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A Framework for the Mobile Interactive Teaching and Learning using Near Field Communication (NFC) Technology

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Abstract: Technology mediated learning such as near field communication (NFC) enables and supports for the interactive and active learning that integrates digital learning material. NFC tags interacts with applications by touching the tagged objects with mobile devices. To date only a limited number of interactive computerized tools have been developed to support teaching and learning using NFC technology. In this paper we explore the idea of the potentials of interactive technology to support interactive teaching and learning process. The aim of the research is to propose a framework and develop a computerized tool for supporting an interactive teaching and learning process using NFC technology. Touching a tag triggers an application in the mobile device to perform an operation that is related to the touched object. The application is animated, interactive, and game-like environments in which learners gain knowledge through exploration. NFC can be used to create an interactive environment that helps learners in their learning process.

Keywords: Interactive teaching and learning, Mobile phone, near field communication (NFC), radio frequency identification (RFID)



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I. Introduction

Desire changes in behavior of the individual result from passing a certain expertise is what is described as learning. Teaching helps an individual to learn. Teaching is also described as the activities and operations carried out by the teacher to facilitate the learning process. To learn is to acquire knowledge and to teach is to impart knowledge or skill. Many students in higher education find learning is difficult, especially when it comes to understanding the course content and doing their course works or assignments.

Experiential learning as a model for teaching and learning pointed out that experiential learning is a non-formal method for teaching and learning (Yong Hui and Liu, 2009). Multimedia technology can be used in teaching and learning especially to learn foreign languages (Renjile 2011). Research has been conducted to compare the learning of students who were involved in active teaching and learning activity with those students who were not involved. Result showed the positive impact for the active learning environment (Luismejias, 2012; Cao and Hui, 2009).

Active learning comprises several models of instruction. It focuses on the responsibility of learning on learners. Qi et al. (2010) discussed a variety of methodologies for promoting active learning. Literature indicates that to learn, students must do more than just to listen. The students must read, write and discuss the way of solving problems. It relates to the three learning domains called taxonomy referred to as cognitive, psychomotor and affective.

Active learning provides a powerful mechanism to enhance depth of learning and get learners involved with learning process instead of passive action (Chi et al., 2012). In addition, active learning can be described as the learning paradigm that actively acquires extra information and actions in achieving gain/goal (Sheng, 2012; Seifert and Granitzer, 2010). Active learning happens when students are given the opportunity to take a more interactive relationship with the subject matter of a course.

Mobile learning is learning across multiple contexts through social and content interaction using personal electronic devices. Learner can learn anywhere at any time using mobile devices. With rapid development of communication information technology can be applied to support teaching and learning process through e-learning environment (Azadeh and Ahmad, 2013).

This learner may use portable devices to communicate with other devices directly or indirectly using technology-mediated learning such as NFC. NFC enables and supports for the interactive, participatory learning that integrates digital learning material.

NFC technology allows object to respond to the tap of mobile devices. This technology allows wireless communication over short distance. In practice, this means that a user brings an NFC enabled devices close to an object containing an NFC sensitive device (i.e. an NFC tag or another NFC enabled devices). The users can retrieve information about the object and in some cases they can share information.

II. Related Works

A. Teaching and learning

Teaching is undertaking certain ethical tasks or activities with the intention to induce learning (Wai and Reimann, 2009). Teaching and learning enhance sustainable development of the society.

Pavlova (2013) explored current research on educational for sustainable development in technology education, and suggested a number of challenges such as technology support as well as teaching and learning paradigm for sustainable development agenda.

Web based technology and ICT both assist teaching and learning process. Educational video with collaborative annotation, a web based interactive asynchronous video teaching and learning platform essentially supports collaborative learning (Wong, 2009).

Shimba et al. (2012) employed paperless teaching and geared towards green technology paradigm. Web based course management tool has been used to manage, coordinate, monitor progress, provide feedback to students and staff. It creates one teaching and learning medium dedicated to promote active learning and achieve best possible outcomes without sacrificing standards.

B. Active learning

Active learning is a term that refers to several models of instruction that focuses on the responsibility of learning on learners. Ahmad et al. (2013) explored the theory of active learning, obstacles or barriers that prevent the use of active learning strategies and how to enhance the ability of active learning. Some guidance and methods are described as well. In the final stage teachers should pay attention to reform of teaching methods and to help students to develop the concept of self-study and train the ability of self-study (Ineke et al. 2011).

Yong (2013) discussed the contribution of the selected examples by proposing an active learning approach based on two criteria which are informative and representative. Additionally an e-learning system assists active learning. Cao and Hui (2009) designed a workflow and e-learning system based on students' requirements and related experiences. Therefore, active learning is an interactive learning where students relay information and engage in teaching and learning activities mainly with the use computerized technology.

