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Knowledge on the Move

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Abstract: Knowledge propagation is the challenge. Better society requires best knowledge management practices and use of latest tools and technologies. Knowledge management is dealing with the problem of different languages in big countries. Also knowledge is present in different forms. It may be knowledge encoded in laws, decrees, standards, policies, rules and regulations and orders. All these forms of knowledge must be combined together so that it is readily available for general public in their own language. In addition there should be a proper knowledge propagation mechanism. Knowledge propagation becomes difficult in multiple languages. Recently mobile phones and in car computers have become widely used in third world country. These moving devices have amazing features like continuous connectivity, location detection, facility of voice and data processing. This attracts Knowledge Management researchers to consider Mobile computing devices and mobile computers as the medium of knowledge propagation. This study proposes a framework for knowledge propagation through voiceXML in different languages using Mobile phone or in car pc as the delivery medium. Voice interface requires minimum resources and works well in the moving car. The study will enhance the knowledge of mobile computing community knowledge communication. In near future this area of study and its related studies will be greater part of applied mobile computing.

Key words: Knowledge management, knowledge society, language and voice based interface, mobile computing, knowledge propagation

INTRODUCTION

A country like India, has 31 states with total population of 1 Billion plus. With 625 districts India has 29 languages having more than 1 million native speakers in more than 1 Billion peoples, 61% peoples educated, India has 7,84,84849 number of mobiles provided by different operators. The expected figures for mobile are attractive. India has only 3.7% internet penetration, so knowledge propagation through internet is a difficult way.

Knowledge propagation is a challenge in the country like India with 1 Billion Plus population.

Every state has its own local laws in addition to the central government laws. States have different tax structure; they have different policies for entertainment, education, law and order, construction, agriculture, food, traffic rules and regulation. Furthermore every state is liable to implement all the central government laws in all these sectors. Furthermore every state has its own languages for example Maharashtra has the primary official language as Marathi while some states have their language as Hindi, other states have languages like Gujrati, Kashmiri, Oriya, Tamil, Kannad, Telgu or Assami. Education rate and technology penetration in all these states are very low. Hence, it requires simple solution without the need of any high end gadgets. Voice Interface is the solution for this problem.

TELECOMMUNICATION INFRASTRUCTURE

India has 91% growth rate in mobile industry. Companies like Air Tel, BSNL, VodaFone and Idea are the major contributors to this enormous growth in the telecom sector. TRAI (Telecom regulatory authority of India) has played the major role in making this sector more competitive. As a result the growth in the sector is enormous with new facilities and cheapest services rates in the world. As the services are cheap and they are affordable for the local economy, mobile penetration in last 5 years is very high. Almost every person and average income household has mobile phones. Although as India being a third world country has very low penetration of high end mobile phones. Most of the peoples have low end mobile phones with basic facility of voice and text communication. A recent study of Zahrani (2010) proposed directions for the development of 4G telecommunication infrastructure. They suggested very good technologies for the growth of 4G technologies.

KNOWLEDGE PROPAGATION IN MOVING CAR AND MOBILE PHONE

Availability of computing devices has become necessity in the moving vehicles. Commercial vehicle require it for always connecting with their corporate

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Fig. 1: PC in car

offices. Personal vehicles like car require it for browsing internet while on the move (Fig. 1).

Best medium of interaction in a moving vehicle is voice.

INFORMATION AND COMMUNICATION TECHNOLOGY IN INDIA

India is considered to be a software superpower. Indian software exports crossed 40 billion USD. India is considered to be the favorite destination for outsourcing. The reasons are (1). Large English speaking population, (2). Large population with domain specific knowledge, (3). Cheap labor cost, (4). Time zone advantage and (5). Information Technology resources (Network specialists, hardware, software's, software developers) are easily available. Favorable government rules and regulations for IT sector is another important aspect of information technology in India.

NIC (National Informatics Center) is the central body in India which runs several government websites including central and state government. It also runs websites for different educational organizations like state educational boards which conduct examinations for 10th and 12th class in India. NIC also runs websites for displaying result for various exams. NIC handles the websites for major corporate entities belonging to various government departments like coal ministry, steel ministry, home ministry and education ministry.

Indian foreign ministry now accepts online applications for passport and related services in some selected cities. It is now mandatory for all the major organization runs by central and state government in power, food, administration, law, public services to have the websites. These websites should have all the related information available to the citizens, particularly the rules and regulations for bidding process. For example Nuclear power corporation of India, state electricity boards, food corporations in state, Steel authority of India, each and every ministry, major government offices and tourism offices. Most colleges in cities now have their own websites. Almost all the higher education colleges and universities admit their students through website. Their admission process is either partial web based or full web based. Engineering and medical college admission processes are almost through web.

