Assignment 3: Implementation prototype

Radio questions & answers platform for agricultural issues

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Abstract: Internet and digital information is still something that is not accessible in rural africa. There is however a solution to the problem of sharing information. The fact is that people in africa do own a basic phone and radio stations are a common source of information sharing, for instance about agricultural issues. To exploit this, the mobile phones needs to interact with the radio stations and vice versa. This paper describes a use-case in Mali where farmers need to share information regarding agriculture issues with each other. The project, where this paper is a result of, has designed, developed and (proposed) an implementation plan for a platform where farmers can callin the radio station and let their question be recorded. The radio station broadcasts the questions and other farmers can then respond to those question by calling in and letting their answer be recorded. The radio station will then broadcast the questions and answers during a agriculture Q&A program.

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1. Introduction

In the last couple of decades it has become a common practice for the western countries to attempt to help developing countries, specifically the African countries, with ICT technologies and equipment. By now, majority of us do agree that ICT does play a tremendous role in improving economic, medical, educational or any other sector's needs. Therefore, now is the question 'how can ICT improve life in developing countries' is becoming more and more important. The value of information and communication technology is very high across all sectors, in both public and private enterprises, and at multiple levels. From software businesses in urban cities, for example, to health delivery in rural areas (Walsham & Sahay, 2006).

Internet and digital information is still something that is not accessible in rural africa. There is however a solution to the problem of sharing information. The fact is people in africa do own a basic phone and radio stations are a common source of information sharing, for instance about agricultural issues. To exploit this, the mobile phones needs to interact with the radio stations and vice versa.

This paper elaborates on the extended functionalities of the platform that makes it possible for the farmers in rural areas such as Mali to share information regarding agriculture issues by calling a radio station as described in "Phase 1: Interaction prototype & phase 2: functional prototype - Radio questions & answers platform for agricultural issues" (Jainandunsing, Bittar, & Nazir, 2016)[1].

The main functionalities added in this final phase are:
a) the functionality to provide information on general topics (feedback Mali). A detail explanation of this functionality is provided below.
b) the database designed in phase 2 is technically developed and added to the prototype. A data model for this database is presented in chapter 7 of this paper.
c) In order to make the questions and answers available on the internet, a website (mockup) is created.

The first functionality described above is added in this final phase enables the farmers to select a general category and provide information on it without having to chose a question. So far, this application provided the farmers, who acts as information providers, only the opportunity to select a posted/recorded question to answer. Now they will be also able to select a general topic such as 'Rain' and provide information on that. This functionality is designed and developed based on the feedback that the project team received from the trip to Mali. In the next chapters, the motivation and problem statement of this research is comprehensively be discussed.

1.1 Motivation & problem statement

During a session in Mali while gathering requirements of the local farmers, a use-case was identified in order to solve a very common problem that farmers in Mali face every day. The need for information to be shared regarding agriculture issue's seemed to be very high among local farmers in Mali. For this reason, a voice-based application is developed and demonstrated to the farmers and the radio stations in Mali. In the last two papers "Interaction & functional prototype - Radio questions & answers platform for agricultural

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[1] *Jainandunsing, P., Bittar, M., & Nazir, M. (2016). Interaction prototype - Radio questions & answers platform for agricultural issues. VU - ICT4D.*

[2] Wyche, Susan, and Charles Steinfield. "Why Don't Farmers Use Cell Phones to Access Market Prices? Technology Affordances and Barriers to Market Information Services Adoption in Rural Kenya." *Information Technology for Development* (2015): 1-14.

[3] *Long List of Pilot Use Cases (Mali) - Radio questions & answers about agricultural issues*