Interactive learning is a more hands-on, real- world process of relaying information in classrooms. Passive learning relies on listening to teacher's lecture or memorization information. With interactive learning, students are invited to participate in the conversation through technology.

Jukka et al. (2013) reported on how NFC technology can be used to create an interactive application that helps children in their learning process and persuade them to do physical exercise. The main contribution is the presentation of NFC as a technology enabler to easily create to use interactive learning environments for learners. This prototype aims to enhance the experience of learning languages through the use of tag which include touch and read,

touch and share, touch and learn capabilities.

Gregor and Doris (2009) considered different ways to increase the learning ability and guidance of applications using NFC / RFID tags for interaction between physical objects and mobile devices. Apart from the novelty factor of the technology, the first interaction is not always immediately clear or self-explaining. Some users face different problems with it. In addition, mobile interaction with tagged objects becomes more complex as it evolves from simple interactions with single tags. This fact proves that NFC technology enhances mobile learning process.

C. Mobile learning

Mobile learning is new learning method and it is defined as the use of mobile devices that can connect to the Internet for educational contexts. It is imposed by new learners' trends to satisfy the increased need of knowledge acquisition using mobile phones and mobile devices. Ouiame et al. (2013) proposed a solution to educational issues by adopting the method for engineering learning systems aims to identify key characteristics and dimensions for developing the appropriate mobile contents. The method is chosen due to its flexibility and its ability to design different learning systems through its various principles.

Thomas (2013) focused on educational insights that led to the development of the Mobile Learning Exploration System (MoLES). The system is as part of wider research on ambient learning spaces. It has been developed on the basis of systemic-constructivist pedagogy, which emphasizes the design of learning environments for contemporary teaching.

Ivan et al. (2011) proposed a ubiquitous game. The game based on NFC technology that composed of game characteristic strategy with an evaluation system by the use of Moodle platform.

The characteristics of NFC technology that allows short range data transfer and a simplification of first-time connections, make it suitable for ubiquitous learning that could potentially enhance students' learning experience beyond conventional mobile learning. Gustavo et al. (2012) proposed an application for the development of contextual learning activities.

The application focused on the experience of interaction with physical object using android mobile devices. Mobile phone enhances learning using technologies such as RFID and NFC. However games-like education will be created with the NFC technology to support teaching and learning process focusing on language learning.

D. Language Learning

It's been difficult to find articles on language learning using computer-mediated technology such as RFID and NFC. Istifei et al. (2011) and Soobin et al. (2011) presented a new English e-learning system where children can be educated using smart phone and a web application at home. With an e-learning system that provides both web application and smart phone application, features such as augmented reality however are not supported.

Wen (2013) discussed the use of English learning strategies in web-based and conventional environments; the first constructs a strategic learning mode in web-based environment, the second discussed how to develop learners English strategy awareness in web based environment. Games are also used in language learning. A game-based English learning tool via lyrics for mobile devices is designed.

Learners can study using collocation word pair anytime and anywhere and combine their interest of music listening with learning to promote studying and strengthen the effect of English learning. Furthermore the features of research are firstly to retrieve verb- noun collocation and make questions automatically, secondly to build a mobile learning environment by music and games (Chen et al., 2012; Garrirado et al., 2011).

Nguyen et al. (2012) proposed a framework that uses perturbation learner model in designing an adaptive system, the research focuses on the fundamental components of a learner model and how to adopt and build an appropriate model for the system, there is a need for system analysis that involves creating learner models for the purpose of classifying learners ability and tracking learner's performance.

Meta communication is a very important powerful and functional concept during knowledge building for the preparation of the course materials in education field. In this regards, this concept is becoming a more carefully designing course for language learners. The good language learners are the ones who can understand and use meta communication element in communicating in English (Istifci et al. 2011; Renjile 2011).

Therefore, this research will focus on development of language learning for active and interactive teaching and learning using NFC technology. The selected language is Malay language for foreigners.

III. Problem Statement

A web based environment is a feasible and a viable alternative to the traditional classroom which has proved to be limited in achieving the necessary need of the student in modern learning context. Furthermore e- learning is a problem to students from rural areas that are not computer literate. But as time goes by, the advent of mobile learning solve these problems. With mobile phone we can learn anywhere at any time. Certain technologies assist in mobile learning; these technologies are RFID and NFC. Both technology work quite similar but NFC is the latest technology.

NFC has been increasingly used in recent years in various aspects of business operation and personal life. Use of NFC in teaching and learning has been seen limited in educational activity mainly in supporting active and interactive teaching and learning environment.

