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Adaptive Mathematical Games for BlackBerry using Fuzzy Logic

Widodo Budiharto	*Binus University*
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Adaptive Mathematical Games for BlackBerry Using Fuzzy Logic

Widodo Budiharto[a*], Michael Yoseph Ricky[a] and Ro'fah Nur Rachmawati[a]

[a]School of Computer Science, Binus-University,

Jl. KH. Syahdan no. 9 Jakarta- Indonesia

*Corresponding Author: wbudiharto@binus.edu

Abstract

The mobile games for education and entertainment rapidly developed. Unfortunately the development of adaptive educational games that consider the psychological aspects for student on mobile platforms in Indonesian language that interesting and entertaining for learning mathematics is very limited. This paper shows the research of development of adaptive games for students who can adjust the difficulty level of games based on the ability of the user, so that it can motivate students to continue to play these games. We propose a method where these games can adjust the level of difficulty, based on the assessment of the results of previous problems using fuzzy with two inputs in the form of percentage correct and the speediness of answer to produce 1 output. The experimental results are presented and show the adaptive games are running well on mobile devices based on BlackBerry platform.

Keyword: adaptive games, BlackBerry, mathematics, mobile games

1. Introduction

Today, students have grown up using devices like computers, mobile phones, and video consoles for almost every activity, from studying and work to entertainment and communication. Drastic increase occurred in the use of games for a fun and educational tool for students and effective discussion about the use of adaptive games to enhance interested learning and entertaining to various aspects of education [1]. To meet the different cognitive requirements of the new generation, the educational community is considering new ways of learning. In particular, there is a wide interest in trying to engage students with the appealing features of videogames and Internet tools [2]. Computer games are an incredibly successful genre that captivates children as well as adults and that instantly mirrors the spirit of a time and the state-of-the-art in computer technology. Computer games combine art and technology in a fascinatingly natural and convincing way. The games' success is reflected in enormous sales figures, economic growth, and numbers of users [3]. Adaptive games-based learning style aims to

support and encourage the learner considering his needs, strengths and weaknesses [4]. The best known of the games-based learning is to increases the motivation of learners [6] and the relationship between games and constructivist theory [7] because the games are well made can have pedagogical value of learning to produce a satisfactory outcome, because the student can cope with issues, work / play together and learn from previous experience. Technological pedagogical content knowledge is described as complex interaction of content, pedagogy and technology. The ways knowledge about tools and their pedagogical affordances, pedagogy, content, learners, and context are synthesized into an understanding of how particular topics that are difficult to be understood by learners, or difficult to be represented by teachers, can be transformed and taught more effectively with ICT, in ways that signify the added value of technology [8].

A crucial factor for adaptively is challenge. It can result from adapting the level of difficulty of the tasks to the learners' ability level so that a constant challenge is felt. Not only the level of difficulty of the tasks is adjusted to the learners' ability level, but also the system reacts to personal learning styles and preferences [16].There have been many studies on the development of education-based games for mobile applications such as [9]. But in the study, there is no comprehensive mechanism of how to identify the ability of users (students) who have a genuine interest in games or games that comes with a lessons and quizzes, as well as not using a Neural Network-based intelligence to input the percentage of correct answers, speed of answer and interest mode of games (animation /lessons). In addition, research on the development and use of adaptive educational games on mobile platforms in Indonesian language for students has not been touched at all.

Educational game for mobile application is one tools of mobile learning. Learning, from constructivism point of view can be understood as achieving understanding through active discovery [11].

Faiola, Newlon, Pfaff, Smyslova[13] found a significant correlation of flow experience and telepresence in virtual world (Second Life game). This finding suggests that learner who experience flow may acquire an improved attitude of learning online. Being in the condition of flow is describe by subjective experience of engaging just manageable challenges by tackling a series of goals, continuously processing feedback about progress, and adjusting action based on this feedback[15]. In order to make a task that is just manageable, game designer should consider the ability that the learner already have. This theory implied to make an educational game that suit a particular group with particular level of proficiency. As Kukulsha-Hulme and Traxler [14] suggested, one of

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the prototypes for learning design exist based on knowing their progress and preferences as learners. In this case, the learners are 8-10 years old students.

We had proposed a framework for adaptive games before [7], but the program run slowly because needs time for training the data. This paper proposes an adaptive game using the method of identifying the ability of the user to answer question using fuzzy logic with 2 inputs and 1 output. The final result of this research is a framework of mathematical games in BlackBerry using Fuzzy Logic.

