QR CODE FOR SAFETY AND SECURITY APPLICATIONS

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Abstract

Vehicle security is a major feature that is making advancement as any other body domain feature in automotive industry. In case of losing or misplacing the car keys, one faces difficulty in accessing the car. In this work, an embedded system is designed and implemented that provides key-less unlock feature using a smart phone while preserving security. This paper details the functionality aspect of the embedded system implemented to control the vehicle doors using existing gadgets and apps: QR code, mobile Bluetooth and Android application. This system provides security against unauthorized access to the car by providing a three level security.

Keywords: Embedded system, QR code, automotive feature

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1. INTRODUCTION

Automotive systems are becoming increasingly sophisticated and interconnected to various gadgets. Vehicle safety and security are one the major issues that pose challenges in the automotive field [1].It appears that the security of the automotive systems have to be looked at more closely than what it is now, as ignoring security could lead to disastrous consequences. A sophisticated mechanism that ensures security and safety of automobiles is a requirement of the day.

Smart phones have replaced most of the electronic gadgets these days and are user-friendly. They even provide enough privacy to its users. In case of theft or mishandling, smart phones can be easily locked and made unusable, thus preventing unauthorized access. In this work, an embedded system is developed to unlock car using an authorized smart phone.

A QR Code (abbreviated from Quick Response Code) as shown in Fig-1is a two-dimensional barcode consisting of a black and white pixel pattern which allows encoding up to a few hundred characters [2]. QR code is the trademark for a type of matrix barcode first designed for the automotive industry in Japan. QR codes can be used with many mobile device operating systems like Android Operating System and iOS (iphone Operating System) [3].

These devices support URL redirection, which allows QR codes to send metadata to existing applications on the device. Many paid or free apps are available with the ability to scan the codes and hard-link to external applications.

Fig -1: QR code

2. OBJECTIVE OF WORK

This work aims at realizing an embedded system that is designed to be implemented in the car to provide key less unlock mechanism for the car doors using the car's unique QR code [4] and smart phone (app). The electronic system realized in this work has the following objectives:

- Provide a cost effective, user-friendly alternative to the conventional auto cop feature available today.
- Give extra functionality to the smart phone at no additional cost.
- Provide a three level security to automobiles and avoid all unauthorized access.

3. SYSTEM DESCRIPTION

ATmega328P based Arduino Uno microcontroller board is used to realize the system. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, USB connection, a power jack and is as shown in fig- 2 . The HC-05 Bluetooth Module can be used in Master or Slave configuration, making it a great solution for wireless communication. Servo motor (Micro Servo DXW90), that can rotate approximately 180 degrees (90 in each direction) is used for locking and unlocking mechanisms.
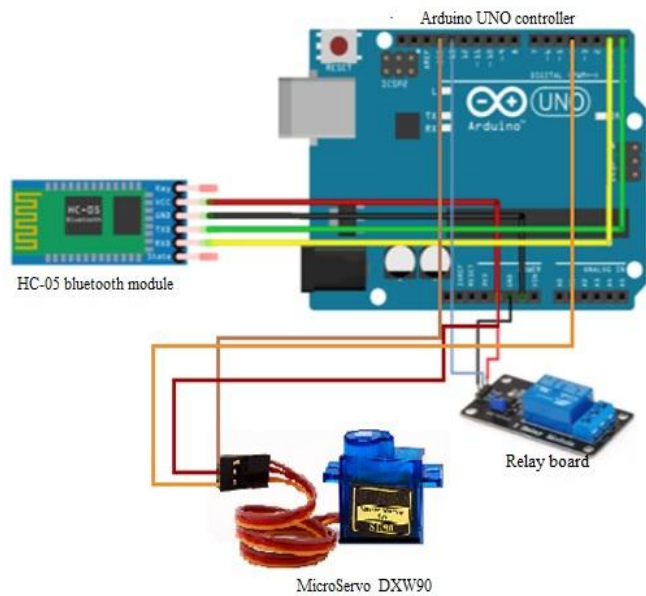
Fig -2:. Circuit connection of the embedded system

4. METHODOLOGY AND IMPLEMENTATION

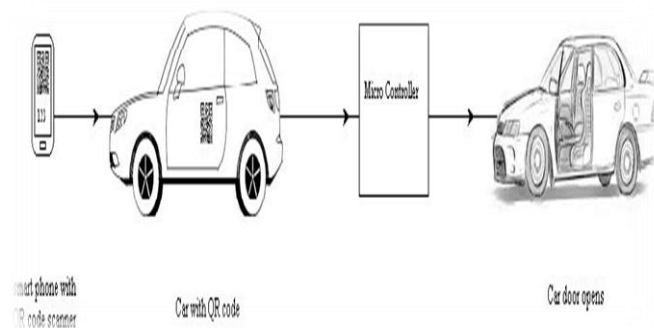Fig- 3 Shows the functional block diagram of this project

