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Full Length Research Paper

A mobile-based knowledge management system for "Ifa": An African traditional oracle

Olusegun Folorunso*, Adio T. Akinwale, Rebecca O. Vincent and Babatunde Olabenjo

Department of Computer Science, University of Agriculture, P. M. B. 2240, Abeokuta, Nigeria.

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Recently, the use of mobile applications in knowledge management systems has been a major discussion in some literatures. In the past, the author's conceptualized and designs a knowledge management system for "Ifa". In this paper, a mobile application is designed which applies mobile knowledge management (mKM) to the "ifa" oracle consultation process implemented with the Netbeans 6.7.1 JavaME IDE and is compatible with MIDP 2.0 and CLDC 1.1 mobile devices. However, we address the potential suitability of mKM as a prototype model for mobile, quick information retrieval in the "ifa" oracle consultation process. This approach promotes the use of mobile technology and mobile knowledge management in African tradition.

Key words: Mobile knowledge management, "Ifa", African tradition, expert system, Nigeria.

INTRODUCTION

Over many years, research on mobile information systems concentrated heavily on technical issues like device capabilities, media presentation, and communication networks, leaving human issues aside (Dirk et al., 2005). In recent times, mobile networks and devices are very powerful, but their acceptance in business use is mostly limited to mobile telephoning and transmitting email over 3G networks. Only occasionally do the devices serve as personal information organizers. Technical achievements like digital cameras in Smart phone and Bluetooth are only rarely used to organize mobile work. Mobile KM is developed as a result of the actual improvements in m-ICT: mobile Information and Communication Technologies and the globalization process (Blunn et al., 2007). In relatively short history, mKM has proved its vitality and viability in knowledge sharing acquisition processes. Several research and implementation projects have been organized all over the world (Keegan, 2005). The mobile approach allows delivering knowledge in place and time that was out of reach before. Based on the concept of mobile knowledge management, the "Ifa" oracle consultation process can be implemented using this technology to provide a more reliable information delivery to its users.

"Ifa" is an African traditional religion and exists in western part of Nigeria. The originator of "Ifa" was Orunmila, (Abimbola, 1980). "Ifa" is based on consultation for a particular problem. It is still belief that "Ifa" directs the consultant into proper direction. It is also stated that "Ifa" as an oracle, is a living process in which the participants experience the presence of the divine (Ifa, 2008). The importance of knowledge Management is increasingly recognized in business, medicine, law and other public sector domains. In "Ifa" divination system, consultation involves information and knowledge about present, past and future events (Folorunso and Sofoluwe, 2002) "Ifa" consultation processes are knowledge-intensive. They host a particular high percentage of professionalism with active "tacit" knowledge that command important domains of knowledge. If we ask ourselves the question "how does the "Ifa" priest knows what he knows? It becomes immediately evident that even though there is indeed a lot of knowledge for this transaction, it is not necessarily available anywhere anytime for anybody. The detailed content of this knowledge repository in the priest is "hidden" to his clients, because it is regularly localized or even personal and difficult to share. Not only does it trend towards knowledge, the society also call for KM solutions in all fields of consultations, but also current practical application in the consultations influence the use in this area of African traditional oracle "Ifa" (Folorunso and Akinwale, 2009). In this paper, the authors recognizing the importance of "Ifa" and "mKM" present a mobile knowledge management

*Corresponding author. E-mail: folorunsolusegun@yahoo.com.

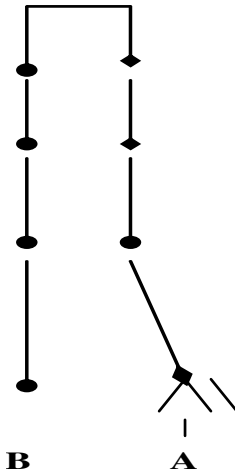

Figure 1. "Ifa" structure.

for "Ifa", throw light on important aspect of this field, and described an "Ifa" knowledge model. The remaining part of the paper presents in brief, important aspects of African traditional Oracle "Ifa". It also discusses, mobile knowledge management concept for "ifa" and application of mKM in "Ifa". The proposed "Ifamobile was also described and finally, conclusions are presented.

"IFA": AN AFRICAN TRADITIONAL ORACLE

"Ifa" structure

"Ifa" is made up of eight nuts that are joined together with chain. The eight nuts are divided into two parts, for example left and right side of four nuts. Figure 1 illustrates the structure of "Ifa". "Ifa" worshipper or priest or domain expert throws the chain down as many times as possible. The appearance of the 8 nuts determines a specific pattern called signatures. Naturally, there are sixteen possible signatures with identical names or tags. The priests read from right to left by combining the signatures together. The combination has a great meaning in determining the solution to a specific problem.

With the "Ifa" priest as domain expert, the device is a chain-like object with four (4) nuts each side way as pictured in Figure 1. When the chain is cast the probability of the combined signature is $^1/_{256}$.

Left side $= A_i = (i = 1,\ldots, 16)$
Right side $= B_i = (i = 1,\ldots, 16)$

The overall sample space for the combined signatures is 256 and one of the 256 signatures must be displayed at any time the chain is cast. The priest combines the appearance of the signatures.

This combination has some meanings in his knowledge base. The exercise is always logical, because the combined signatures need to be detected with IF..... THEN condition. IF is true/false while the then condition fired an aspect of the knowledge base, of which the poem will be relayed from his (priest) knowledge-base to the client.

With the exercises above one would see that developing an expert system for such a device is very necessary as it will promote native African culture and remove the belief of the people that there is a supernatural activity in the "Ifa" system.