issues'' by (Jainandunsing, Bittar, & Nazir, 2016) the design and functionalities of this platform was extensively discussed.
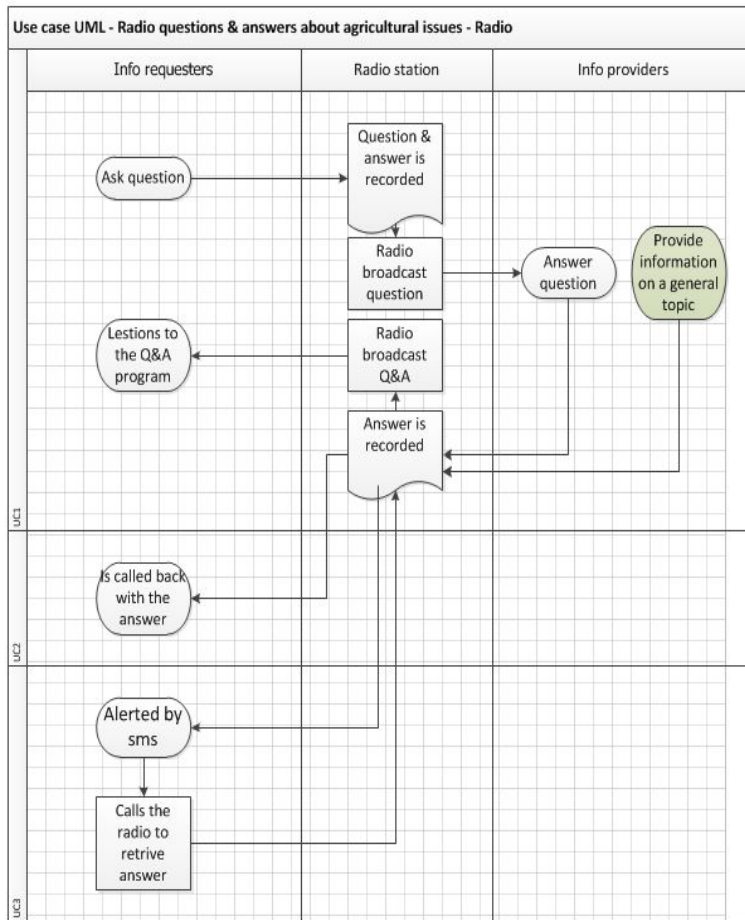
The expansion of functionalities of this application by adding the multilingual aspect and date dimension in the data model was an essential part of the second phase. By adding more languages the scalability and usage of this platform is increased. By recording the questions of the farmers per date made the application more organized and intuitive.

One of the problems farmers come across is, there is no platform to share information about agricultural issues, such as information about the rainfall, harvesting or any weather conditions. So, considering these needs and above problem statement, the central question of this research is: **how can we help farmers in Mali in order to enable them to share information regarding agriculture issues with each other?** A solution to this problem is a platform where people can ask and answer questions by using their mobile phones. These questions are retrieved by the radio station and recorded. The radio station will broadcast these questions. Other people respond to these questions and provide an answer by phoning them in. The information requester will now have the option to be called back to be provided with the answer or they can receive a message, telling them to phone in to access the answer. If the question is asked multiple times the radio station could possibly broadcast the question and answer.

1.2 Use-case

The use case and the extension made in this final prototyping phase described earlier is illustrated by using the application the Unified Modeling Language (UML) in figure 1. The extension includes the functionality for information providers that enables them to provide information on general topics such as rainfall, etc. Before, they could only answer posted questions by choosing it's category and date. With the new functionality, they can chose to provide information on any topic whether there is a question posted on or not. This application is chosen because it visualize the concept properly. The UML describes the system architecture and all the steps that needs to be taken to actually request and receive. Table 1 describe all the possible actions that could occur for a user when using the application.

	Use case UML - Radio questions & answers about agricultural issues - Radio		

User action (UA) & System responses (SR)

Use case UML diagram	User action (UA) & System responses (SR)
(diagram)	UA1: User calls radio station and gives question in a particular category SR1: User's question is recorded and stored in a VMA file
	UA2: User calls for providing answer for a particular category SR2: User's answer is recorded and stored in a VMA file
	UA3: User waits for answer SR3: Radio broadcast question and answer or radio sends alert message to user
	UA4: User calls radio station SR4: Radio provides answers

Figure 1: Use case UML

2. The contextual issues

Below the contextual issues around the use case is presented from different perspectives: social context and technical context.

2.1 Social context

In social context there are a few issues that could arise, for instance the problem of multiple languages. In rural africa alone there are a variety of local languages[3], but how can someone

[2] Stone, Debbie; Caroline Jarrett - User Interface Design and Evaluation. The Morgan Kaufmann Series in Interactive Technologies
[3] De Pauw, Guy, et al. "Introduction to the special issue on African Language Technology." Language Resources and Evaluation 45.3 (2011): 263-269.

approach these people? More is explained in detail in chapter 3.3.2. A application would be successful if more people can understand it.

Another problem that could arise in rural africa is struggling with poverty and people earning less than $1.25.[4] The question arise would people actually want to pay for the service in order to get information. The application would be made as inexpensive as possible, but still people need to pay a small amount. By stating this problem to people in Mali(see chapter 5.3.1), it was concluded that they indeed wanted to pay for it if it gives them the right kind of information.

