MathEasy: An Application for m-Learning in Mathematics

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Abstract: The rapid change in technology in the 21st century is changing the way we observe the world around us. Integration of computer with education opens new dynamic and adaptive learning paradigms for education. M-learning emerges as a major subset of e-learning which provides just-in-time adaptive learning solutions which may be used complimentary with the traditional education in classrooms. To boost the m-learning this paper presents an application to aid learning in mathematics for children of age group 6 to 10 years.

***Index Terms*—M-learning, mobile phones, mathematics, mobile applications, j2me**

I. Introduction

With the advent of 21st century, technology replaced many traditional aspects of our lives. It changed the methods of communication, altered the phenomenon of mobility and had a great impact on reducing the round world to a flat world. It had an unprecedented impact on the way education was perceived. Education incepted from pictography and hieroglyphs in early 2000 BC and evolved to books with the discovery of printing press. With the evolution of internet, books were digitized and a new era of e-learning began. E-learning is education – anywhere, anytime. With the portability associated with computers, scholars can now sit in their houses or be on a move while watching the podcasts and video-casts of their professors. This may also help educate people who have access to infrastructure but not enough tutors available.

One of the emerging dimensions of e-learning is m-learning. In principle, m-learning is a subset of e-learning which deals with learning through a mobile phone. With a mobile phone, comes the flexibility and mobility which traditional e-learning applications can't provide while it compromises on the speed, processing power and the vast number of applications which e-learning provide.

This paper details one such application that deals with m-learning in mathematics. The paper details the motivation behind developing such an application and also details the intricacies of the application such as design, implementation and technology used.

In the later part of the paper we explain the step by step installation of the application and explain the future enhancement possibilities.

The objective of this paper is to detail the application named "MathEasy" as an m-learning initiative taken for mathematics along with its architectures and the technical details.

II. Mobile Learning – Motivation

The number of internet users in the world is approximately half to that of the number of mobile phone users [1]. This number of mobile phone users is expected to rise to a whooping 6 Billion figure by 2013. The major advantage associated with mobile phones is the affordability and portability. With the increase in the number of mobile phone users, there is a tremendous increase in the number and types of applications for mobile phones.

The biggest challenge in mobile computing is to build applications that are acceptable across all geographical regions in language independent manner. Our motivation was to provide a language independent [3] mathematics quiz for students which will act as supplement to their studies and add fun to learning.

III. MathEasy - Target Audience

This application has been developed for Children of age groups 6-10 years which will use the mobile application to learn addition and subtraction.

This is also in fulfillment of coursework for CSE 594 - Mobile Computing for informal economies.

IV. Application Functionality

The application generates random questions on simple addition and subtraction. It has three difficulty levels and enables the user to select a difficulty level according to his preference.

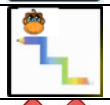
- Easy: Single digit addition and subtraction
- Medium: Two digit addition and subtraction
- Hard: Three digit addition and subtraction

V. Design

The design of the application can be divided into following sub-categories:

- Front end: User Interface
- Back end: Question generation
- Integration with Mobile

The user interface was developed with images created with Adobe Photoshop. Since the target audience is children of age 6-12, the user interface of MathEasy has been designed to be very attractive at the same time as simple as possible. Some of the images of the application along with their meaning are listed below.

	Starts the application and takes the user to the difficulty level screen where he can select the level of difficulty of the quiz.
	Closes the application
	Clicking on this button on any screen, takes the user to the main screen of the application.
	Takes the user to the next question or if the user is in the last question it takes him to the score report page.
	Easy Level (Single Digit Questions)
	Medium Level (Two Digit Questions)
	Hard Level (Three Digit Questions)
	No of Incorrect Answers
	No of Correct Answers

The backend of the application takes care of the generation of the questions based on the difficulty level chosen. Since the questions are generated randomly there is no need of a question database. The backend also takes care of the navigation across various screens of the application and the generation of score report depending upon the user's responses. If the user selects a correct answer on the first shot he gets a point and no negative points for incorrect responses.

During the development stage the application was tested in a low end Sony Ericson w350i phone. Later while testing stage the application was tested in various low end and high end phones of different makes.

