

Mobile-Based Digital Car Plate Number for Future Automotive Industry

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Abstract

Number plate is the identity of a car. The existing number utilizes an old system that is prepared manually. Besides that, the road tax renewal is another manual process where users have to wait for a long queue or learn to use online option. In this proposed system, wireless application using digital plate was configured to help manage the renewal process. Using this proposed system, users are able to update their road tax by utilizing the digital screen, hence, reduces the time and resources needed. The system applies a serial input and there is no need to stick road tax on the windshield. In addition, there is an option where user can trigger an alert to indicate if the car is stolen and establish a panic situation by activating the car siren automatically in order to alert the nearby security officers.

Keywords

Digital number, Number plate, Road tax renewal.

Introduction

Number plate is a sign on a road vehicle that shows its registration number. Number plate is a standard maintained by government bodies. The existing number plate is using an old system that is prepared manually during the purchase of a vehicle. The renewal process will also need to go through a long procedure and time consuming. Researches are working closely to improve the number plate detection system in order to overcome this situation (Sarfranz, M. et al, 2003; Kranthi, S. et al, 2011 & Ahmed, M. J. et al, 2003).

Digital Number Plate is a system used by USA (Gehlot, N., & Lawrence, V., 2003; Vitale, R. L., & Kolpasky, K. G., 2007) and Saudi Arab (Sarfranz, M. et al, 2003) and going through a pilot testing. Digital Number Plate can be implemented for cars, truck, bike and buses that requires number plate and can be controlled using Mobile Application. Users can renew road tax just with serial input without the need to place sticker on windshield. This system can be helpful for the Road Transport Department where renewal is fast by using online system in order to obtain the input key for mobile application and update the new expiry date.

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Smart cars today have added features to enhance the performance. Smart cars started with fuel efficient and environmentally friendly. However the smart car features must include safety for users (Smart, R. G. et al, 2005; Zhou, W. et al, 2018). To add to this function, the proposed system provides an option where user can enable an alert to indicate if the car is stolen and create a panic situation. The car siren will be activated automatically to alert the nearby security officers. This system can be integrated with smart cars so that their function that can expanded in order to provide useful communication to pedestrian as well help help minimizing the number of road accident. As for now, this system expand the user's safety and minimize manual hassle using the application on their mobile phone.

In our current state, the only thing that is holding back the technology advancement on a car is the ancient number plate that was implemented 100 years ago. As our cars are getting smarter with more safety features, the current system can be substituted with digital number plate. This can be useful and handy in emergency situation.

The current number plate cannot notify when the car gets stolen or even broadcast the location of the car through number plate. The digital number plate display can solve some of the problem and can be further improved in future (Parker Sr, H. C., 2006). This is an easy solution for users who carries phone all the time. Car manufacturer can make use of this integrated features in the nearest future implementation.

Methodology

The methodology that has been carried out in this project comprises of three major steps. First step is by gathering the requirements using two techniques i.e. background study and feedback form questionnaire. The background study on the current direction is needed to analyze the need of the system and use the data to improve the system based on user requirements. Apart from that, questionnaire where a form of feedback were gathered from various users of a particular field of interest. This questionnaire is a feedback from a group of people to analysis the results. The results is presented into chart which can help to analyze large number or responses.

Second step is system development and implementation. Digital Number Plate system is developed using Arduino Uno 3, Modular display (2x16), Bluetooth module, Mobile Phone, Arduino IDE and MIT App Inventor is used to improve this system. This system is enable to change the old number plate system into a Digital Number Plate Display. The Arduino is a very simple working mechanism that can be easily programmed, erased and reprogrammed (Badamasi, Y. A., 2014].

The schematic diagram of Arduino is detailed in figure 1. The prototype model of Car Digital Number Plate Display of the proposed system is shown in figure 2. Figure 2 also shows the markup on how the prototype model will be connected for this application.

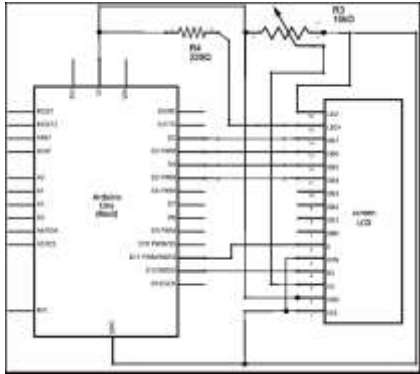


Figure 1: Schematic diagram of Arduino.