Another problem could be if there are so many questions asked in one session, not all questions could be broadcasted since it would just take too much time for the radio station. So a trade-off needs to be made, such as selecting a few questions in order to decrease the broadcasting time, But here is the problem would farmers actually call again if it turns out his question is not been answered? A solution to this problem would be receiving calls where farmers explain the answer to his question provided improvement. This way others will get motivated to call again even though there might be a chance of not getting the question answered.

2.2 Technical context

The application is extended by the language french but the more local languages in rural africa seems to be difficult to achieve on the internet.

Also how can an question be checked if it belongs to the correct category and is legit. This should be done by the radio station to validate every record and check for inappropriateness. This would take time and time is money. Are radio stations willing to do this kind of job? Another solution would be considering using a system that checks every word for inappropriateness. Also how can an answer be tested on accuracy and not an incorrect answer has been given? A solution would be validation from farmers and explaining that the answer helped improving.

3. Theoretical background

Before an application can be launched several steps needs to be taken into consideration before making the application. First requirements needs to be determined in order to specify the problems and find solutions.

3.1 Requirements and Approach

It is important to have a good understanding of all the requirements that are needed in order to achieve a successful application. Specific information is gained and collected which will improve the user interface. The gathering of such requirements can be acquired by different

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[4] Morgan Windsor.Mobile Phones In Africa: Subscriber Growth To Slow Sharply As Companies Struggle To Reach Rural Populations And Offer Faster, Cheaper Services.International business times.

methods.The main essence is to investigate different topics of the specific application in order to establish what is actually needed by people who are going to use the application. Also interviews can be conducted in order to gain information. In this case people from Mali provided information about which categories are the most important ones, that is seed planting,animal health, rainfall, harvest and calendre de pluvio which are included in the application.[5]

Table 2: requirements gathering

Investigation points	Data gathering	Approach
The domain	No specific knowledge is needed in order to use the application. Basic knowledge of how to use a basic phone.	Creating application on a basic phone with any extra features available on the phone.
The users	The primary user would be the farmers who are interested in seeking answers to questions about: harvesting, rainfall or weather conditions. Secondary users would be people who wants to ask a question for a specific category or provide answers.	Providing a platform to choose a specific category to ask a question or to provide an answer.
User characteristics	- not age specific - people from rural parts of africa - physical ability: speech and listening - physical disabilities: reading, language understanding	Physical ability: No reading but a voice system which provides the options to choose from. Physical disabilities: providing the user the option to listen the application in different languages such as english and french.
Task characteristics	Tasks are easy to complete. Also the menus are repetitive so it is intuitive. It requires collaboration between the person and the application voice system. Person needs to respond to options provided by the voice system.	The application is straightforward, every time you hear the possible options and what the user should to in order to perform an action.
Physical environment	When using the phone, background noise could be available at the place where the person is. Also dirt, heating and dust might be available	Option to listen the options to choose from again when something is not heard correctly.
Social environment	It is a collaborative working environment since people ask questions and are waiting for answers from other people.	Broadcasting the question, so other people will hear the questions so they can react on it.
Organizational environment	Radio needs to be addressed when applying the application into the world.	The radio station is the source where everything can

[5] Stone, Debbie; Caroline Jarrett - User Interface Design and Evaluation. The Morgan Kaufmann Series in Interactive Technologies

		be broadcasted. And people can call in to provide answers for others.
Qualitative usability aspects	User interface is intuitive	Options are mentioned Click on a number which corresponds to the category Ask question.

3.2 Expected problems and constraints

The expected problems are that there are too many questions and not all questions could be broadcasted, so not all farmers could be satisfied. Also there is only english and french language support so people with other native languages would not be able to use the application. Also a certain amount of payment needs to be inclined in order to ask a question, but after a interview on people in Mali it was established that people would be willing to pay for the service.

Table 3: constraints and trade-offs

Constraints	**Trade-offs**
Costs → relatively small	People who are going to answer a particular questions needs to be motivated for them to actually call.
Technology hardware → basic phone	People can ask a question but need to pay, but there might be the possibility of not getting your question answered when too many questions are asked.

3.3 Specific technology in different context

Technology can be discussed in different contexts, for instance the use of technology in social science aspect, the language technologies and data technologies. Each differ from each other but are necessary together.

