A Mobile Application for Preparing the Driving Tests in Hong Kong

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Abstract. This paper presents an educational mobile application in Android platform called "HK driving tests All-In-One" to help young private automatic car learners prepare for driving tests in Hong Kong. Car learners who are going to take the driving tests may do revision at anytime and anywhere provided that they have an Android device on hand. They can learn in an interesting way and understand the driving techniques more easily with notes, mock tests, animations and games. It will also help in reducing dangerous driving and promoting proper driving skills. The results indicated that developing a mobile application to prepare driving tests in Hong Kong is useful and helpful.

Keywords: mobile learning, driving tests in Hong Kong, Android apps, educational mobile application.

1 Introduction

It is difficult for people who are going to take driving tests in Hong Kong to revise the driving skills and theories themselves because most of the driving schools will not provide many materials or notes although learners have paid ten thousand or more for about fifteen driving lessons.

This paper presents an educational mobile application on the Android platform for preparing both the driving theory test and road test in Hong Kong. It provides guidebooks, mock tests, animations and virtual driving games to help users, especially young private automatic car learners who are going to take the driving tests, to do revision and pass the driving tests in Hong Kong easily.

1.1 Impact and Value of this Mobile Application

Car learners who are going to take the driving tests in Hong Kong may practice and revise the main points of driving anywhere at any time provided that they have a mobile device in their hands. They can have most of the driving materials in one application without bringing a lot of notes or heavy books. Also, those materials inside the application would definitely clam them down and bring back the memory before taking the tests, thus having a better performance.

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Also, there are animations and virtual game-based driving practice for the road driving tests so the users can learn in an interesting way and understand the techniques more easily. Learners can experience driving a car with a first-person view and similar physical settings in real life to get familiar with driving a car. Those materials with graphics and games which contextualize the learning may help users to have a long term memory and a better performance in revision. [1-2]

It is free of charge so everyone who is interested in driving may know more about driving in Hong Kong and pre-learners can understand some basic driving concepts before learning driving without paying. Therefore, this application does not only help learners to pass the driving tests, but also helps in increasing road safety and reducing dangerous driving.

1.2 Hong Kong Driving Tests

There are three parts of the tests which are written test (Part A), Competence test (Part B) and the on-the-road test (Part C). The learners have to pass the written test before learning to drive and the two driving test parts can be tested separately or combined to test at the same time.

In the written test, candidates have to answer twenty multiple-choice questions about driving theories in twenty minutes. Competence test is the basic driving and parking techniques test including parking the car, making a U-turn on a narrow road and stop on the steep road. Candidates will be asked to drive for around twenty minutes on the real road in the city in the on-the-road test (Part C) where their driving skills and responses in real situation can be tested.

1.3 Review of Existing Solutions

There are about five driving applications for Hong Kong driving theory test and two are listed to compare with the other two applications from the United Kingdom and Mainland China respectively [3-6]. Table 1 below compares those applications which have been downloaded more than 10,000 times in Google play store. It shows that all the applications focus on the driving theory part only by providing practice and mock test but there is no handbook for users to study the theories before doing exercise or mock test. There is no application that provides lessons on the road test part.

Table 1. Comparison of Existing Applications

Function\App	Driving Theory Test(UK) [3]	HK Driving Written Mock Exam[4]	Hong Kong Driving Test[5]	考駕照[6]
1.Theory Handbook	✘	✘	✘	✘
2.Theory Test practice	✔	✘	✔	✔
3.Theory Mock Test	✔	✔	✔	✔
4.Driving animation	✘	✘	✘	✘
5.Virtual driving test	✘	✘	✘	✘
6.Game	✘	✘	✘	✘
7.Language used	English	Traditional Chinese	Traditional Chinese	Simplified Chinese

2 Methodology

The application platform will be Android OS which is written in the Java language with Eclipse. Android OS is preferred because it is an open-source mobile phone operating system where its application market is popular and has less restriction so it is easier for beginners to develop mobile applications [7-8].

A game engine called Unity will be used to develop all the animations and games contained in the application. JavaScript and C++ language are used for coding and the libraries of Unity are widely used to get the best quality of the graphics and object design. Most of the animations and games are drawn in 3D if possible [9].

For the simple 2D graphics in the application, Adobe Photoshop or some simple graphics applications such as Paint are used. All of the graphics will be designed and drawn by myself, except some special logos which have been permitted [10].