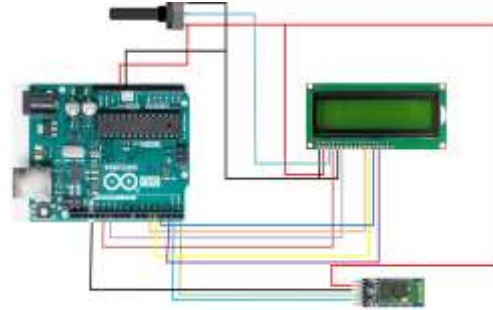


Figure 2: Architecture Mobile-Based Digital Car Plate Number

To develop the system, Arduino UNO, display module, Bluetooth module, Arduino IDE and MIT App Inventor are required. Figure 3, 4 and 5 show the Arduino UNO, display module, Bluetooth module separately. The Arduino UNO board is an open-source microcontroller board where user can purchase it together with other component in order to develop their own system and simply download the Arduino IDE and start program the board accordingly.



Figure 3: Arduino UNO



Figure 4: Display module



Figure 5: Bluetooth module

Figure 6 shows the Arduino integrated development environment implements Java programming language and it supports Windows, Mac OS as well as Linux since it is cross-platform. Programs that are to be uploaded to the Arduino board can be written using this IDE. Plus, all the source code of IDE is released by GNU General Public License. Figure 7 shows the MIT App Inventor for Android which is an open-source web application originally provided by Google, and now maintained by the Massachusetts Institute of Technology, which allows newcomers to computer programming to create software applications for Android operating system



Figure 6: Arduino IDE



Figure 7: MIT App Inventor

Phone application was connected to the database and used to access this system via Bluetooth. The Bluetooth is set as client and its one way transmission. Figure 8 and 9, show the Home Screen of the application on controlling the Car Digital Number Plate Display. Figure 10 shows the Admin Screen of the application on Creating Car Code together with number plate and due date of road tax. Figure 11 shows the Road Tax Renewal Screen of the application for creating renewal code with the road tax expiry date.

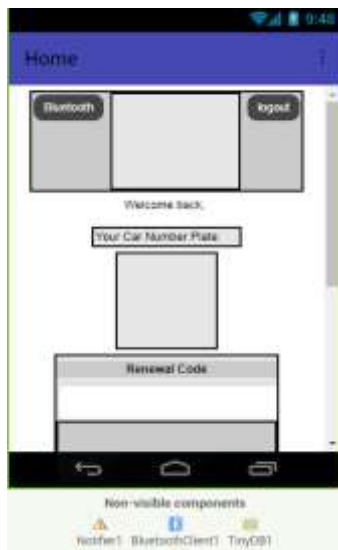


Figure 8

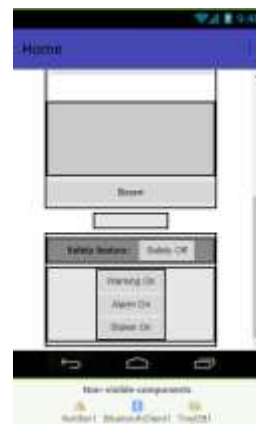


Figure 9

Figure 8 and 9: Home Screen of Car Digital Number Plate Application.



Figure 10: Admin Screen

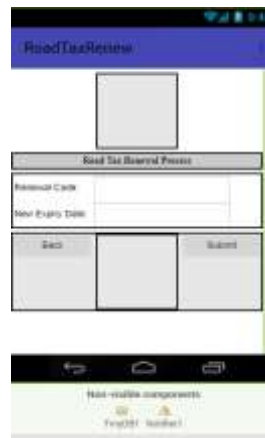


Figure 11: Road Tax Renewal

Figure 10 and 11: Admin Screen and Road Tax Renewal Screen.

The proposed system could help users, admin and other functions. The users could login, register, renew roadtax and click on safety function for theft, warning and alarm. The admin can also login, create car code, create number plate and current expiry date and create renewal code and next expiry day. Besides that, other function includes navigation and Arduino receive data from Bluetooth and display on screen.