The STOPE stands for Strategy, Technology, Organizations, Peoples and Environment. Indian Government and organizations have positive strategy towards the information technology industry. Currently government does not impose any taxes on the business related to software as being a new and emerging business. As India is a super power in the Information Technology industry, technology is easily available to Indian organization for knowledge management. Organizations have positive side towards the implementation of information technology is their area. For example Indian railways has the largest setup for their website www.irctc.nic.in which is highly loaded website for online railway reservations. Peoples working in government, semi government and private sector are highly educated with English as their primary language. With all these inputs the environment in India for being a knowledge society is more prominent.

KNOWLEDGE SOCIETY

With the innovation of mobile communication, internet penetration, availability of higher education and ever knowledge seeking young community India is going towards the knowledge enabled society. Students, universities, colleges Indian young community is really the knowledge seeker. They want to acquire new knowledge, work with innovations in each and every field. For example FieldWise, which is a Mobile knowledge management architecture, was proposed by Fagrell *et al.* (2000a). Another important development

Table 1: Google table for Queries hit from India

Fastest rising	Most popular
Youtube	Orkut
Orkut	Gmail
Katrina Kaif	Yahoo
Cricket	Google
Irctc	Youtube
Facebook	Yahoomail
Genelia d'souza	Indianrailways
Beijing 2008 olympic games	Rediff
Sixth pay commission	Cricket
Ipl	Katrina kaif

Table 2: Top 'how to' searches and top searches on mobile

Top 'how to' searches	Top searches on mobile
How to reduce weight	Orkut
How to ######	Yahoo
How to earn money	Waptrick
How to get #####	Gmail
How to learn English	Games
How to gain weight	Katrina kaif
How to play guitar	rediffmail
How to create a website	yahoomail
How to impress a #####	Namitha
How to tie a tie	Google

was development of audio wiki collaboration by Wang *et al.* (2008).

Table 1 shows queries hit through Google India. It clearly shows that India has greater knowledge seekers in the world and Table 2 shows Top 'how to' searches and Top searches on Mobile. Framework proposed by Olajubu *et al.* (2006) suggests measures to ensure the manpower development and economical development.

Not only India, regions such as Africa is also coming up in mobile and knowledge society. The study proposed by Olajubu *et al.* (2006) suggests measures to ensure the manpower development and economical development.

Not only India, regions such as Africa is also coming up in mobile and knowledge society. The study conducted by Agbeja and Salawu (2007) suggest various measures to fill the digital divided between Africa and rest of the world. Recently many verticals such as e-commerce have seen development in knowledge society. For example Zanjani *et al.* (2009) has proposed "Mechanisms of Customer Knowledge Management in E-Commerce Websites". In this study they proposed a model for seeking and managing the customer related knowledge.

India with 1 billion plus population has different industries, banks, organizations working in different sectors. Every organization is run by some rules and regulations. Peoples working in those organizations, taking services from those organizations want to know those rules and regulations and policies in order to take maximum advantages out of that. Hence India is emerging as knowledge based society. With the, high penetration of internet, availability of broadband and presence of cheap mobile communication India is a true knowledge society today. Particularly specialized peoples working in specific job like journalists require on the move mobile knowledge management facility. The problems before the Knowledge Management experts are to propagate the knowledge in some form which is understandable to common man. As they are not educated they are not able to browse through Internet, so mobile communication through voice is the best medium to do so.

STATEMENT OF PROBLEM

Every industry, organization coming under the Indian eGovernance paradigm has its own data, rules and regulations, policies, laws, way of working and financial power/implications. Every organization has to manage data related to these things in proper way and propagate it to its employees and customers. The organizations working for development and education have to manager larger knowledge bases. For example there are organizations like 'Krushi Vikas Kendra' (Agricultural Development Center) in each district. It is kind of knowledge base for all kinds agricultural activities and related industries (like Department of Animal Care which is called as *Animal husbandry*). They provide expert advice to the farmers on different issues related to agriculture. Like they provide various issues related to allied industries like animal husbandry. Another example is the customer service centers of organizations like banks, railways, foreign office, power corporations, education departments, food corporation etc. At customer service center of these organizations the customer executives have to face lot of questions on different issues. The executive may or may not have knowledge about the question being asked. A knowledge base helps them in order to properly answer the queries of those customers. The queries about railways and bank loans may not be common so customer support executive always require the help of a knowledge base. The presence of updated knowledge base makes the answer to every question possible.