"Ifa" signature

"Ifa" signature contains 16 appearances with specific name as specified by the "Orunmila" the founder of "Ifa". "Ifa" signature is in a standard hierarchical ordering. The name, hierarchical order and signature signs are illustrated in Table 1. As shown in Table 1, OGBE as a name, the signature sign (I, I, I, I) has the highest precedence than other signatures. The lowest is OFUN as a name with the signature sign (II, I, II, I). The hierarchical ordering is not based on arithmetic counting. The appearance of signatures serves as data for knowledge processing. According to (Folorunso and Sofoluwe, 2002) their paper titled "On Randomized Expert System for "Ifa" (An African Traditional Oracle), there are five phases of "Ifa" divination. The algorithm is shown in Figure 2 and 3a, b.

APPLYING MOBILE KNOWLEDGE MANAGEMENT TO "IFA"

Mobile knowledge management

Mobile devices are devices that have been developed for mobile use. Thus the category of mobile devices encompasses a wide spectrum of appliances. Mobile Phones are mobile devices that are geared primarily at the use of the telephone functionality. 2 G mobile phones are usually internet enabled and support Short Message Service. With Java support, even complex applications can be implemented. Additionally, pro-prietary devices, which have been designed according to the specific needs of an organization, have to be considered as well.

We strive for IT support facilitating knowledge registration, distribution, and usage in spatially distributed business processes (in short: mobile work). When work is both knowledge-intensive (e.g. associated with recording a great deal of new information to be shared with other people) and mobile (that is, outside the office, often without any pre-planned infrastructure (Radu-Adrian and Simca, 2006; Tazari et al., 2005), the acquisition and sharing of the organizational knowledge becomes challenging.

These challenges pertain to limitations with which

Table 1. Hierarchical ordering of precedence of “Ifa” signatures.

1. OGBE	2. OYEKU	3. I W ORI	4. O D I
I	II	II	I
I	II	I	II
I	II	I	II
I	II	II	I
5. IROSUN	6. OWONRI	7. OBARA	8. OKANRAN
I	II	I	II
I	II	II	II
II	I	II	II
II	I	II	I
9. IYONU	10. OSA	11. IKA	12. OTURUPON
I	II	II	II
I	I	I	II
I	I	II	I
II	I	II	II
13. OTURA	14. IRETE	15. OSE	16. OFUN
I	I	I	II
II	I	II	I
I	II	I	II
I	I	II	I

mobile workers are confronted. Some of these limitations defined by (Kristoffersen et al., 1998) can be classified as:

1. Technical and infrastructure-conditional limitations of mobile devices and mobile connectivity,
2. Organizational limitations, such as distance to experts and corporate resources, and
3. Individual limitations concerning the cognitive load resulting from concurrent tasks, time pressure, ad-hoc situations, distracting or “manipulated” environments under the strong influence of the needs and desires of the customer.

Obviously, there is a direct connection between mKM and technical progress in the field of Mobile Computing, in areas such as mobile networks and mobile and personal devices. Hence, we do not define mKM as an enhancement to the management discipline “knowledge management”. That is, for us, the question is about the focus of mKM as a distinguished part of knowledge management in organizations, (Bruno et al., 2006). Mobile KM has as its focus the seamless integration of mobile work into the corporate knowledge management control loop, especially where knowledge is associated while performing tasks, tasks necessitate out-of-office work, and tasks necessitate communication. According to (Kristoffersen et al., 1998) the most important organizational knowledge goals specific to mobile work can often be classified as.

1. Facilitating the registration and sharing of insights without pushing the technique into the foreground and distracting mobile workers from the actual work,
2. Exploiting available and accessible resources for optimized task handling, whether they are remote (at home, in the office, or on the Web) or local (accompanying or at the customer’s site), and as
3. Privacy-aware situational support for mobile workers, especially when confronted with ad-hoc situations.

That is, mKM systems must not only provide mobile access to existing KM systems, but also contribute to at least some of the above management goals. Taking a glance at the well-established building blocks” (Figure 4) of Knowledge Management (Probst, 1999), the dedicated areas of mKM can easily be outlined as to:

- Knowledge preservation: e.g. on-site, mobile registration of new knowledge.
- Knowledge sharing / distribution: e.g. ad-hoc distribution to co-workers and mobile collaboration, and
- Knowledge use: e.g. mobile accessibility of knowledge and situational assistance.

Typical use cases within these building blocks are:

- Knowledge development: to capture information, to

Algorithm: "Ifa" Process

Begin:
Get Spaces X and Y
Step 1: Generate INTEGER RANDOM No (1 TO 16) = space X
Set $\{N_1\} \in X$ *: Left side.*
Generate INTEGER (1 to 16) = space Y
Set $\{N_2\} \in Y$ *: Right side.*
Step 2: Set Another Space $Z = \{N_1\} \times \{N_2\}$
(N:B The elements of the spaces X and Y are not deterministic but stochastic.)
Z = Combined signatures.
*Card(Z) = 256 i.e. X *Y*
Step 3: GO TO STEP 1
SELECT $\{N_2\} = \alpha$ */* from 1 through 16*/*
Step 4: GO TO STEP 1
SELECT $\{N_2\} = \beta$ */* from 1 through 16*/*
Step 5: GET Minimum $(\alpha \beta)$ *= MIN*
$\Rightarrow$ *MIN = minimum* $\{N_2, N_2\}$
IF Space $\beta <$ *Space* α
THEN
DISPLAY SUCCESS ON VDU or PRINTER
ELSE
FAILURE
DISPLAY "The Related Poems" on VDU/Printer. From Knowledge Base
End

The order of presedence of the ifa signatures determines the event, either positive or negative.

```
if (first_odu < sec ){
   stringItem4.setText (name + "IFA says," + POSITIVE_POEM);
} else {
   stringItem4.setText (name + "IFA says," + NEGATIVE_POEM);
```

Figure 2. Algorithm "Ifa" process.

author/register knowledge, to rank/evaluate knowledge, to prepare knowledge for later mobile use.
- Knowledge Sharing/Distribution: to share knowledge, to perform mobile collaboration, to communicate.
- Knowledge Use: to retrieve and present knowledge, to get situational assistance, to post-process (report) the captured knowledge.