All the questions, answers, theories and other text-based contents inside the application are mostly stored in a rational database using a popular free relational database management system called SQLite because it is a reliable embedded database which is fast, powerful and simple to use [11].

2.1 Design of the Application

There are two main sections in the application which are the theory test and road test. The overview of the application is shown in Fig. 1.

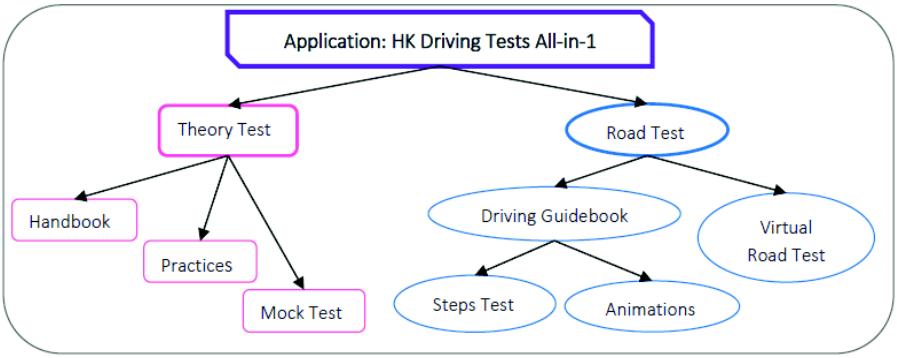

Fig. 1. Overview of the application

Fig. 1 shows the structure of the application. In the theory test section, there are three parts including a theory handbook, theory test practice and theory mock test. There are driving guidebooks with animations, driving step test and virtual road test games inside the road test section.

All materials in the application are sorted by topics so users can follow the flow to revise step by step. Also, the format of the mock tests is similar to the real driving tests so users can get familiar with it.

3 Implementation

The starting page of the mobile application is shown in Fig. 2. Fig. 3 shows the main menu which is entered by clicking the rotating red car in the animation on the starting page.

Fig. 2. Starting page of the application

Fig. 3. Main menu of the application

3.1 Theory Test Part

In theory test section, there are three parts including a theory handbook, theory test practice and theory mock test.

3.1.1 Theory Handbook

The handbook shows all the theories from the Road Users' Code sorted by topics. Sliding layout is used to have a multi-plane layout on top of the UI and each chapter of the handbook will be displayed in a slider which is designed to look like an e-book. Users can turn the page by swiping the slider to left or right or clicking the button on the top right corner in the action menu bar. The content will be interpreted and rearranged into essential notes so learners can study the theories easily and efficiently. Also, fewer activities will be created so the structure of the program will be clear and the performance of the application will be improved [12-14].

3.1.2 Theory Test Practice

There are practices for the theory test sorted by topics without time limit using screen slider with FrameLayout. Questions on the topic selected will be displayed in a slider randomly chosen from the database. There are three options in each multiple choice

question and the options will also be randomly generated to prevent users from memorizing the correct option instead of the answer. After answering a question by choosing and submit the option, the answer chosen will be compared to the correct answer from the database. The result will then be shown right after answering each question like the one in Fig. 4 and the correct answer will be given if the answer is wrong. Fig. 5 shows the final score after answering all the questions in that topic so users may revise the topic if the score of the topic is low. Users may keep doing the practices of the same topic until getting full mark or they may stop at any point by closing the slider. The practices may help users to get used to the question format and to know which topic should be strengthened.

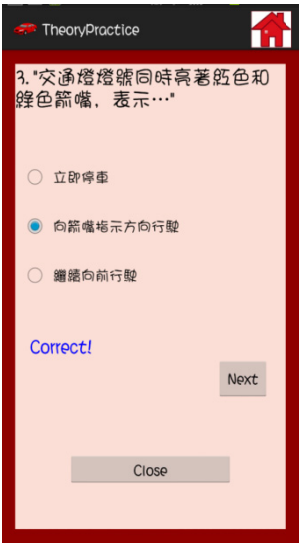

Fig. 4. Answer correctly in the Theory Practice

Fig. 5. Last Question in Theory Practice Slider

Fig. 6. Last Question in Mock Test

3.1.3 Theory Mock Test

The theory mock test can help learners to check if they are ready for the real written theory test or not. The format is the same as the real test where candidates have to answer twenty multiple-choice questions within twenty minutes. When the test is started, the timer will start and is always on the right hand side in blue which is shown in Fig. 6. The questions will be randomly chosen from all topics in the database. The options selected by the user will be saved into the database after user answering the question. If the user does not select any option in a question, that question will be marked as incorrect.