2. Mathematical Games using Fuzzy Logic

2.1 BlackBerry

One of the well-known providers of mobile games applications that are used in Indonesia is BlackBerry devices from Research in Motion (RIM). However, the application of adaptive educational games using Indonesian language is not a lot, this is a new challenge in the development of mobile games in Indonesia. BlackBerry Operating System enables the developers to develop open source Java and C-based that can be easily commercialized [15]. Advantage in developing applications of mobile games based on BlackBerry platform is still the lack of games for the application that is widely used in Indonesia, because given applications of BlackBerry tend to be focused on business. This is an important point for our research in developing games at low cost and reliable.

The BlackBerry is a line of wireless handheld devices and services designed and marketed by BlackBerry Limited, formerly known as Research In Motion Limited (RIM). The most recent BlackBerry devices are the Z30, Z10, Q10 and Q5. The Z10 and Q10 were announced on January 30, 2013, and the Q5 was announced on May 14, 2013. The current version of the BlackBerry OS has numerous capabilities and features. These features include; over the air activation, ability to synchronize contracts and appointments with Microsoft Outlook, a password keeper program to store sensitive information and the ability to customize your blackberry display data.

2.2 Fuzzy Logic

The term "fuzzy logic" was introduced with the 1965 proposal of fuzzy set theory by Lotfi A. Zadeh. Fuzzy logic has been applied to many fields, from control theory to artificial intelligence. Fuzzy logic is used in a wide variety of real-world control applications such as controlling trains, air conditioning and heating systems, and robots, among other applications.

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To determine what is the membership value of an object in a set, refer to membership functions of the object's attribute. For example, we may define our membership functions for speediness as three sets slow, medium and fast.
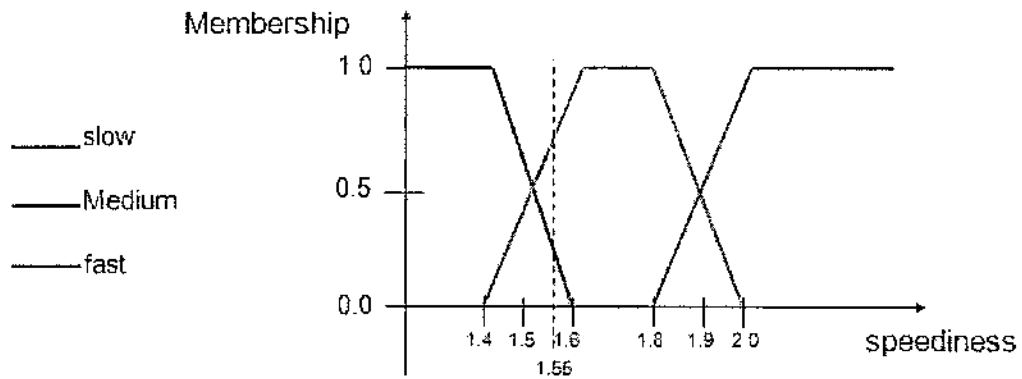
Membership

slow

Medium

fast

Figure 1. Membership function for speediness

Fuzzy inference is the process of formulating the mapping from a given input to an output using fuzzy logic. The mapping then provides a basis from which decisions can be made, or patterns discerned. The process of fuzzy inference involves all of the pieces that are described in Membership Functions, Logical Operations, and If-Then Rules. The fuzzy inference diagram is the composite of all the smaller diagrams presented so far in this section. It simultaneously displays all parts of the fuzzy inference process you have examined. Information flows through the fuzzy inference diagram as shown in the following figure.