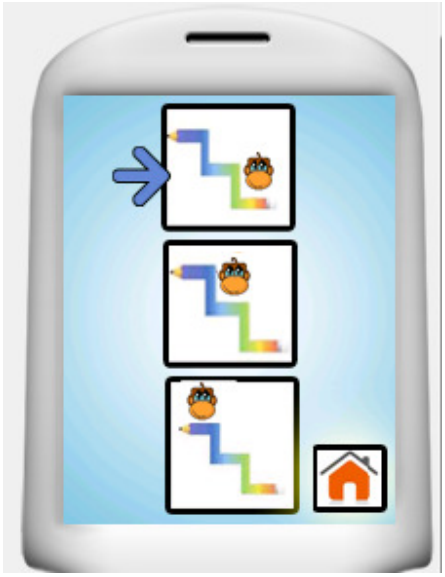
VI. APPLICATION FLOW

The application has been split into four main screens

- Main Screen
- Difficulty Level Screen
- Question Screen
- Score Report Screen

Main Screen

The Main Screen of the application consists of the start and the exit button. The red color on the button indicates that the particular button has been highlighted. Using the up and down arrows in the phone the user can change his selection and can use the middle button for clicking on a button. Clicking on the exit button closes the application. Clicking on the "Start" button takes the user to the following screen



Difficulty Level Screen

This screen shows the three levels of difficulty of the questions. The arrow sign indicates the level selected currently. Selecting the home button takes the user to the main screen again. Clicking on any one of the level button takes the

user to the question screen having questions with the selected difficulty level. Below are screenshots of easy, medium and hard questions screens.

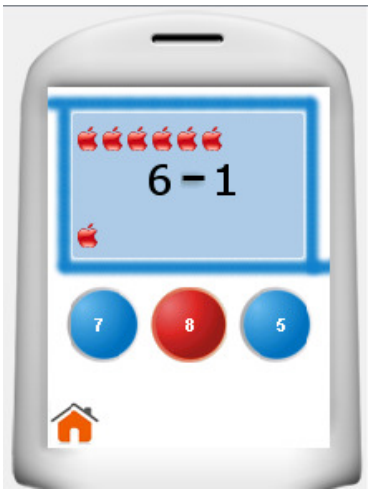
Easy Question Screen

Medium Question Screen

Hard Question Screen

In the easy level apart from the question it has visual representation of the numbers in the form of apples which would help children to learn counting. The currently selected option is displayed as an orange ball. The user can use the arrows to navigate between the options and use the middle button to select an option as his answer.

Depending on whether the selected option was correct or incorrect the following screens get displayed



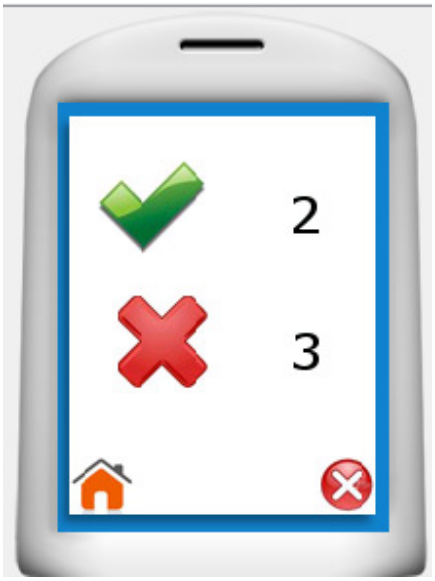
Incorrect Answer

Correct Answer

In the above case the user doesn't get any point for this question since he has not answered the question in a single shot. The next button gets displayed only when the user has selected a correct answer. Clicking on the next option takes the user to the next question. Totally the user has to answer 5 questions for completing the quiz. If he has answered the 5th question then clicking on the next button takes the user to the score report screen.

The score report screen displays the number of correct and incorrect responses given by the user. Apart from

that it also has two buttons. One "**home**" button which takes the user to the main screen if he wishes to take the quiz again. Second one is the "**exit**" button using which the user can close the application. The score report screen is shown below