Mobile knowledge management concept for "ifa"

The key concept of mobile KM is context-aware information processing. This means that the system has certain knowledge about the user's current situation while assisting the user in the tasks he is performing with his portable computing device. This concept has also been presented in existing approaches to non-mobile KM (Ludger Van Elst and Andreas Abecker, 2001). Thus, some of the most important features of Knowledge Management systems are to support knowledge workers in the creation, capturing, organization, linking and searching of knowledge (Maier, 2004; Folorunso and Ogunde, 2005; Folorunso et al., 2007; Metaxiotis and Psarras, 2004). In a slight variation of the widespread understanding of knowledge being information in a specific context, our operative

From the Ifamobile application, the J2me code below defines its operation;

```
//Midlet class for the mobile application
public class IfaApp extends MIDlet implements CommandListener {
   //String values for poems
   static final String POSITIVE_POEM = "You are going now into a new place. The new place will accomodate you with success";
    static final String NEGATIVE_POEM = "Death is moving with you, but if you make sacrifices, somebody will die instead of you";
   private int first_odu;
    // signature base for the ifa signatures
public String getOdu(int sig_value){
   String name = null;
   switch (sig_value){
      case 1: name = "Ogbe";break;
      case 2: name = "Oyeku";break;
      case 3: name = "Iwori";break;
      case 4: name = "Odi";break;
      case 5: name = "Irosun";break;
      case 6: name = "Owonri";break;
      case 7: name = "Obara";break;
      case 8: name = "Okanran";break;
      case 9: name = "Iyonu";break;
      case 10: name = "Osa";break;
      case 11: name = "Ika";break;
      case 12: name = "Oturupon";break;
      case 13: name = "Oturai";break;
      case 14: name = "Irete";break;
      case 15: name = "Ose";break;
      case 16: name = "Ofun";break;
   }
   return name;
}
//end of class that defines the ifa signatures
 //perform the initial operation and read from right to left
         int odu1;
        int odu2;
```

Figure 3a. Ifamobile application, the J2me code.

understanding of knowledge for mKM is: information generated or needed within the specific context of an action (here: working action) a person is performing or is going to perform. With this task-oriented view on knowledge, the core building blocks of mKM can be arranged in a cube-like form as given in Figure 5.

Limitations for the use in the mobile KM context arise above all due to display sizes and input possibilities as well as bandwidth and transfer modes. With the exception of Tablet PCs, the displays sizes range from

```
Random rnd = new Random();
        odu1= rnd.nextInt(16)+1;
         odu2=rnd.nextInt(16)+1;
       String right =  getOdu(odu1);
         String left = getOdu(odu2);
         stringItem1.setLabel(right + "-" + left +": ");
// perform the first odu
         int first;
          Random rnd = new Random();
          first = rnd.nextInt(16)+1;
         first_odu = first;
          String fOdu = getOdu(first);
          stringItem3.setLabel(fOdu + ": ");
  //perform second odu and find out the outcome
         //positive or negative. send info to the user.
         int sec;
          Random rnd = new Random();
          sec = rnd.nextInt(16)+1;
          String sOdu = getOdu(sec);
          stringItem4.setLabel(sOdu + ": ");
          String name = textField.getString();
         if (first_odu < sec ){
            stringItem4.setText(name + " IFA says, " + POSITIVE_POEM + "\n\nThank you for using IFA
Mobile");
         }else{
             stringItem4.setText(name + " IFA says, " + NEGATIVE_POEM + "\n\nThank you for using IFA
Mobile");
         }
```

Figure 3b. Ifamobile application, the J2me code.

few lines only (mobile phone) to a resolution of 240 x 320 or larger (PDA). Regarding the input methods, the possibilities vary from a restricted number of pushbuttons that enable operating simple menus to more sophisticated solutions like hand writing recognition or virtual keyboards. As stated above, possible benefits of mKM are restricted because of the inadequacy to facilitate ubiquitous access to knowledge. Analyzing the conventional Ifa consultation process, it is very obvious that there is an ineffective respectively non existing integration of knowledge into the “Ifa” consultation processes that include mobile aspects. This limitation can actually be controlled by implementing a remote mKM system for the application, because of the capacity required to store the poems and signatures. The Figure 6 demonstrates an example of this.

