

Development of a Simulator of Abacus: Ancient Analog Calculator on a Mobile Phone as a Teaching Material

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Abstract. Portable electric devices such as mobile phones and video game consoles are becoming high performance and they are becoming ubiquitous. And a lot of people are in situations that allow for use of these applications. On one hand, it is useful for students to study out of class if they can use teaching materials at school with a portable device. And Japanese people had widely been using an abacus until the electronic digital calculator appeared recently. Even today, the abacus is used to teach math in Japanese primary schools teaching. We are developing a simulator of abacus as one of the computerizations of the teaching materials in this research.

Keywords: abacus, android, education, teaching material, mobile phone.

1 Introduction

The spread of mobile phones has advanced in Japan. In the research of Ministry of Public Management, Penetration rate for households of mobile phone was 95% at the end of 2007 [3]. And the mobile phone's availability of junior high school and high school students were over 85%. On one hand, the performance of mobile phones has advanced. There are a mobile phone which became possible to execute high-speed processing and equipped with a touch sensor and an acceleration sensor like Google Android (Android) [1]. Therefore, developers became possible to make applications which have a lot of functions.

Then we thought if we make teaching material's applications for students, they can study without a constraint by using these applications because a lot of students use mobile phone. We paid attention to the calculator named the abacus used in Japan from old as one of the teaching material applications. The abacus is not only a mere calculator but also a teaching material improved a mental calculation [2]. The abacus is used in the primary school class now.

In this research, we paid attention to it and developed an application that students can use like an actual abacus for using the touch sensor of Android. In addition, we

developed functions which display the number to understand expression of peculiar number for abacus and set simple addition problem to practice the calculation for using this application.

2 Overview of Japan Style Abacus

The arrangement of an abacus is five beads per row as in Figure 1. A single row shows one digit. The top five beads are shown of 5. Four beads under the top show one respectively. And as shown in Figure 2, number from 0 to 9 is shown by sequence of the beads. Students using an abacus learn skills that not only the calculation using an abacus is quick but also a mental calculation that the student images the abacus their mind. If a student can use the mental calculation, a student can come out calculations quickly without the abacus [4].

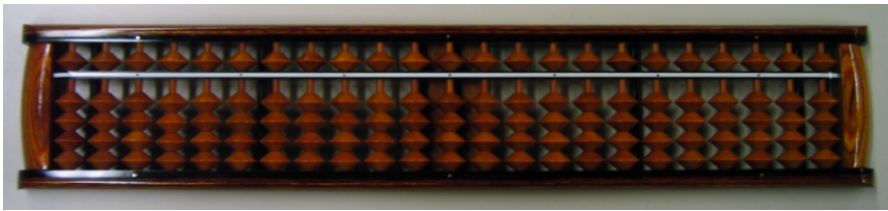


Fig. 1. Sharpe of a Japanese abacus

An abacus is used to understand a basic calculation at classes of primary school. However, they don't have enough time to study it. Therefore almost students can't master the mental calculation using abacuses. A lot of students who can make the mental calculation have been to the abacus classroom besides school classes.

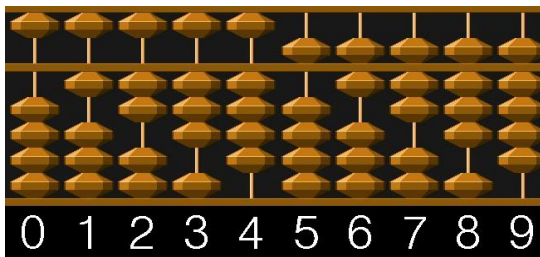


Fig. 2. How to show number from 0 to 9

3 The Android Platform

3.1 Overview

The Android is a platform that it was developed Google and Open Handset Alliance (OHA) [5]. OHA is a group of forty seven technology and mobile companies. They

released Android as an open source. We can use Android and a development environment for free. T-Mobile releases G1 [6] as a mobile phone equipped Android. A million units had sold from October 2008 to December 2008 in USA. In addition, Google have sold Android Dev phone that was removed to SIM lock and Hardware lock from G1 since December 2008. There are some features in Android. One of features is using the touch sensor and the acceleration sensor. So, a user can sensuously operate Android with there sensors. And the Android implements OpenGL ES as a 3D graphic function and a database corresponding to SQLite. Moreover, Android can synchronize Google account. Therefore, a user can take the schedule the user made and message of Gmail.