So in conclusion the problem of knowledge propagation has multiple faces. It needs multi face solution. We propose that problem can be solved with following two possibilities. (1). Knowledge propagation through mobile phones and (2). Knowledge propagation through PC in car.

Following is the proposed architecture for solving the knowledge propagation in moving car or through mobile (Fig. 2).

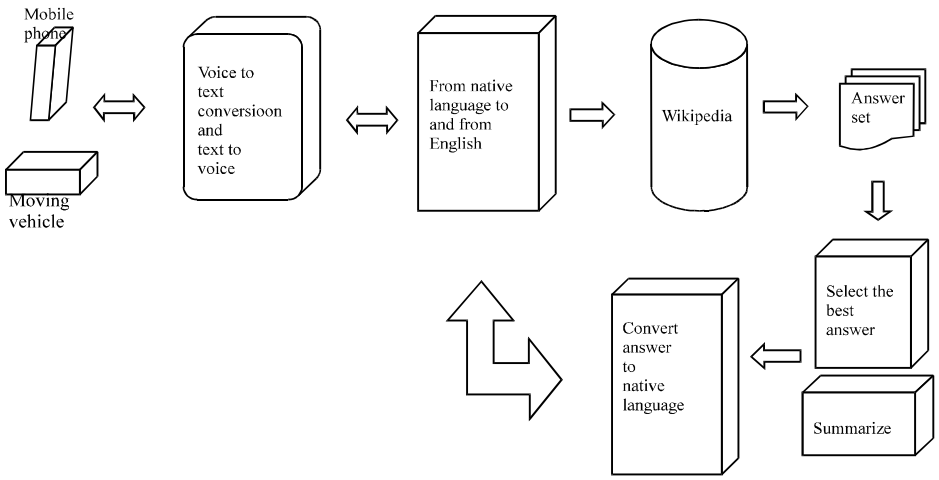

Fig. 2: Framework for Knowledge on the move

Earlier work: A paper presented in PETRA'08 on July15-19, 2008 at Athens, Greece by Kolias *et al.* (2010) proposed an application based on voiceXML This application uses the wiki as the source, then it makes a small database in SQL server. The user asks the required information; navigate in the file using voice commands like NEXT, BEGIN and SKIP. The system uses Wiki Engine, Voice Browser, TTS engine and AVR Engine.

Critical analysis: The proposed architecture in above paper has the following areas where improvements can be done.

The system uses all propriety software so the cost will be more; open source software can be proposed to solve cost issue.

System supports only English language, if translators are implemented, this can work for other languages as well.

Present study proposes the following theoretical architecture, which solves above problems. Furthermore in the next paper we will make the system practical.

The proposed system will have the following strong points.

- Based on open architecture
- Use Wikipedia as the source of knowledge
- Use automatic Language translation to implement multilingual system
- Summarize the target articles, so as it becomes easy to listen while moving

PROPOSED ARCHITECTURE

Figure 1 shows the proposed architecture to solve multi faced problem. Figure 1 shows that query can be submitted through mobile devices (may be low end mobile or any mobile computing device). The query can be submitted for particular information forwarded to a particular number. Through mobile network it will convert the multilingual voice query to text based query. This is discussed by Jing *et al.* (2006). This multilingual query should then be translated to English language. This English query should be fired to an already existing knowledge base (i.e., Wikipedia). The knowledge base then responds with the multiple results. The best result must be select with the help of some algorithm. Once the best result is selected then the results should be translated from English language to the native language of a mobile holder. Once the voice answer is ready, it can be fired to the mobile device with the help of the voice Browser.

COMPONENTS IN THE PROPOSED ARCHITECTURE

Voice to text convertern / vice versa: This is the software working on the mobile operator server, where mobile is directly connected after dialing a number to get the information about his/her query. Once the person dial a number the system should activate voice to text converter. Once this converter is activated, the person will ask his query. There should be some directive to put his/her query in a well formatted manner. This will make searching the knowledge base easy and reliable. There are many text-voice converters available. AT and T has a demo available for converting the text into the voice which can be seen.

http://www.research.att.com/~ttsweb/tts/demo.php. Furthermore Jing *et al.* (2006) conducted a comparative study of speaker recognition system. They found Hidden

Markov Models (HMM) more correct compared to other systems. They introduced a security system based on the voice of the user.