Considering the limitation of the storage in mobile devices, the “Ifa” mobile application can implement remote storage for the storage of the poems and “Ifa” signatures. This can be implemented by the use of requests in the mobile application and a web server for the storage of the web application together with a database backend for the storage of these poems and

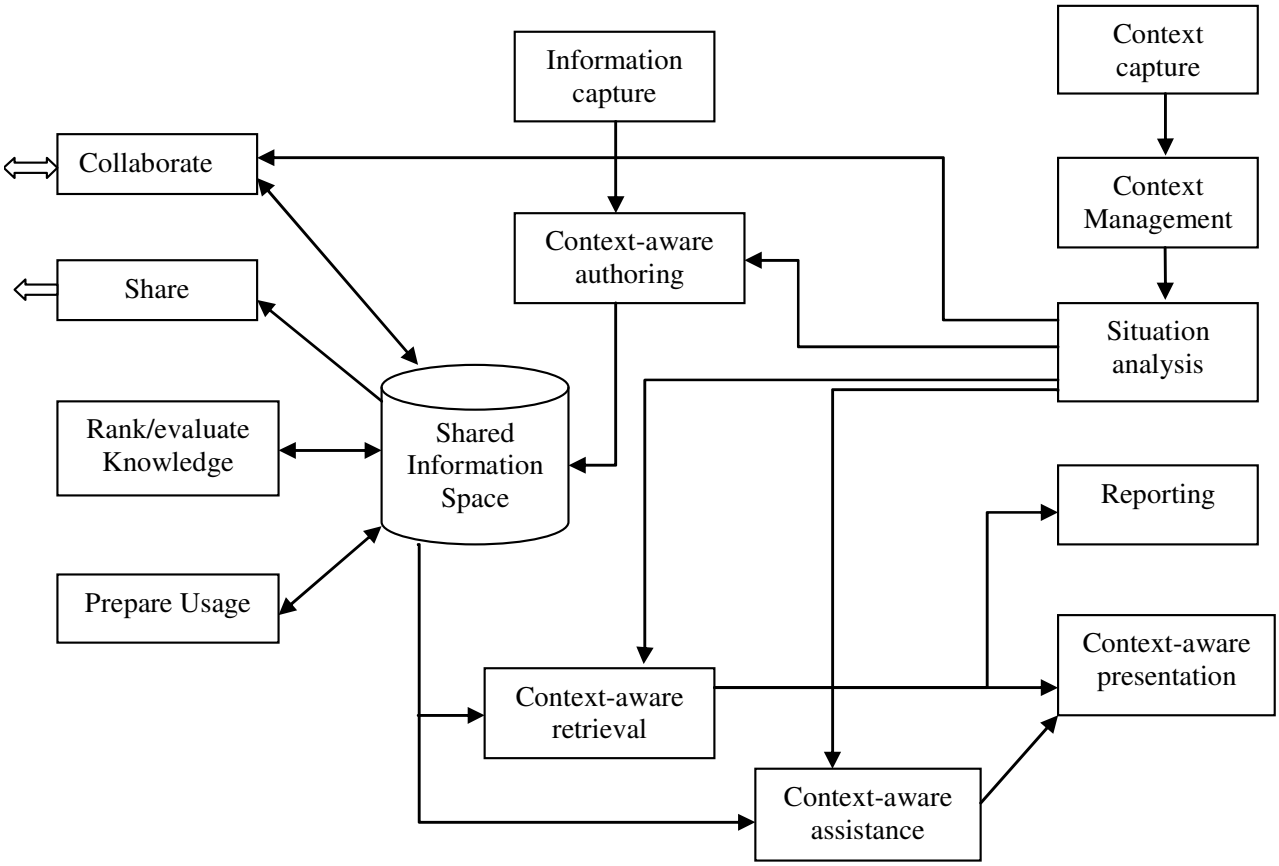

Figure 4. Architecture for mobile knowledge management (Adapted from Dirk et al., 2005).

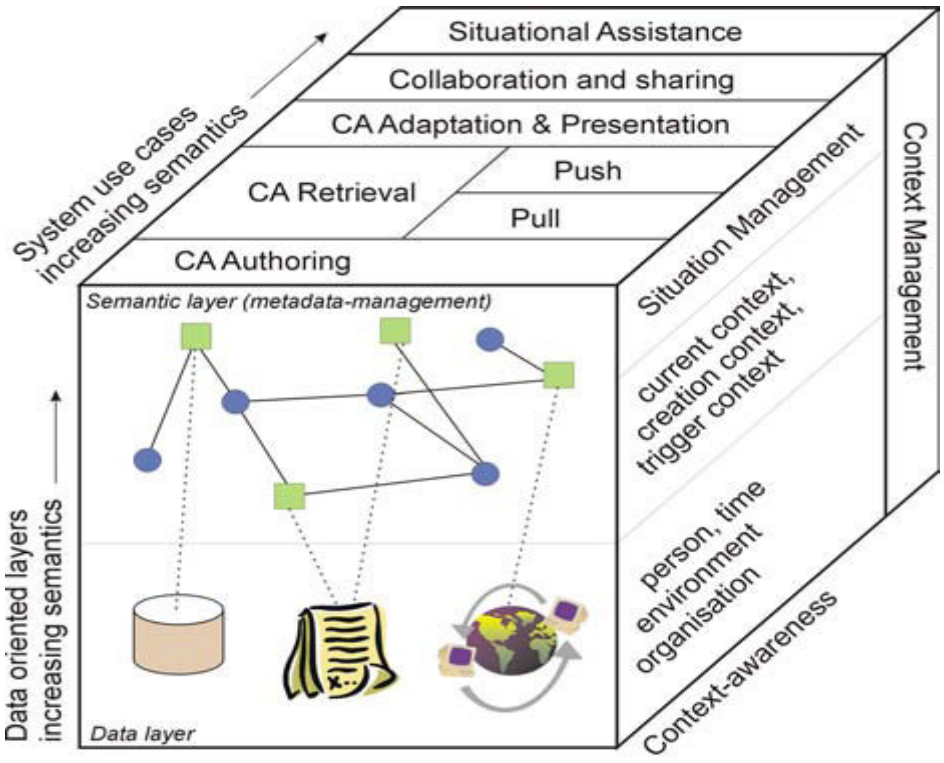

Figure 5. Concept Cube of mKM building blocks (Adapted from Dirk et al., 2005).