The last step in the methodology is system testing whereby two testing methods were carried out i.e. unit and integration testing followed by functional testing that focuses on the functionality of the system features against the developer's expected result. The deliberation of this step and the results is written in the following section.

Results and Discussion

Based on the background study shows that Digital Car Plate system is yet to explore and if implemented with additional function, it can help solve several issues that arise nowadays. On the other hand, quantitative methods shows clearly that IoT and Arduino platform is an important direction for exploration. About 50% of the user find the app UI very organize and user friendly. All respondent finds the Arduino System is performing according to expectation and the application is fast.

To develop this system, Arduino UNO, display module, Bluetooth module, Arduino IDE and MIT App Inventor are integrated. The digital car plate system can be controlled using mobile application which reduced manual processing and also work for anti-theft functionality. Figure 12 shows the actual prototype model in a working mode.

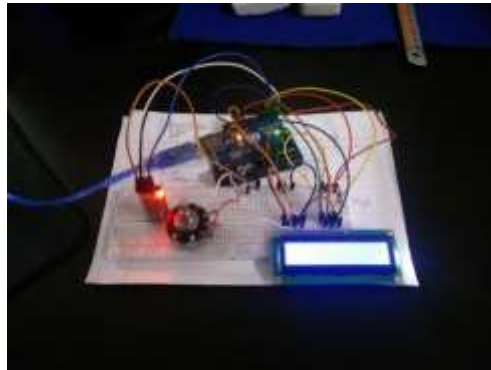


Figure 12: Prototype model in working mode.

The system was then tested using unit testing and functionality testing methods. This method ensures that the mobile application and Arduino System are able to handle daily task with error checking in the system that might cause unexpected failure to the system. Test conducted in a controlled environment to identify all the possible issue. Unit testing method was used to test the systems unit components while Integration testing was used to ensure that all of the systems components are able to work together. Functionality testing method was used to test all of the systems functions. The following analysis was gathered from the testing methods:

Unit testing & Integration testing

The main goal of this user interface system is to ensure that cars are able to display number plate with renewal date of roadtax. The Arduino module attached provides this function to the proposed system. All the devices are also able to integrate and communicate with each other as required.

Functionality Testing

Functionality testing as in Table 1 provides function such as login in, register, create car code, create number plate, create current expiry date, renewal code, next expiry date and most important safety function buttons. The test done on all unit are successful as per the expected results as per detail below.

Table 1: Functionality Test

Functional Test	Expected Result	Final Result
Login In	User able to login to the application without any issue	Pass
Register	User able register to the application without any issue	Pass
Create Car Code	Admin can create code for new user without any issue	Pass
Create Number Plate	Admin can create user number plate without any issue	Pass
Create Current Expiry Date	Admin can create user expiry date without any issue	Pass
Create Renewal Code	Admin can create renewal code for user without any issue	Pass
Create Next Expiry Date	Admin can create next expiry date without any issue	Pass
Safety function buttons	User able to execute Stolen, Warning, Alarm to the Arduino System without any issue	Pass

Conclusions

The Digital Car Plate system is a complete digital number plate display using mobile application. The system could change the 100 years old of obsolete technology of number plate and modernize it to give new function and provide additional safety. The interface between Arduino model and mobile application software is linked using tiny database. The wireless application using digital plate were configured to help handled the renewal process and users are able to renew road tax by just updating on the digital screen that reduces the time and resources needed. In addition to that, there is an option where user can enable an alert to indicate if the car is stolen and create a panic situation. The car siren will be activated automatically to alert the nearby security if the user's key is stolen.

The future enhancement of this system can be implemented and unlock more features and function that improve not only for the driver but the passenger and the other people surrounding them. One of the function could be real time display of the road front view to the back of the car number plate by using camera. This function is useful for trucks and other vehicle that too long or wide that blocks the view of the back drivers. This could help the back drivers to view the real time display. This can prevent dangerous overtaking and let behind drives to be more aware of the situation and act accordingly. Other useful function to be implemented in the future will be payment for public parking, automatic toll payment, wireless transmit entry to mall car park via online. This digital number plate can show the time limit left

in public parking and the technology that currently on test pilot phase on RFID can be integrated inside number plate and avoid exceeding the time limit. Car manufacture can now promote safer and useful function through integrating this kind of proposed system by using the car central console to configure it.

Acknowledgements

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