Several researches have been conducted using NFC such as in business and credit card payment (Lai et al., 2013; Sun et al., 2013), mobile payment Garry et al. (2014), training (Sieck and Brokov, 2012), health (Andreas 2012; Devendron and Bhuvanesuari, 2012), and education (Winkler and Herczeg, 2013; Ivan et al., 2011). However, this technology has been

employed in the other applications, as far as the authors are concerned, NFC technology has not been used in language learning.

Mobile learning is learning through mobile computational devices such as palms, windows, even for digital cell phone (Catherine et al., 2013). The focus on technology does not assist in understanding the nature of learning and overlooks the wider context of learning as part of an increasingly mobile lifestyle.

While discovering a city during vacation, a tourist might learn foreign language from a travel internet site on a home desktop computer, phone, interactive multimedia guide on the tourist information, it is a combination of these experiences that constitutes mobile learning.

RFID is a wireless and non-contact use of radio frequency electromagnetic field to transfer data for the purpose of automatically identifying and tracking tags attached to objects. The tags will electronically store information. RFID systems can be classified into two types Passive RFID and Active RFID. In passive systems, whenever a tag comes within the radio frequency (RF) range of the reader, the tag absorbs some of the reader's radiated RF power and this power is rectified and amplified to power up the circuitry.

Tag identification (ID) is sent back to reader as a response using backscatter modulation. Once the tag ID reaches reader, it hands over the ID value to application server for further data processing as shown in Figure 1.

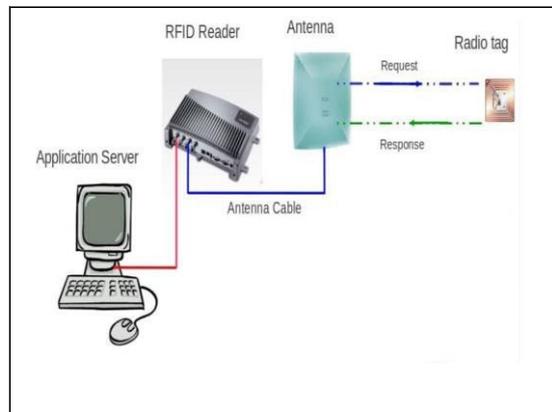


Figure 1. A basic RFID system

The entire enterprise application logic is implemented in the application server. The major difference between active and passive RFID systems is that the active tag has inbuilt battery to power up its circuitry and does not depend on reader's RF power. Also, the range of active systems is much better compared to passive systems (Kumar et al., 2011). NFC is a breakthrough technology that allow object to respond to the tap of a mobile device.

NFC is a subset of RFID technology which allows the fast and easy exchange of small amount of data between mobile devices, PCs, and smart objects. NFC depends on smart card technology standard ISO 14443 allowing wireless data transfers up to a range of 2 to 3

centimeters. Though NFC is emerging as the leading standard for the mobile payments, it has wider applications because of its uses the concept of ‘touch to exchange information capability’ (Bernado et al., 2014)

IV. Methodology

Method of carrying the research focuses on modified content presentation model as shown in Figure 2. This model illustrates the NFC technology in learning process. The content presentation model is presented in RFID technology (Kumar et al., 2011). In addition, Figure 3 illustrates the overall sequence of the content presentation model.

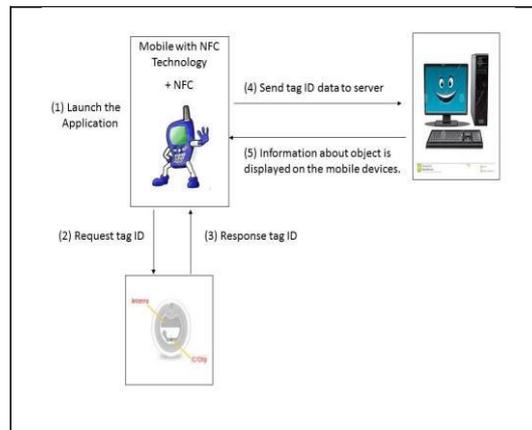


Figure 2. Architecture of NFC based content presentation model

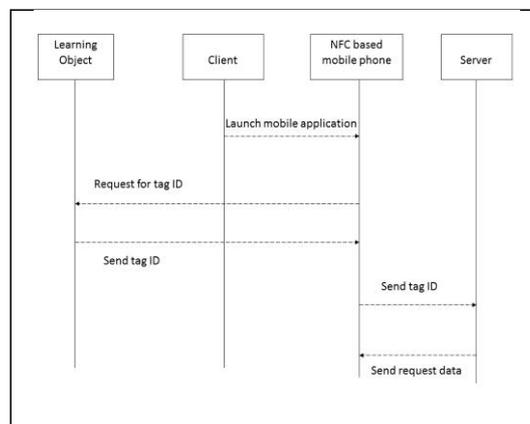


Figure 3. Sequence diagram of NFC based content presentation

Figure 4 shows a framework of the system. Tools needed for the research are:

- Mobile phone that supports NFC technology.
- A server that will store the database.
- Object NFC tag.
- Programming tools.
 - Eclipse compiler.
 - My SQL software.