Score Report Screen

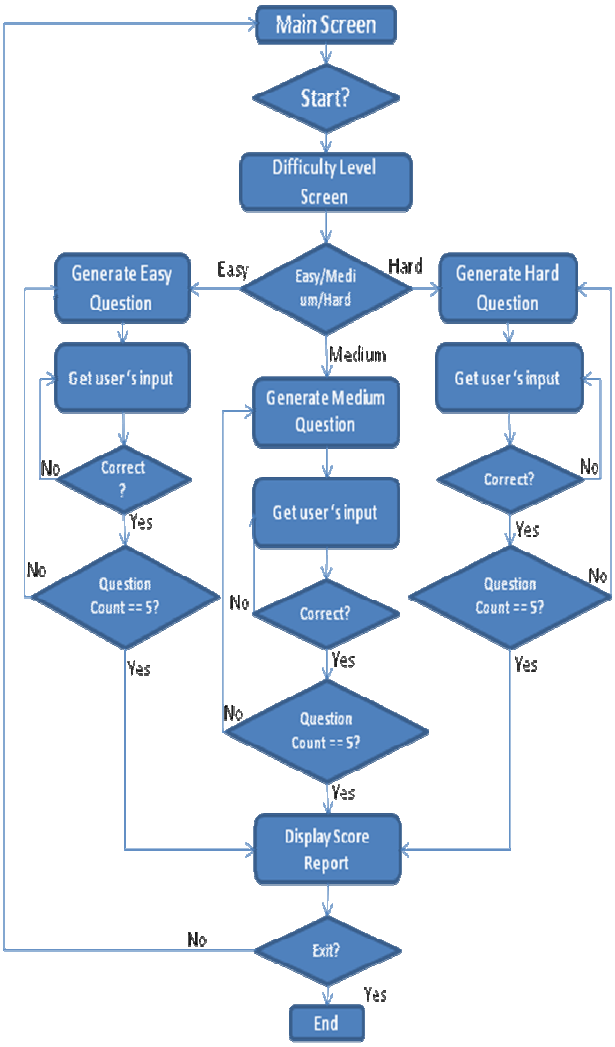
VII. TECHNICAL DETAILS

The application is developed using NetBeans IDE 6.7.1 in CLDC/MIDP platform and the images were created using Adobe Photoshop CS2. The application contains the following JAVA files

- **ME_Midlet.java :** This is the main midlet of the application it creates an instance of mycanvas and uses it.
- **MyCanvas.java :** This is the canvas classes laid over the midlet. It controls various screens inside by maintaining state variables.

The keypressed () event of the Canvas class is used for getting the user input. Whenever the user presses a key in his mobile the control comes to this particular function and depending on the key pressed and the current state variables the application does necessary things corresponding to the user action. The application generates the question on the fly. It used the built in java class java.util.Random for generation of the questions. In case of easy level we generate number between 0-9 and in case of medium level we generate numbers in the range10 – 99 and in case of hard level we generate numbers in the range of 100-999.

The application also makes use of a function called resizeImage () [5]. The main use of this image is to resize a particular image to adjust itself depending on the screen-size of the mobile. This helps to make the application portable on every mobile irrespective of the screen-size or make of the mobile.



Flowchart of the MathEasy

The size of the application comes to 158kb including all the images in it.

VIII. CHALLENGES FACED DURING DEVELOPMENT

The most challenging part during the development of the application was to maintain the layout of the application look the same in different mobiles. The images were designed for screen size of 170x220 pixels but they will be resized dynamically during the execution of the application depending on the screen size of the mobile.

The other challenging part was to play with random numbers. While generating the options for the questions we had to take care no two options turn out to be the same and the position of the correct answer had to be placed randomly in one of the three positions available.

IX. DEPLOYING MATHEASY

To install the application on a mobile just copy the .JAR and .JAD files into the mobile and run the .JAD file which would read the .JAR file and install the application on the mobile. In some mobile we need to specify where the application has to be installed (such as Sony Ericson w350i) and in some mobiles the application gets installed in the **Applications** folder.

To work with the source code, NetBeans IDE 6.7.1 is needed and the project can be opened from it. Once the project is opened in NetBeans the .JAR and .JAD files can be created by building the project. The .JAR and .JAD files will be available in the "dist" folder inside the project. Using these files the application can be installed into a mobile as explained above.

X. INTEGRATION TESTING

The application was tested on Sony Ericson w350i, Nokia 2320-c, Nokia6300 and Nokia E71 and made sure that there are no alignment issues in the application. The flow of the application was tested with various test cases.

E.g. EasyLevel: Selection of a Wrong answer

EasyLevel: Selection of a correct answer

The above cases were tested for Medium and Hard level also.

XI. FUTURE ENHANCEMENTS

- The difficulty level of the questions can be made adaptive. For example if a user gives a correct response the level of difficulty of next question should be more and in case of a wrong answer it has to go down.
- The score report of the quiz can be sent to the child's parent via SMS.
- Questions based on multiplication and division operation can also be implemented to cover a larger set of audience.

XII. REFERENCES

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