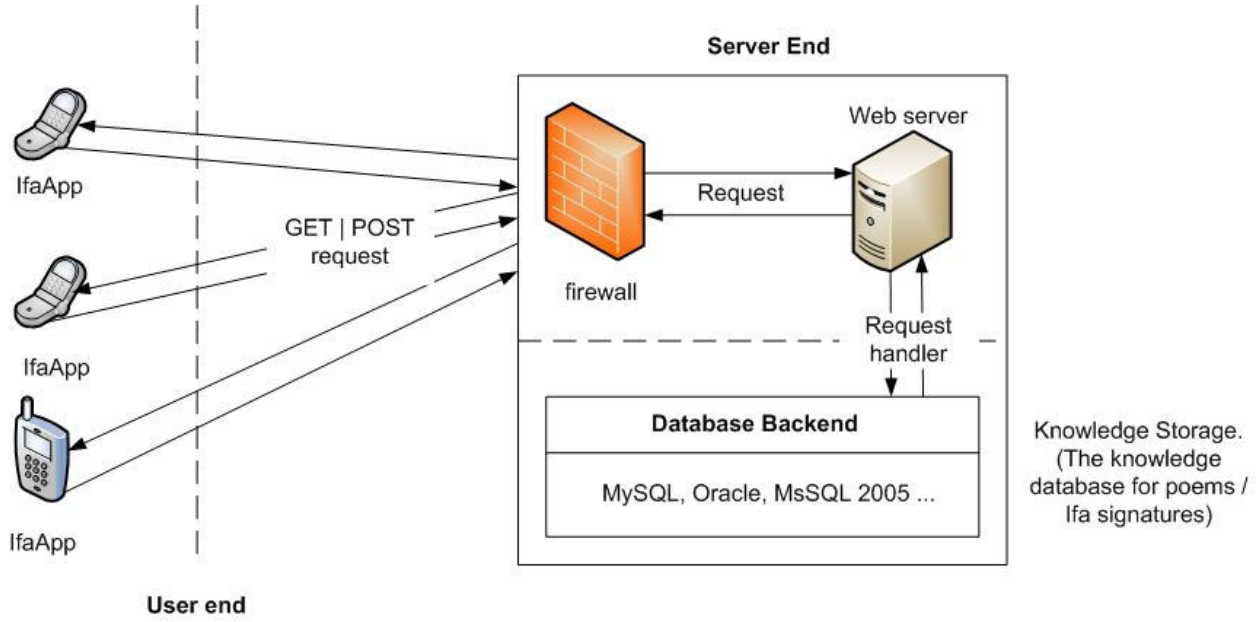

Figure 6. A Remote mobile knowledge management system for "Ifa".

signatures. The solution is to develop mobile KM processes that take into account the different work settings. Using the potentials of mobile technology, substantial contributions can be made in this area. Existing knowledge management projects have shown that mobile knowledge management may have real and valuable contribution to development of knowledge society. The IFAmobile application helps to apply mKM to the Ifa consultation process.

The "Ifa" Process can be related to a learning organization. "A learning organization is an organization that facilitates the learning of all its members and continuously transforms itself". The basic idea behind it is to create a knowledge chain (collection, production, customization, and delivery), suitable to support for the whole process functioning. The critical point for applying mKM concept in "Ifa" is principally to build a suitable knowledge model and then to find the materials appropriate to feed the knowledge chain. Due to the fact that "Ifa" Oracle is characterized by the presence two major actors (e.g. "Ifa" priest and his client), the critical point for applying a mKM concept to "Ifa" is principally to build a suitable knowledge model and then to find the materials appropriate to feed the knowledge chain.

IFAMOBILE: A MOBILE BASED KM SOFTWARE (EXPERIMENT)

Definition

IfaMobile is a mobile based KM software system that provides a hands-on way to visualize process of carrying out "Ifa" divination. The IfaMobile is rendered as interactive mobile application, which lends itself to a variety of transformations. Search and navigation tools are provided. Other features of the IfaMobile include options to control levels of thoughts. The operation of the mobile based system works and the operation of the application is shown in Figure 7. The following images below show the screen shot of the running mobile application on a mobile phone emulator.

DISCUSSION

The images Figures 8 - 14 show the GUI for "Ifa" (IfaMobile) divination processes. In Figure 9, the user identifies himself or herself to the "Ifa" oracle. After the user identifies himself or herself to the oracle, the user then selects the "OK" button to continue with the consultation process. In Figure 10, the first randomization is performed for the left and right signatures. Figure 11 displays the right and left signatures after performing the random operation {1...16} to produce "Okanran-Obara" this establishes the combined or working signatures for the client. The user then selects the "Next" command to perform the next operation. To proceed on the combined-signature derived, the user selects "Next" (to cast the first vote); looking at the signature generated, the first signature called "Ose" (which is the 15th signature on the "ifa" signature hierarchy).