During the test, all answers can be checked and modified by clicking “Back” and “Next” buttons unless the answers are submitted or time is up. The result and correct answers will be shown after the end of test by comparing the correct answer and options user selected which are stored in the database. Users will pass the test if they

answered 16 or more questions (out of 20 questions) correctly and the user may check the solution after receiving the result.

3.2 Road Test Part

There are four parts in the road test section which are the driving guidebook, animation, driving steps test and virtual driving test.

3.2.1 Driving Guidebook

The driving guidebook is kind of a driving textbook with some basic driving techniques. There are some driving skills and techniques written in texts which stored in the resource file. The content of each topic is shown on pages with the use of screen slider similar to the theory handbook. Users can swipe the slider or click the "Previous" or "Next" button in the action menu bar to turn page. Learners can study the driving steps and skills to have pre-learning before driving a real car or practice in mind when there is no car for users to drive. Also, there will be some reminders and techniques of driving, such as some solutions in different situations, for users' references.

3.2.2 Driving Steps Test

After studying the driving guidebook, there are some mini game-based tests about the driving steps sorted by topic. The driving steps of the same topic will be stored in an arraylist in correct order. After selecting the test topic from menu and enter the test, there are buttons with different driving steps assigned randomly and users have to select the step buttons in the correct order. If correct step button is chosen, the text of driving step on the corresponding button will disappear; else, nothing will happen. Fig. 7 shows a partially completed test. The timer will start at once the step button is clicked and the time used to finish the test will be shown after all the driving steps are selected correctly. All the driving steps will be reassigned randomly and the test will be reset if users clicked the restart button. The more the user study, the shorter the time may be used.

3.2.3 Driving Animations

For further demonstration, users can watch the driving animations to understand the driving skills shown in the guidebook more clearly which is especially helpful for those who have not driven before to have the fundamental images in mind. Those animations are recorded with Unity player which are the game scenes in the virtual driving tests.

There are three animations including S-shape parking, L-shape parking and the on-the-road driving which are stored in the raw file in resource and one of them will be played in the video view after the user has selected it from the drop down menu like the one in Fig. 8 and Fig. 9. The animations will show the correct driving steps

through the whole driving test and there are narrations in Chinese telling the actions that the driver is doing so users can understand the driving steps easily. Also, the animations can be the demonstration of the virtual road tests so the users can know what to do in the virtual road tests with these instructions showing in animations.

Fig. 7. Half-completed Driving Steps Test

Fig. 8. Driving Animation Dropdown Menu

Fig. 9. S-shape parking Animation

3.2.4 Virtual Road Tests

Learners can take the virtual road tests after watching the animations to see if they have studied the guidebook well enough. There are three virtual driving tests which are the L-shape parking test, S-shape parking test and on-the-road test developed with the game engine Unity.

The car used in these tests is not powerful with an automatic transmission although it is designed like a sport car. The car is created by putting different components together such as car engine, glasses, brake and indication lights. Then, adding the accessories to decorate the interior of the car like the steering wheel, rear mirror and dash and speedometer board. Different cameras have to be used for different views like the driver view, rear mirrors view and map view so they have to put in different positions with specific angles of view. A C-sharp (C#) script will be written for each component to handle user input, update the states and do different actions under specific conditions. Finally, the physical settings of the car have to be adjusted and the painting and artwork can be added to make the car look better.

There are two parts in the virtual road tests similar to the real tests, which are the parking test and on-the-road test. Therefore, the settings of the tests are not the same where the parking tests are held in a car park with parking lots and the on-the-road test is held in a city with traffic lights, buildings and street light poles. However, their

environments are similar, for example, there is a sun on top with the same intensity and the texture of the roads is the same. Most of the components in the test environment are created by adding the object with deciding shape and size, and then put the textures designed with Photoshop on it and set its physical properties. Some common components can be added from the assets downloaded from the Unity Assets Store.

The test scenes in all tests are designed as the first-person view which is the view of the driver and there are the major components of car which are required for driving such as the rear mirror, steering wheel and dash and speedometer board. The steering wheel is controlled by rotating the mobile device like turning the steering wheel and the brake is on the left half of screen and the gas input is on the right half of screen so users can use the thumbs to control the driving speed easily when holding the mobile device with two hands.