3.2 Execution Environment of Android Applications

The Android runs on a Linux operating system. Applications for the Android operate by using Dalvik Virtual Machine (DVM) of Java Virtual Machine (VM) implemented on Linux. DVM is what Google developed originally for the Android, it is suitable architecture for operation on a mobile phone. DVM is different from normally Java VM. Google develops originally for Android. And this is suitable shape to operate on mobile phone.

4 Development of Application for the Android

4.1 Background and Purpose

Various teaching materials like the abacus are used in schools. However, it is costly to the purchase of a lot of teaching tools and student can't freely take these teaching materials out of classroom. We developed such a teaching material as application. Students can use a teaching material anywhere by using the teaching material application.

Then in this research, we paid attention to the Android platform for mobile phones. The mobile phone is small. So, students can use the application any time and everywhere. Students easily can get the mobile phone for mass-production. The used mobile phone is cheaper than other portable electronic instruments. Therefore, there is a possibility of spreading because people in the poor segment of the population and the developing country can buy it. In addition, Android is free that license fee as for use regardless of the efficient platform. Therefore, there is a good possibility that famous companies sell Android mobile phone and people using other mobile phone use Android.

4.2 Operation Method and the Main Function

We develop the simulator of abacus using a touch sensor function. The start screen of a simulator of abacus is shown in Figure 3. It uses like an actual abacus.

Students can move a bead to touch it as shown Figure 4. When a learner touches it, the application emits the sound in which the abacus moves. Also, if the student moves their finger like the arrow shown in Figure 5, all beads are initialized as shown Figure 3. Of course, this operation is the same as an actual abacus. Thus, we expect that the effect of the calculation power improvement as well as an actual abacus to reproduce the operation feeling similar to an actual abacus.



Fig. 3. Start screen of a simulator of abacus

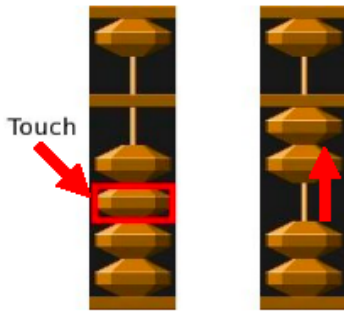


Fig. 4. An example of beads operations

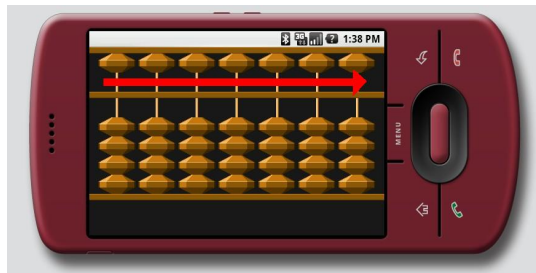


Fig. 5. Initialization operation

And we developed the function to display number shown with the abacus by numbers to understand expression of peculiar number to abacus as shown Figure 6. Therefore, the inexperienced student to handling the abacus becomes easy to understand expression of numerical value that uses abacus. In addition, we developed the computational problem mode. This mode set questions of the addition. Students can see a problem and current answer at the lower side of screen as shown Figure 7. Students operate numerical values using the abacus. It is possible to become accustomed to the abacus by solving the problem of addition in this function with an abacus, and the calculation ability improvement can expect it.

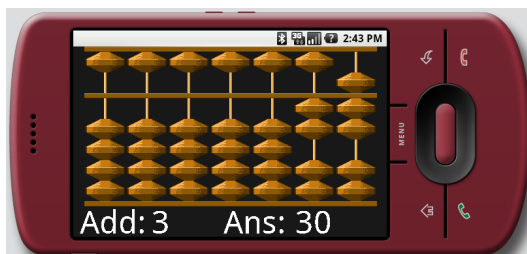


Fig. 6. Display of numerical value



Fig. 7. An example of the computational problem mode

5 Conclusion

We developed of the simulator of abacus using Android. This simulator achieved similar to an actual abacus by using Android, and students came to be able to use the abacus anytime anywhere.

We plan to add the function that students can practice the abacus and the calculation test to use the abacus application. As a practice function of the abacus, we will develop the calculation function that the student listen to the sound reading number and add them and the correction function when students mistake the operation of the abacus. And we will develop an application of Android not only abacus but also other teaching materials. Moreover, we opened the source file of this simulator of abacus to the public because we would like for this application to be used by many students. The application can be improved in the future by taking into account student's opinions.

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