interpreting the fuzzy inference diagram
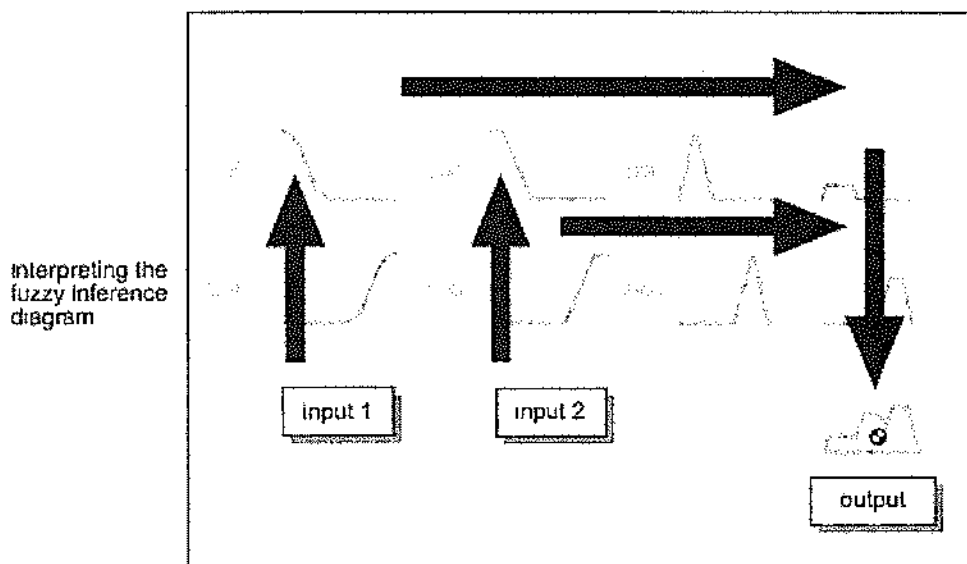
input 1

input 2

output

Figure 2. The process of fuzzy inference diagram

We can use fuzzy logic in games in a variety of ways. For example, you can use fuzzy logic to control bots or other nonplayer character units. We also can use it for assessing threats posed by players. Further, we can use fuzzy logic to classify both player and nonplayer characters.

In this research, we propose a fuzzy logic for mathematical games as an adaptive game in mobile application, with speediness and correctness as input, difficulty as an output with some rules as shown in figure below:
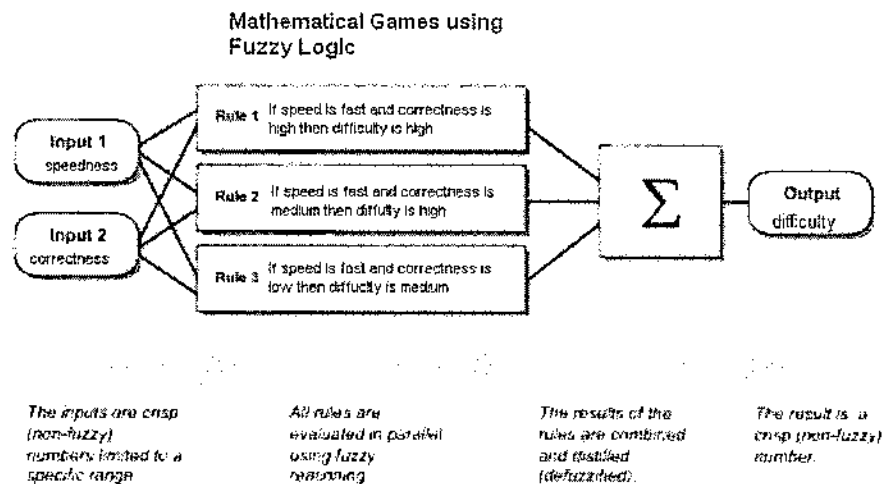

Figure 3. Proposed Fuzzy logic for Mathematical games using BlackBerry

Figure 4 is our general framework shown using usecase diagram that describe the actor and the important action in the games such as input name of the user, view high score, set the sound/voice, and playing with one/multiplayer. We are also in progress to develop games using BB Q10 for more reliable application than previous version.
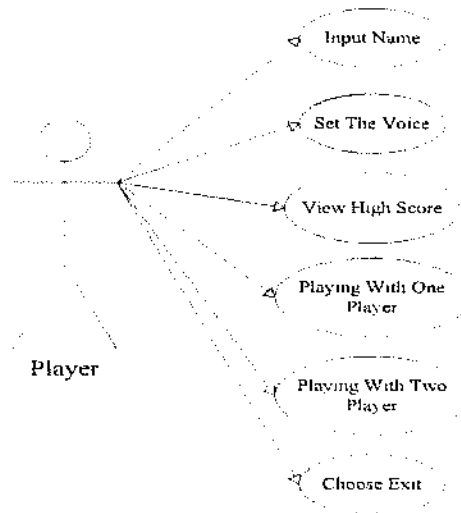
Figure 4. Usecase diagram for adaptive games using Fuzzy Logic

3. Experimental Result

We have questionnaire for students and use 100 math questions for this experiment. Experiments performed on the Simulator and the real device BlackBerry without lag and the results shown in figure 4. We have some mathematics questions for elementary until junior high school level, and some animation games such as "simple moving ball" and "Collecting bananas to basket" games to be choose by the user as shown in fig 5. For the mathematics and animation games, we set that the user/student said to be master if the correct result >=80 percent from 10 questions and time needed <=80% from the maximum time allowed.