On-the-Road Test

Users have to follow the driving steps to drive like having driving lessons or tests in real car with an instructor so there are instructions and warning given in form of both voice and text. During the test, users have to choose the actions in the correct order or do the right things in different situations. The scripts of each component will detect whether the user is doing correctly. For example, the left indicator light should be turned on before turning left by turning the steering wheel so there is a function in indicator light script to check if the correct indicator light is turned on when it received the turning angle from the function of the steering wheel script.

Users will be asked to drive according to the instructor's commands where the soundtracks will only be played once with text version shown in the scene when the car is detected in a specific position.

When the mistakes that users have made are detected from all the component scripts, they will be sent to the result script and the records will be saved. Also, the warning voice message will be played like what the examiners or instructors do in the real world and there will be a text box on the scene showing the warning. There will be reminder when minor mistake is made where Fig. 10 shows as an example that users forget to turn off the indicator light.

If there is any big serious mistake, such as car crash and driving speed over 90km/h, the test will immediately stop and a special menu will show the serious mistake that the user has just made and users may choose to restart or exit the test from that menu. This mechanism is designed for preventing users misusing this application as a car racing game instead of an educational virtual driving practice.

The marking scheme will be similar to the real one where the users will pass if there is no big mistake or there are no more than three minor mistakes. The result script collects all the mistakes detected by different component and integrates them to a clear mark sheet. The final mark sheet will be shown after finishing the test with showing the numbers of different mistakes have been made during the whole test and the result of passing the test or not.

Users can get used to the driving test environment and format with a virtual examiner and driving scene. The warning and the final result can remind users to be

careful of those mistakes they have made and can practice more on those aspects in real driving lessons.

Fig. 10. Examiner's reminder in On-the-road test

Parking Tests

There are two parking tests, L-shape and S-shape parking where Fig. 11 and Fig. 12 show the overview of the car park, for users to choose as different style of parking will be tested in random in the real competence test where Different position of the parking lots need different way to park the car but the control of the car and driving skills are the same.

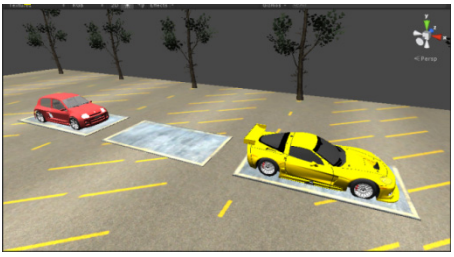

Fig. 11. S-shape parking test

Fig. 12. L-shape parking test

The target car park lot is always on the left hand side of the users' car and users can make use of the three rear mirrors to help checking the parking position. The driving steps and the control of the car in this test are the same as the virtual on-the-road test where it is similar to the real driving. For example, the car cannot move backwards without gear R and the car should be parked with gear P where those are controlled in the car controller script.

Similar to the virtual on-the-road test, the warning voice message will be played and the warning will be shown in a text box on the scene when the users have made any mistakes. If there is any big serious mistake like crashing other car detected by collision detection, the test will immediately end.

After finishing parking, users can click the "Switch View" button on the top right corner to get the test result and see if the car is parked correctly by switching the camera to the a top view which allows users to overlook the car. Users will pass the test if there is no big mistake and the car is parked inside the lot without touching the lines of the parking lot detected by the car tires where Fig. 13 shows as an example.