The user then selects "Continue" for the application to perform the final randomization in order to determine the poem to be displayed. In Figure 13, "Owonri" is displayed (which is the 6th signature on the ifa signature hierarchy). Since the first signature "Ose" (see figure 12) is greater than that of the second signature

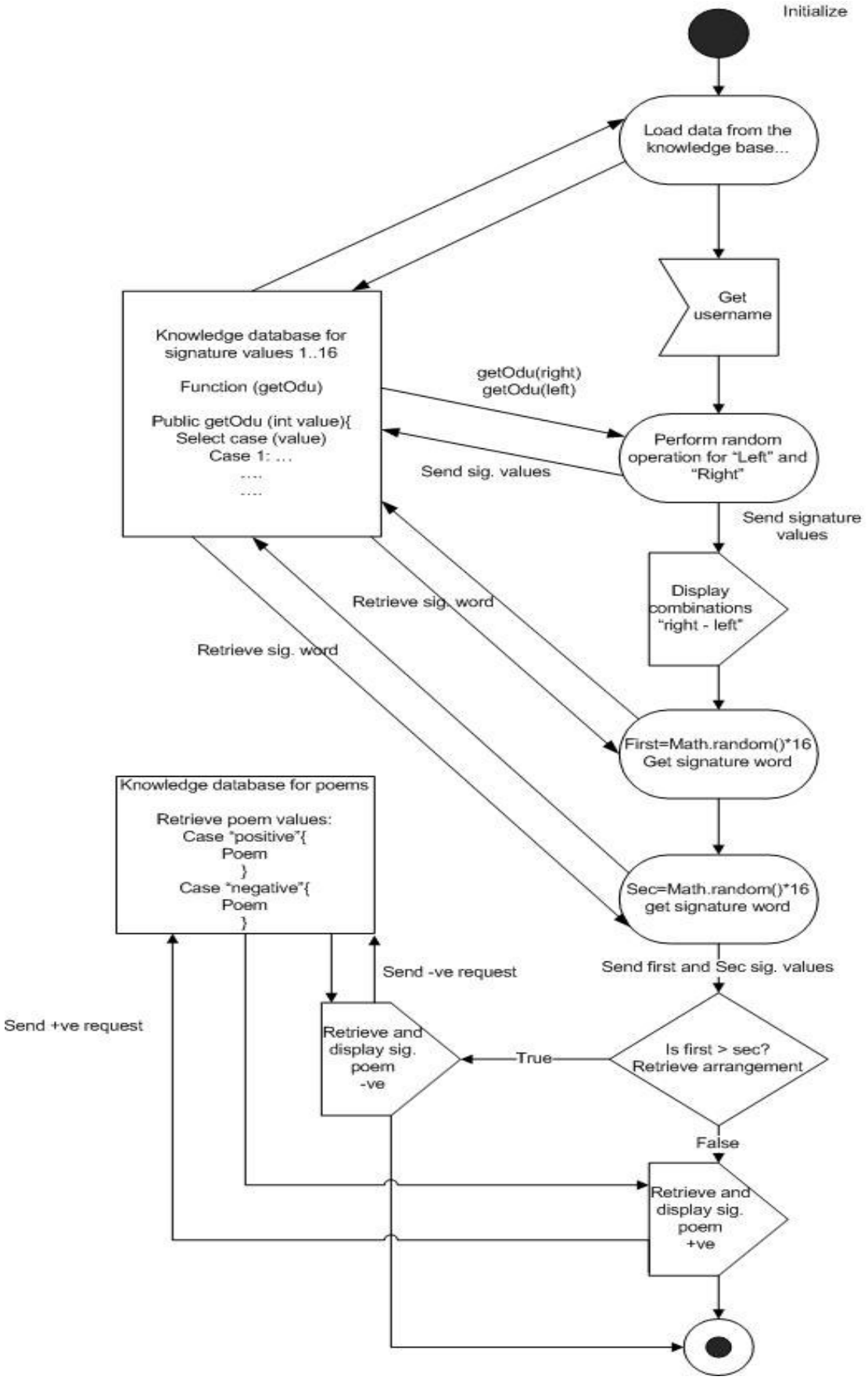

Figure 7. Operation of the mobile application.