Fig -3: Functional Block Diagram

Flow of operations involved in the application:

- A unique QR code is generated for every car and is placed in a secure and accessible location in the car.
- A smart phone having a *customized* QR code scanner is used to scan the QR code [5] of car. The QR code scanner designed in this work provides a secure and intended access to the car. The scanner app is designed to work in a unique way for every car, hence is referred to as *customized* scanner.
- The user who knows the unique password of the app can scan the code. This scanned data is encrypted and sent to the vehicle's locking system via Bluetooth module.

The locking system has a controller that is programmed such that it unlocks the door only if the encrypted data sent from the app matches the one in the controller (preset).Fig- 4 depicts the sequence of events.

As can be understood, a QR code scanner freely available on Google play or elsewhere cannot be used to scan the QR

code of the car. Further, data communicated between the phone and car's Bluetooth module is encrypted and cannot be hacked. In the last step, before the car door unlocks, the encrypted data received by the controller through Bluetooth module is decrypted and matched with a PRESET code in the controller.

In the event of loss of smart phone that is tagged to the car unlock mechanism, the phone may be disabled and the password, QR code generation key could be recovered from a database which could be maintained by the car dealers.
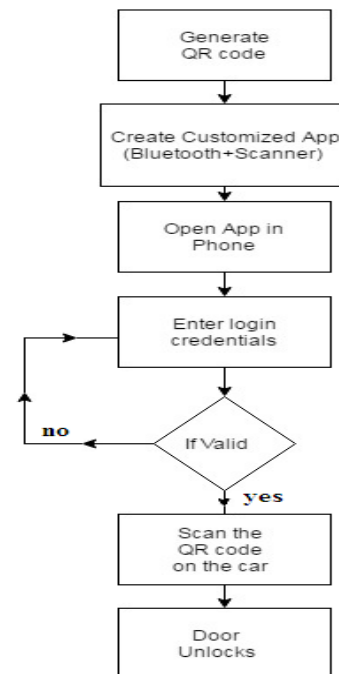

Fig -4: Flow chart of process involved in keyless unlock

4.1 Generation of Customizable QR Code Scanner using App Generation (MIT App Inventor 2) – Free Software

MIT App Inventor is a cloud-based tool that can be used to build apps right in the web browser. This website offers all the support that is required to build our own apps. APP development is done as follows:

- Setup: To set up a smart-phone for live testing (or, to start the emulator in case of no phone).
- Familiarize with the App Inventor environment.
- Packaging and Sharing Apps: Once the app is built, package it for your phone and share it as required.
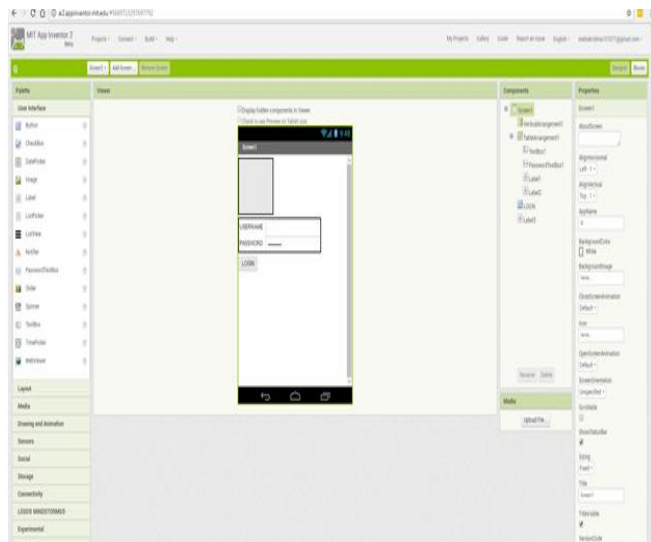
Fig -5a: MIT inventor app (screen 1)