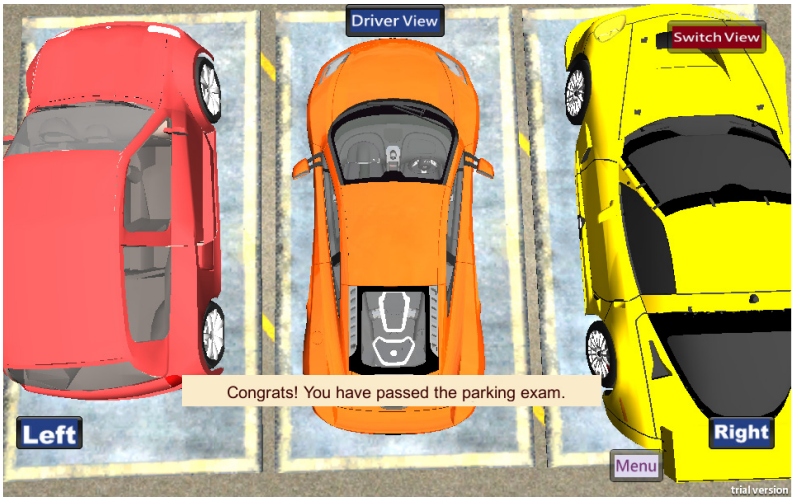

Fig. 13. Passed in the L-shape parking test

4 Evaluation Results and Findings

The purpose of the evaluation is to check the effectiveness of the mobile application whether it can help car learners to prepare the driving tests in Hong Kong. Twenty participants are invited to evaluate the application. There are three kinds of evaluation data including the results of tests in the application done by the participants, data from questionnaires and comments from interview. The overall results tend to be positive but there is still room for improvement.

4.1 Evaluation Data

- 90% and 100% of the participants in (Group A) get a better result in Theory Mock Test and the Virtual on-the-road Test respectively after revision with the application for five days.
- The average score of the ability on helping in preparing driving test of this application is 4.2 out of 5 (84/100).

- The average overall score of the application is 4 out of 5 (80/100).
- Fig. 14 shows that 100%, 50% and 70% of participants agree that the application help in preparing written test, competence test (Part B) and on-the-road (Part C) test in Hong Kong respectively.
- 100% of participants agree that the application helps in preparing the driving tests in Hong Kong and gives basic driving concepts.
- 100%, 75% and 80% of participants believe that the attractiveness of this application is free of charge, multi-purpose (helps in preparing all parts of driving tests) and the multimedia (helps in memorizing) respectively.

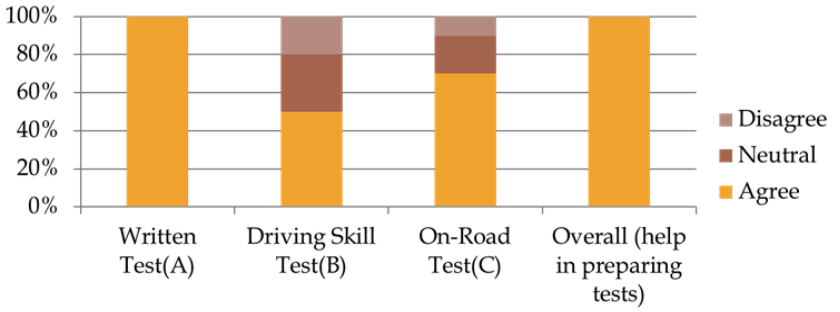

Fig. 14. Participants' attitude toward the help of the application in preparing driving tests in Hong Kong

4.2 Interpretation

The mobile application helps in preparing both the driving theory test and road test in Hong Kong and gives basic driving concepts to learners. Users are quite satisfied with the application with score of 4 out of 5 in average.

This application provides enough materials for car learners to do revision themselves and they may pass the driving tests in Hong Kong easily with better result. The virtual road tests provide a contextual learning which may help learners to learn driving effectively in an interesting way. It is believed that the multimedia in the application can help learners to have long term memory which is in favor of preparing driving tests.

5 Conclusion

In this paper, an Android educational application for car learners to prepare driving tests in Hong Kong is developed. The virtual examiner and the function of detecting driving mistake in virtual road tests is one of the big successes to make the road test practice more useful and realistic. Also, the use of slider layout in the theory practice and handbook greatly reduces the number of activities used and the memory usage because of the decrease of the activities in the stack. It also helps with the file size due to the reduction of coding. The design will be optimized and the application can become more user-friendly.

However, there are some limitations in the virtual road test because the physical setting of Unity is slightly different from the real world. For example, the side rear mirrors cannot be shown together in the scene without clicking the button because the number of cameras shown in one scene is limited. Also, the road test part will only be available for the learners who want to learn driving a car with an automatic transmission due to the lack of driving techniques of the manual one. However, the basic driving skills and theories are still useful to all private car learner drivers except the motorbike learners.

It is suggested that more scenario cases can be added to test the users' response and increase their experience for future work. For example, someone runs under the pedestrian red-light or the driving test is held under a special environment or weather condition. Also, the results of all the tests and exercises can be saved and shown with charts so the users may know their weaknesses and practice more on those topics which can have a better learning outcome and efficiency.

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