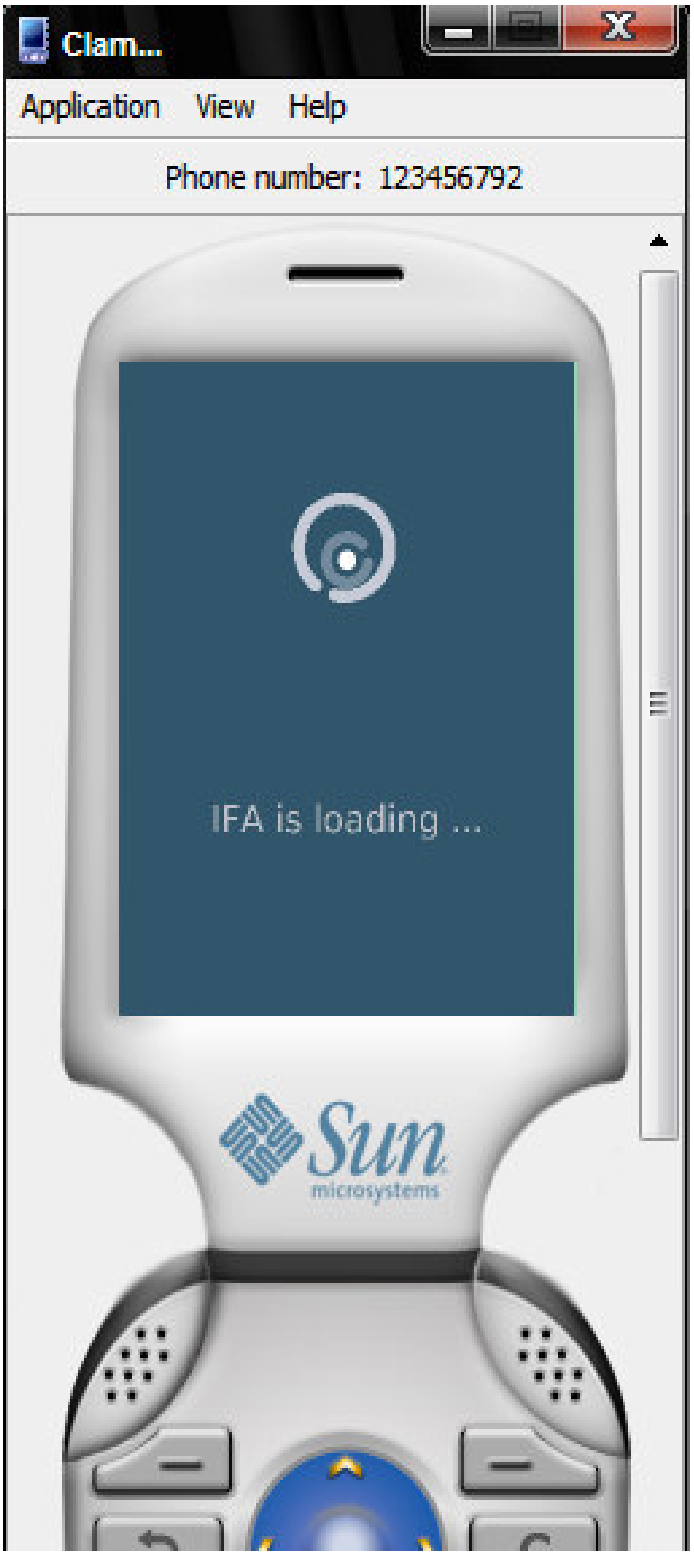

Figure 8. Loading screen.

"Owonri", this triggers the display of the negative poem. But in Figure 14, a positive poem is triggered due to the fact that the first signature is less than the second signature "Okanran".

The information displayed here is of the given format: *If (first_odu < sec){ stringItem4.setText (name + "IFA says,"+POSITIVE_POEM");} else { stringItem4.setText (name + "IFA says," +*

Figure 9. User section form.

NEGATIVE_POEM "); }

EVALUATION

Due to the fact that Ifa Oracle is characterized by the presence two major actors (e.g. Ifa priest and his client), the critical point for applying a mKM concept to “Ifa” is principally to build a suitable knowledge model and then to find the materials appropriate to feed the knowledge chain. The ifaMobile application was tested by six ifa priests. In ifaMobile, two approaches where used to evaluate the system.

Usability: Evaluation could measure how usable the interface is, using classic usability measures such as speed of performance or error rates on simple imposed representative tasks.

Efficiency: Evaluation could measure how efficient the ifaMobile application is to its users, it measures the speed, reliability and the effect on the java enabled mobile phone. It also measures how relevant the result

Figure 10. The first random operation to identify the right and left signatures.

produced is; and the difference between the automated form and the manual consultation process. Feedback about the usability and efficiency were collected from about 6 users (ifa priests) during individual demonstrations. The test was carried out using the manual system of operation and using ifa Mobile application alongside.

Usability

The average satisfaction ratings are shown in Table 2. All ratings were made using a 4 point Likert scale, with 1 = Disagree and 4 = Agree. Overall, participants thought ifaMobile was quite easy to use and still felt fairly comfortable and also felt the consultation process

Figure 11. Displays the right and left signatures and requests for user interaction to perform the second operation.

Figure 12. Second randomization performed. This is the first in the two operations.