Multilingual converter from any language to the english language: Once the query is translated into the text, you have to activate the next component. This component will convert text query from native language to the English language. Once the text query is converted from native language to English language, it becomes searchable in the knowledge base. There are various converters available for this job. In case of implementation in India, where you have 28 different languages being spoken among 1 billion plus peoples, you will need a master translator to convert all 28 languages to English. A lot of work is already done in this area. Multilingual retrieval was discussed by Bertagna *et al*. (2004). Following are some of the experimental translation system already developed:

- MEANING (Developing Multilingual Web-scale technologies)-aiming at developing technologies to search by concepts and not by words; contributing in this was to sense disambiguation
- ONELOOK - "search engine for words and phrases", based on wordnet. You enter the word and get the links to the dictionaries where you can find it
- TERMINAUTA-a terminological metasearch engine developed for translation resources online, where you can combine different languages
- MUCHMORE-aiming at developing technologies that will result in a prototype system for cross-lingual information organization and access for the medical domain

Search in the Wikipedia: The converted English language query can be fired to the stored knowledge base. Wikipedia is the largest such database in the world today. For example the bank, agriculture or foreign office.

Once you fire the query to the knowledge base, there will be multiple answers. This is because the searching word may match to multiple files in the knowledge base. Here it will be difficult to select the file to be forwarded to mobile client. Now, question is how to select the best file to be converted and ultimately play on the mobile handset. Here we have to use another component called answer selector, this component should decide the best and most effective answer to be played on the mobile phone.

Answer selector: This component will select the best answer to be sent to the recipient's mobile handset. Here we can consider various algorithms to select the best answer.

Summarization: In order to listen to audio conversion of results found during searching, there is need to summarize the articles found after searching in the Wikipedia. A summarizer component is proposed in the architecture which will summarize it before converting it into the voice format. This will ease the listening and understanding process of the person firing the query.

Voice browser: This is the software which will be used on the mobile client to speak the text. VoiceXML(VXML) is theW3C's standardXMLformat for specifying interactive voice dialogues between a human and a computer. VoiceXML documents are interpreted by a voice browser (Capra and Perez-Quinones, 2005). There are various experimental systems developed depending on the VoiceXML. For example, VoiceBox is system for talking books by Jain and Gupta (2006). VoiceBox is a framework through which you can access the written book through interactive telephone system. Furthermore paper also discusses the navigation control in the hands of the user. Mobile refining of web information using voice interface is the exploratory study conducted by Capra and Perez-Quinones (2005). This paper discusses the experimental system for refining of information on the web with the help of telephones. The making of semantic web browser is discussed by Quan and Karger (2004). This study discusses the RDF (Resource Description Framework) to be interpreted by the semantic web browser. Derballa and Pousttchi (2004) discusses extending of knowledge management to the workplace with mobile technology. Another interesting paper discusses the implementation of Audio wikis through mobile collaboration. They discuss how wikis in the audio format can be made, navigated and run mobile handsets for fast and extensive knowledge management. Detailed discussion about the information retrieval is written by Baeza-Yates and Ribeiro-Neto (1999).

With mobile: An uneducated / semi educated person who wants to know about the problem he has on his farm/ field, cannot visit the help center for many reasons. Even if he is uneducated, he uses his mobile phone in English or in regional language for his day to day communication. Mobile phones in regional languages are available in India from various vendors like NOKIA, SAMSUNG and LG etc. the Knowledge can be propagated through this small magical piece in the form of voice. There may be many knowledge seekers like this who seeks information on eGovernment related information. The procedures in the government offices like issues of ration cards, National ID cards, papers related to agricultural and non agricultural land, sale and purchase of properties, sale and purchase

of 2/4 wheeler vehicles ...etc require awareness about the local rules and regulations. Person who wants to get a two- wheeler or four-wheeler license needs information regarding the procedure. The knowledge of procedure is required by both educated and uneducated persons. Educated person may visit website or can get information by some other means, but uneducated person cannot. Also if the person lives in the remote region, mobile is the best medium to propagate this knowledge. Village people use most basic handset. They have minimum functions available. Mostly the communication is voice and text based, the buttons are available for basic alphanumeric operations. There are various tools developed for knowledge management like RepTool, gIBIS (Conklin and Begeman, 1988). Some field specific tools also exist like NewsMate. Newsmate was developed for journalists to manage their knowledge in multiple languages (Fagrell *et al*., 2000b).

