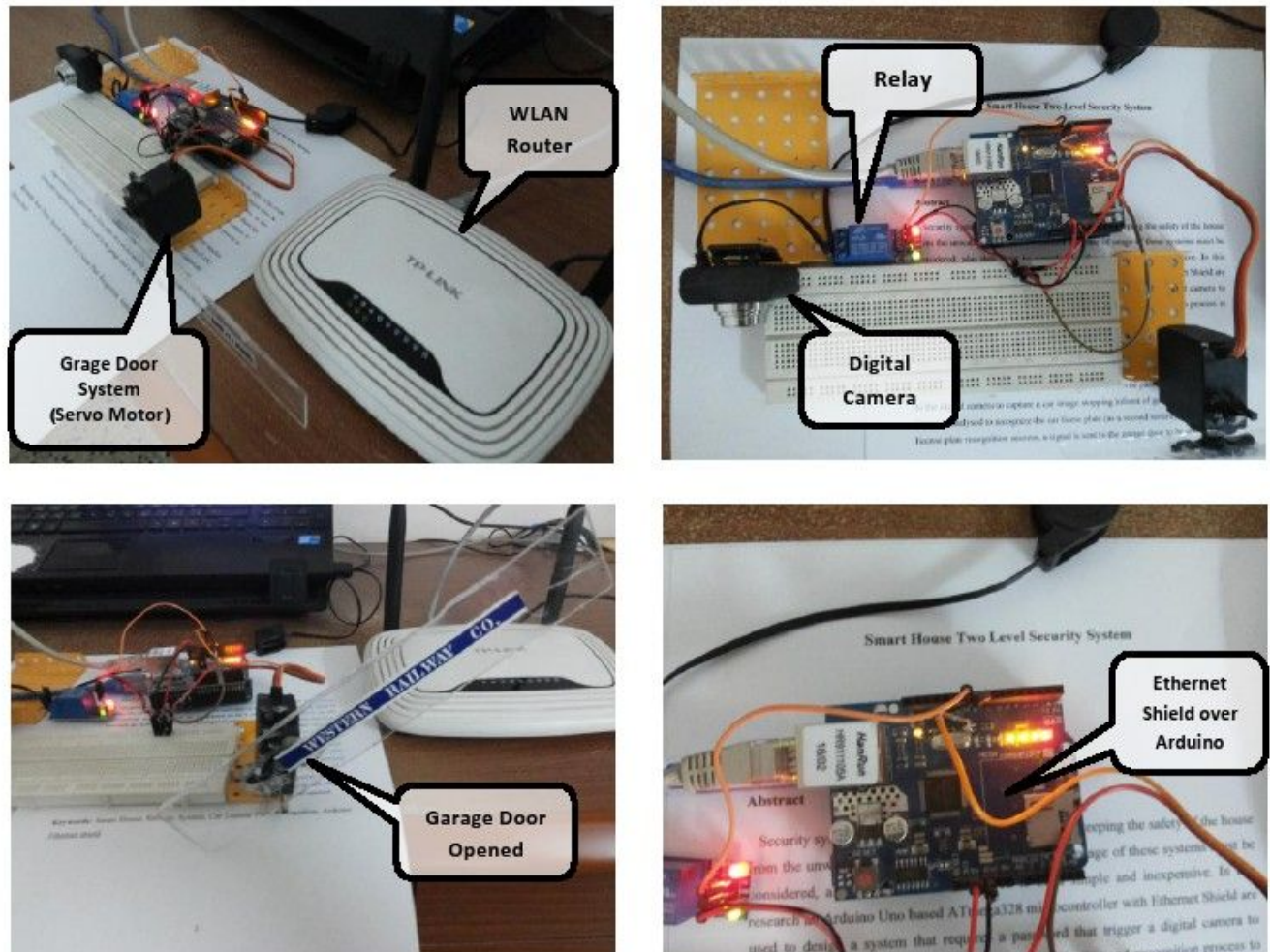


Figure 7: Implementation of the Represented System

٩. Conclusion

Instead of using one level of a garage door opening technique, which is presented by a car license plate recognition process, that can be a poor method and unsecure; a two level authentication system is designed for a secure garage door opener system, which is presented by adding a level before the license plate recognition level which is presented by a request of a password to permit the system to capture an image to a car and start a license plate recognition process. So instead of opening a garage door with one switch, two switches are used to ensure security.

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