Fig -5b: MIT inventor app (screen 2)
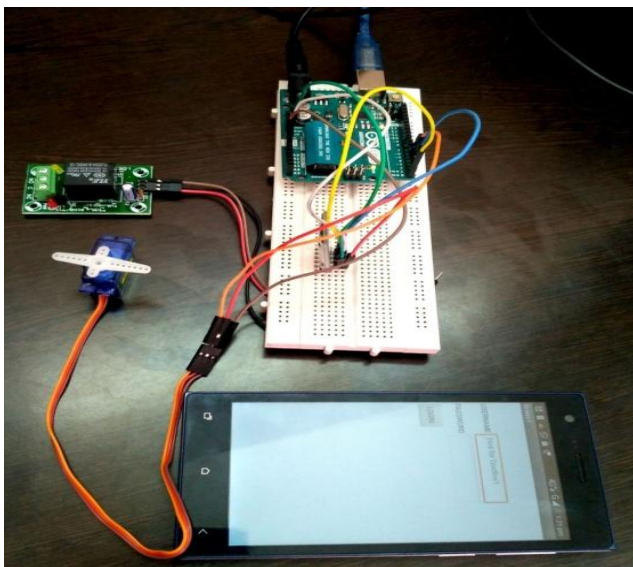
5. RESULTS

Fig -6: Final Product

Fig- 6 shows the final product. After the implementation of the project, as discussed in the previous sections, app generated using MIT App Inventor 2 is installed on smart phone(owner's). Every time the owner has to access car, he/she must use the app to unlock the door.The first screen of the app will be username and password,where user enters the username and password given and login to use the app as shown in Fig-6a.
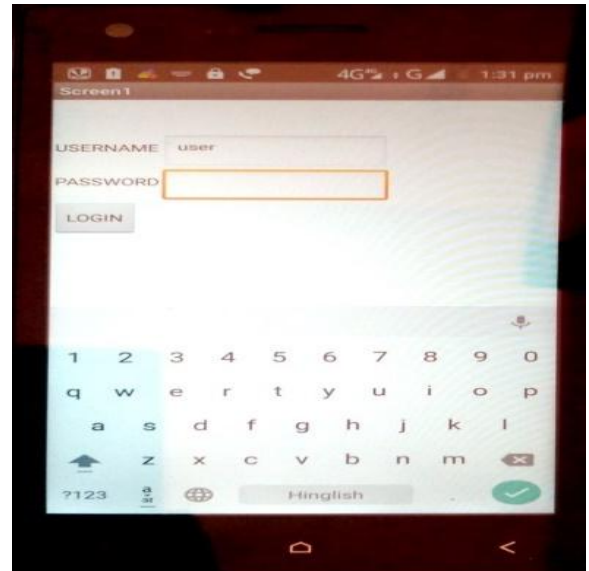

Fig -6a: Screen1 of the App

After successful login, second screen opens,where the user should select the car's bluetooth module by clicking 'Select bluetooth module' button to send the code as shown in Fig-6b.
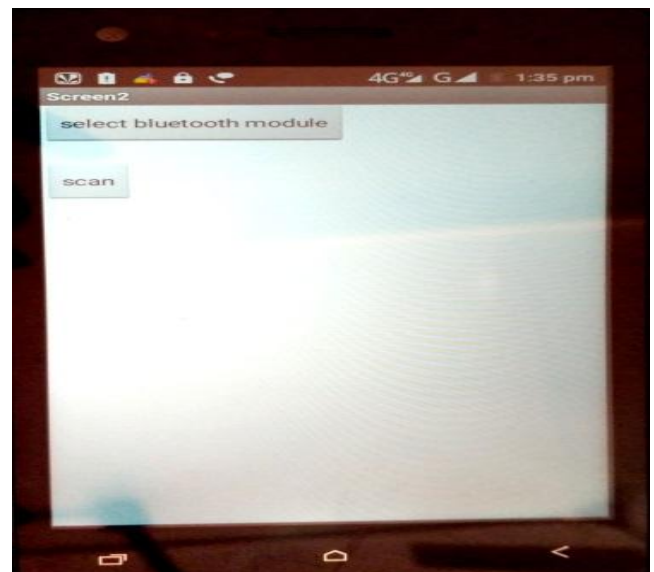

Fig -6b: Screen2 of App

As soon as the car's bluetooth module is selected , the QR code on the caris scanned and sentsecurely to the bluetooth module. Upon successful access, the door unlocks and the whole process takes less than 3s as measured over several trials.

6. CONCLUSION

QR Code based car unlock system is designed and a new customizable android app to scan the QR code is developed. Vehicle's keyless secure access system is designed to work with the existing Bluetooth module of the car by establishing connectivity between an authorized smart phone and the car. The appropriate code is sent from the smart phone to the unlock system in an encrypted way. If the code matches the door opens. Similar method has been used to lock the car as well. This feature provides authorized access to car/s at no extra cost. This can be a safe replacement to the existing RFID based locking system wherein car users need not carry an extra gadget with them. Smart phones of car owners can be given extra feature at no additional cost. Further safety of the vehicle is ensured using a three level authentication in the lock/unlock process.

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