In the moving vehicle: Peoples travel long distances in their cars. Particularly the peoples of upper rich class, rich class and moderate class now days own a car. These classes of peoples prefer own vehicle instead of public transport. There is a question of knowledge seeking process of the individual travelling in these vehicles. The introduction of WiFi and wireless broadband networks provided by telecom companies can make this knowledge propagation idea a reality.

Some popular uses of computers in the moving car are as follows.

- Verbal email announcer
- Satellite navigation
- Vehicle Integration
- Hands Free Phone systems
- Wi-fi Connectivity
- Voice Recognition

Table 3 shows comparison of our application with pervasive wiki application based on voice XML.

Table 3: Comparisons with Pervasive Wiki application based on VoiceXML

Our application	Pervasive wiki application
• Multilingual	• Not multilingual
• Summarize the audio applications	• Run long text to audio converted files
• Suggests building on open source technology	• Propriety software are used which increase costs
• Talks about narrow implementation like implementation in the Car or one's mobile phone	• Talks about in general as pervasive

A CASE STUDY

Mr. Ashish Shah visits a Conference in San Francisco: Mr. Ashish Shah is an Indian, currently living in city Bombay. He knows only regional language Marathi and other language Hindi. Other facts about him are as follows:

- He is traveling for the first time
- He is not aware of systems of taxis, airport, location and conference details

Before the take off, he uses our system to search basic information about San Francisco airport, city information and the hotel information. Here Mr. Ashish knows only two regional languages, i.e. Hindi and Marathi. As he asks the questions the system search in the backend Wikipedia, summarize it and run the audio in his language. In this way, the system is capable of interacting in any language. Mr. Ashish can search for the following using our system, then he can listen to audio in his own language.

- Information about the city
- Information about the location, hotel and conference
- Information about the meals, local transportation system and others

HOW PROPOSED ARCHITECTURE IS ADVANTAGEOUS

- Multilingual
- Audio format which works on mobile and in vehicle
- Use open sources which makes it affordable and open for continuous improvement
- Utilize the time of knowledge seeker in efficient manner
- Summarize the article to be able to grasp easily

FUTURE WORK

- Implementing the real system using the proposed theoretical work
- Solving the problem like non availability of information in the Wikipedia

Implementation: We will implement the VoiceXML coding using Voxeo platform. Voxeo platform is dependent on the open standards like VoiceXML, CCXML and SIP. Voxeo provides hosted/SaaSservices using VoiceXML platform.

Following is a sample code in VoiceXML for extracting the voice jokes from the .wav files:

```
readStream.Close
Set readStream = Nothing
Set fso = Nothing
%>
<vxml version="2.0">
    <%'<property name="caching" value="safe" /> %>
    <property name="com.nuance.core.ep.EndSeconds" value=".2" />
    <property name="com.nuance.core.ep.PrepareForBargeIn" value="TRUE" />
    <property name="com.nuance.core.ep.ThresholdSnr" value="5" />
<form id="knockknock">
          <field name="knock" slot="knock">
           <grammar type="text/gsl" src="knock.grammar#WHOS-THERE" />
           <prompt bargein="false">Knock knock!</prompt>
<filled mode="any"></filled>
       </field>
            <field name="setup" slot="setup">
           <grammar type="text/gsl" src="knock.grammar#MSG-WHO" />
           <prompt bargein="true"><%= setup %></prompt>
           <filled mode="any"></filled>
       </field>

       <block>
        <%= delivery %>
    </block>

    <field name="again" slot="again">
      <grammar type="text/gsl" src="knock.grammar#YES-NO" />
      <prompt bargein="false">
       <break />
       Would you like to hear another?
     </prompt>
     <filled mode="any">
      <var name="answer" expr="again" />
      <if cond="answer == 'yes'">
       <goto next="knock_f.asp" />
      <elseif cond="answer == 'no'" />
       <prompt bargein="false">Thank you!</prompt>
            <exit />
      </if>
     </filled>
    </field>
  </form>
</vxml>
```

CONCLUSIONS

The use of mobile technology for knowledge propagation is the need of the hour. As mobile services are cheap and widely available in the country like India, knowledge propagation through mobile is mandatory. With the presence of Telecommunication and Information Technology infrastructure India presents a best case of implementing such framework. Knowledge propagation puts two problems in front of KM researchers. First problem is to deal with multiple languages and second is interacting with user communication with audio rather than textual information. The framework has two components to deal with these issues, one is audio to text converter which converts and audio message into regional text and then to the English language query. The second component is the voice browser which can speak out the answer. This framework combines different/ emerging technologies from different areas of research. After implementation the architecture brings the Knowledge to every household in their own language.

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