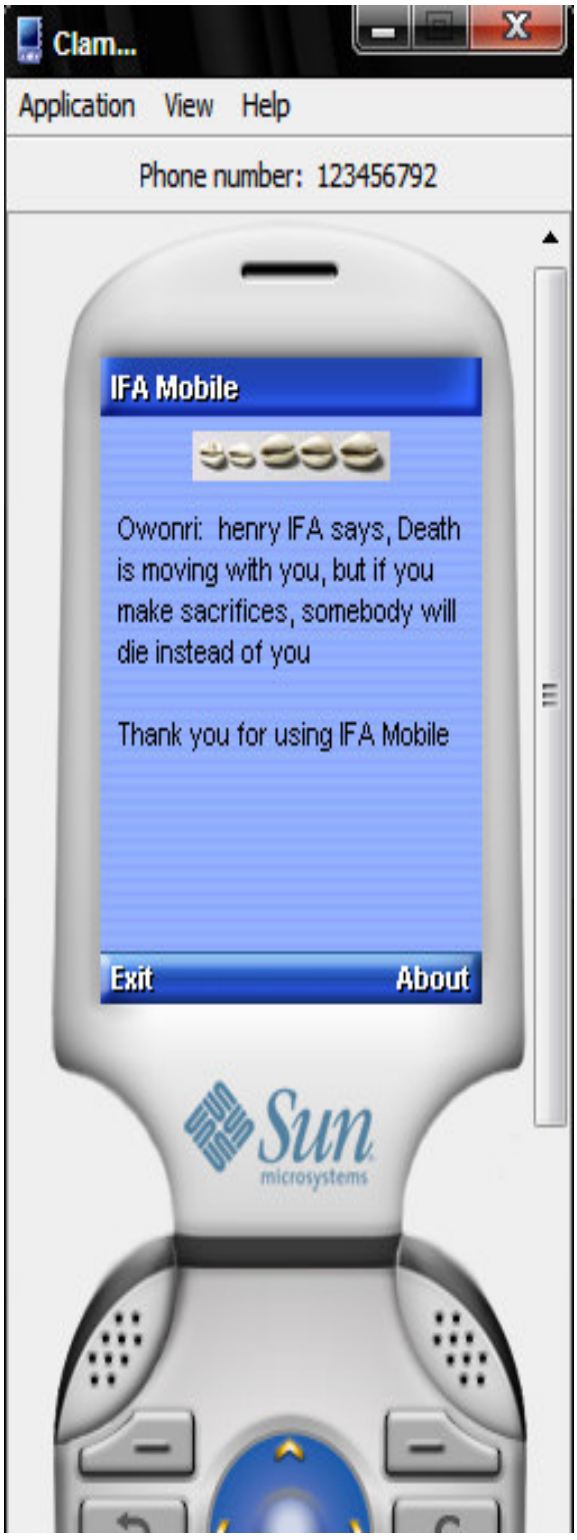

Figure 13. Final operation that determines a negative event. (The poems are retrieved from string constants POSITIVE_POEM and NEGATIVE_POEM)

was straightforward. While participants indicate that they actually made mistakes while using the system with a 2.9 scale, they also show that the organization of information on the application was quite clear with an average of 3.5. As it's always the case, usability study was very useful in uncovering problems that had not

Figure 14. Final operation that determines a positive event.

transpired from collecting feedback from personal demonstrations. Overall, the result of the test was encouraging but there are many ways to correct the issue where users make mistakes while using the system by training users to explain the inner workings of ifaMobile. The interpretation of this result shows that the core design of ifaMobile works and once the usability issue is improved then it has a potential for offering a solution to the ifa consultation process using a mobile platform.

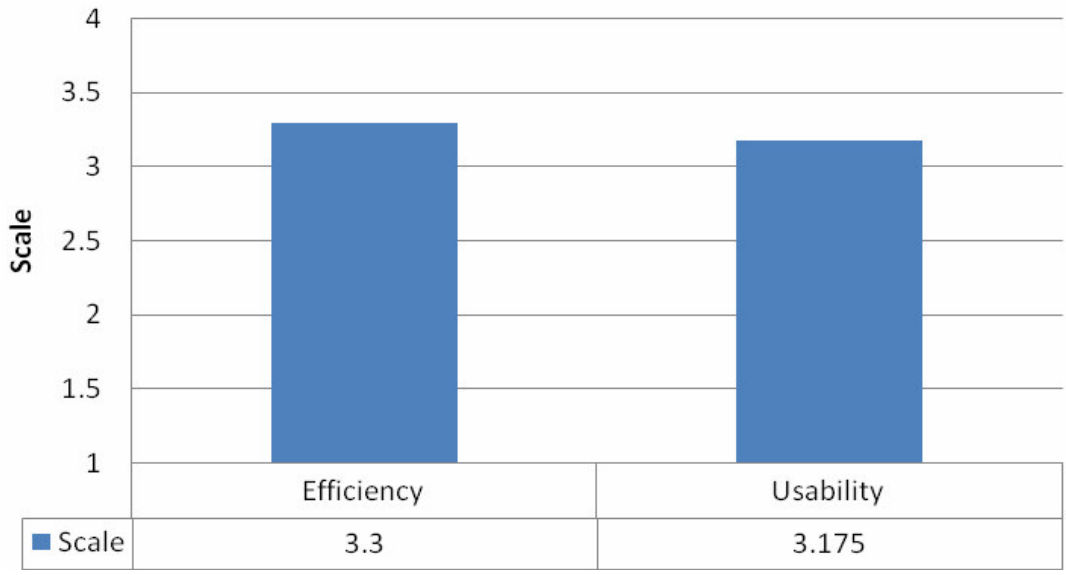

Figure 15. Average Likert scale graph for usability and efficiency.

Table 2. Average Likert scale for usability.

Average likert scale ratings for ifaMobile, using the scale of 1 = Disagree, 4 = Agree	
It was easy using the application	3.1
The consultation process was straightforward.	3.2
I rarely make mistakes while using the application	2.9
The organization of information in the application was clear	3.5

Table 3. Average Likert scale for efficiency.

Average likert scale ratings for ifaMobile, using the scale of 1 = Disagree, 4 = Agree	
The result generated where faster than the manual system.	3.9
Does the application follow the normal ifa consultation process?	3.2
Is the application better than the manual system?	2.6
Can the application be useful for ifa consultation?	3.5

Efficiency

Using 4 point Likert scale, with 1 = Disagree and 4 = Agree on Table 3, the ifa priests generally noticed that the application was faster than the manual system of consultation, they also realized that the application follows the normal ifa consultation process. The respondents also feel that the application is better than the manual system of operation with a scale of 2.6 and they also feel the application will be useful in the nearest future this with a 3.5 scale. The results generated by the application are of two variants, the positive and the negative result which actually determines the state of the users' current situation. For more accuracy, more signatures need to be added to the signature database to create more specific results.

CONCLUSION

The author's conceptualize and design a mobile based KM system for "Ifa" divination. In our system, applying mobile based Knowledge Management to "Ifa" oracle consultation plays the core role. Moreover, the formal explanation of the whole process was given. The author's validated the system and illustrative experimental results were presented. The author's came up with a mobile knowledge visualization framework

implemented with the Netbeans 6.7.1 JavaME IDE and is compatible with MIDP 2.0 and CLDC 1.1 mobile devices. Finally, the author's presented an application tagged "IfaMobile" that modifies the signatures from (Knowledge Engine) and content (Knowledge Base) and express the way the oracle interact when executed. It is our believe that in future more statistical analysis will be done on the novel concept and it can be developed into games on our mobile devices.

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