(a)   (b)
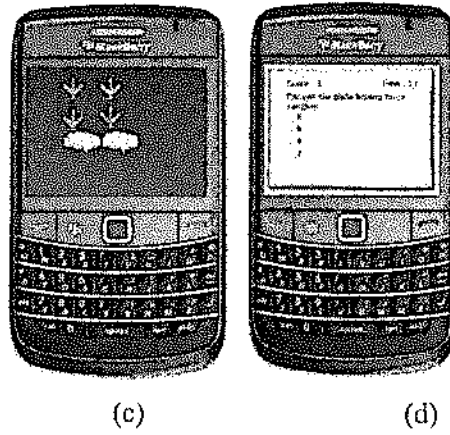
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(c)   (d)
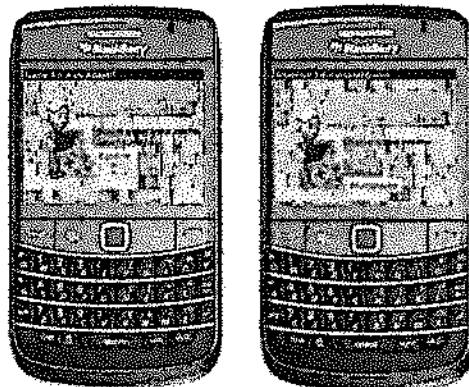
Figure 5. Result of simulation using BlackBerry Simulator, Main form for starting and choosing games(a), questionin mathematics games (b) and example of ball games(c) and the best scorer stored in SQLite (d).

Based on questionnaires and sampling that has been done to the 33 elementary school students as follows:

TABLE I. QUESTIONNAIRE ABOUT USING A MOBILE PHONE FOR PLAYING GAMES

Answer	Total	Percentage
Yes	33	100%
No	0	0%

TABLE II. QUESTIONNAIRE ABOUT HOW MANY TIMES A DAY FOR PLAYING GAMES

Answer	Total	Percentage
1	8	24%
2	12	36%
3	7	21%
4	2	6%
5	2	6%
6	1	6%

TABLE III. QUESTIONNAIRE ABOUT TIME FOR PLAYING GAME

Answer	Total	Percentage
Morning	23	70%
Noon	3	9%
Evening	5	15%
Night	2	6%

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TABLE IV. QUESTIONNAIRE ABOUT TIME FOR PLAYING GAMES

Answer	Total	Percentage
< 30 minutes	1	3%
30 minutes	10	30%
> 30 minutes	22	67%

TABLE V. QUESTIONNAIRE ABOUT HAVE EXPERIENCED DIFFICULTIES WHEN LEARNING MATHEMATICS

Answer	Total	Percentage
Yes	33	100%
No	0	0%

TABLE VII. QUESTIONNAIRE ABOUT INTERESTED IN LEARNING MATHEMATHICS USING GAMES

Answer	Total	Percentage
Yes	32	97%
No	1	3%

TABLE VII. QUESTIONNAIRE ABOUT THIS GAMES ARE FUN

Answer	Total	Percentage
Yes	33	100%
No	0	0%

From the above it can be concluded that most gamers love a game because exciting, fun, challenging, and easy to play. Usually players more often play games in the morning for more than 30 minutes and accompanied by brother/sister. Almost all students interested in learning math using games or fun learning. Each student is confirmed to have tried adaptive games that have been made.

4. Conlusion

This research has developed a novel method for adaptive mathematical games using fuzzy logic with 2 inputs and 1 output. The proposed adaptive system using the method of identifying the profile and level of understanding of the material field of interest from the user contributes to a new method for adaptive games. Fuzzy logic able to determine

the output (level of difficulty) based on the inputs and also game start loading quite fast compared with previous method (neural networks). Almost all students interested in learning math using games or fun learning. Each student is confirmed to have tried adaptive games that have been made. Our adaptive games successfully achieve the goals to be played with multiplayer mode and able to identify the level of the user and adjust the difficulty level of the next questions.

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