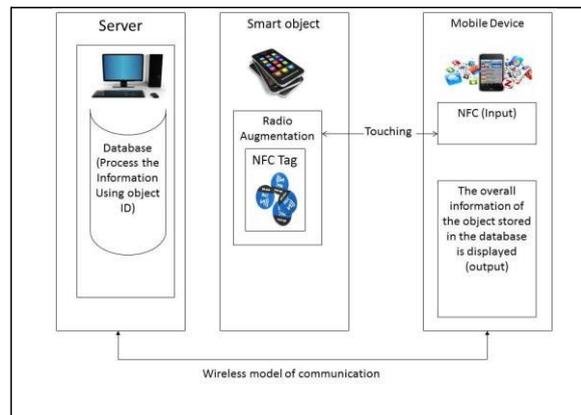


Figure 4. A framework for language learning using NFC

Mobile phone is needed in this research and is the most important amongst all. A mobile phone that supports NFC technology will be used. It is embedded with NFC reader and antenna.

The reader is connected to the server using local area network. For the current technology both the reader and antenna are embedded in the mobile phone and wireless communication is used to communicate between the phone and the server that remotely store the database. The process of the content presentation model is as follows:

- Step 1: Launch the application of mobile phone.
- Step 2: The mobile phone requests the ID of the object (embedded with NFC tag).
- Step 3: The ID will respond back to the phone.
- Step 4: The ID will automatically send to the remote server via wireless and programming code that call the service of the server.
- Step 5: Finally the information about the object is displayed on the mobile device that signifies the meaning of such object in the respective language.

The database will be remotely accessed using wireless connection unlike in the former technology that uses local area network. The database will be created using query language such as MySQL. Objects definitions and video help users to easily learn a specific language such as Malay language. It will be stored and used as teaching aids.

Each NFC tag object that has to be stored in the database must have NFC tag. This tag has an identification that will be read from the mobile phone and written to the server. It needs to have the correct definition of the object stored in the database.

Programming tools assist in designing user interface of the system. Eclipse compiler is a Java compiler that is used to design the programming part of an application. Most android application is created using Java programming language. Therefore Java programming language will be used to develop a Malay language system as the prototype for an interactive mobile learning application.

V. DISCUSSION

Shen et al. (2014) proposed a framework of smart classroom system comprises a computer and server, NFC readers, NFC smartcard and NFC mobile devices for teachers and students. Recent research work proposed several potentials using NFC technology in education as well.

Likewise, Pelakiyaselvi et al., (2012) discussed a framework for implementing e-attendance system using NFC in android system. Nevertheless, NFC technology application framework has not been used to tackle the problems in supporting an interactive and active learning especially in learning foreign language. Moreover, the use of NFC technology can offer an essential support for interactive teaching and learning. In this research we propose a complete framework comprises of server, smart object and mobile device with NFC technology to support for an interactive teaching and learning.

NFC technology is considered as an enabler to build an interactive environment in teaching and learning process. The most important difference in this research work is the use of the proposed tool as language learning. The NFC technology is convenient to use, simple, faster, and secure. Moreover, the mobile phones with NFC can automatically be supplied with updated data.

In addition, the proposed framework supports the communication between the smart object and the mobile device. The augmentation provides several mediums such as visual, auditory and based on radio communication for direct interaction, whereas for an indirect interaction the user acts as mediator between the smart object and the mobile device.

VI. CONCLUSION

Using mobile phone with NFC technology, the learning process can be done anywhere at any time. The video tag and games supports the learning process as well. Touching a tag triggers an application in the mobile device to perform an operation that is related to the touched object. Once an object is embedded with NFC tag, the object directed the mobile phone to access word definition hosted from the dedicated server or computer.

A framework illustrates the integration of NFC and mobile phone to support learning process. The main purpose of the research is to develop an interactive teaching and learning environment using NFC technology. In further research, a prototype of mobile application is to be developed. The application is animated, interactive, and game-like environments in which learners gain knowledge through exploration. The contribution of this research is to propose framework and to develop a tool that can be used to create an interactive environment that helps learners in their learning process such as in Malay language learning.

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