3.3.1 Social Science

In order to improve life in rural parts of Africa, different solutions needs to be taken into consideration. Even Though rural africa had a financial growth it still struggles with poverty. A solution to this problem is making use of existing tools which can provide different ways of information sharing. But are people actually waiting for such tools. The answer is yes. Multiple times it has been showed that advanced technology is no use in rural countries, for instance computers were donated but they ended up as a bridge, because the people did not have a use

for it or did not have the proper training in order to use such devices. What they need is a solution with existing tools, tools which do not require training and are easy and intuitive to use.[6]

3.3.2 Language technologies

It has been established that applications or internet websites lack a variety of african languages. The reason behind this is that there is a lack of motivation, because the article stated that computers and internet are more often used by people who are educated and would use the language which is available, where people who use their own language would probably not be in the right situation to be able to work in this area. There might be also another concern regarding structural factors for not having a variety of african languages, since they can affect access and the use. In a majority of african countries there seem to be a inadequacy of bridging language policies with ICT policies. This is not happening since there is insufficient cooperation between linguistics and ICT technicians, because there is not enough knowledge about the languages to actually implement them.[7] Literacy is also something to take into consideration, a solution to this is voice based system. Giving options in the form of speech where the users is not expected to read anything. This gives a good opportunity to approach a broader audience. For the application created for this project, it is extended with the language french, which is also a large language. The problem with more local languages is that it is not easy to find on the internet, so in order to approach the more local people in small towns a vocabulary needs to be setup for using the voice based technology. Here data technology presents itself and linked data can be used. But this is beyond the scope of the project since there is no linked data used.

4. Related literature

ICT-4D has offered a possibility to gain understanding towards many different challenges and threats that people come across nowadays. This possibility has spread to others, seeing possibilities and solutions which ICT-4D offers. People have noticed that people in rural africa could actually benefit from ICT-4D. People in rural africa has gained insight into ICT-4D and how it can solve the obstacle of geographical isolation. The open platform that ICT-4D offers a method for knowledge sharing in both micro-level and macro-level ways. Micro-level means individual and firms who are not isolated. And Macro-level means rural region, isolated regions. It gives them a way to compete again in the economy domain of nowadays.

Furthermore although rural regions have plentiful natural and cultural resources, they are still illustrated as not having enough knowledge. When having certain amount and kind of knowledge it can help to improve lifestyle and bring resources to another level. But without this

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[6] Blackboard.ICT4D introduction lecture.2016

[7] Osborn, Donald Z. "African languages and information and communication technologies: Literacy, access, and the future." *Selected proceedings of the 35th annual conference on African linguistics.* 2006.

knowledge the regions are limited. Knowledge can be stored and shared making it a powerful tool, also for those in rural regions, since it can offer new perspectives.[8]

After all the perspective and opportunities ICT-4D offers for rural regions, its application into the field still remains passive. The reason for this is the many different local languages a rural region owns pose a problem, but also the ICT infrastructure is inadequate and the agency officials who are operable in these regions have little knowledge of the potentials ICT offers.[9]

Because of the isolation and the difficulties mentioned above, projects often do not get beyond their piloting phase. The rural regions are not popular for professionals and experienced operatives. They rather go to larger cities with the possibilities of earning more money and see more options. But how can this problem be handled and to create a project which is more developed. The answer is attrac more parties to the project, for instance stakeholders, investors, donors. One should also gain knowledge and understanding about the consumers and all the parties that are needed for the project. Asking people in rural regions what they need and how the find the project and if they see benefit to it, gives a good indication if it will work.[10]

African countries do own devices which are available in developed countries, but they struggle to maintain them due to expenses, which makes ICT-4D a perfect solution since it is affordable and gives an opportunity to share information and be connected to others.[11]

5. Solution Design

In this chapter, design and infrastructure of the solution is broadly discussed. Next to those two topics, the prototype improvements per phase including how the feedback received from Mali has been added to this solution is discussed briefly.

5.1 Infrastructure

All the elements that necessary in the infrastructure to be presented, are illustrated below in figure 3. The actors a) farmer that request information, b) farmer that provides information and c) the radio station that broadcasts the questions and answers are all shown below in order to clarify their contribution as actors of this infrastructure. The server and database are also part of this infrastructure. The database and data model is furthermore described in the next chapter.

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[8] Stratigea, Anastasia. "ICTs for rural development: potential applications and barriers involved." *Netcom. Réseaux, communication et territoires* 25-3/4 (2011): 179-204.
[9] Kumar, Abhay and Singh, Krishna M., Role of ICTs in Rural Development with Reference to Changing Climatic Conditions (March 23, 2012). ICT FOR AGRICULTURAL DEVELOPMENT UNDER CHANGING CLIMATE, Krishna M. Singh, M.S. Meena, eds., Narenda Publishing House, 2012
[10] A SANGONeT Conference. ICTs for rural development. Rural Realities, Real Solution
[11] International Journal of Education and Development using Information and Communication Technology (IJEDICT), 2005, Vol. 2, Issue 4, pp. 144156.
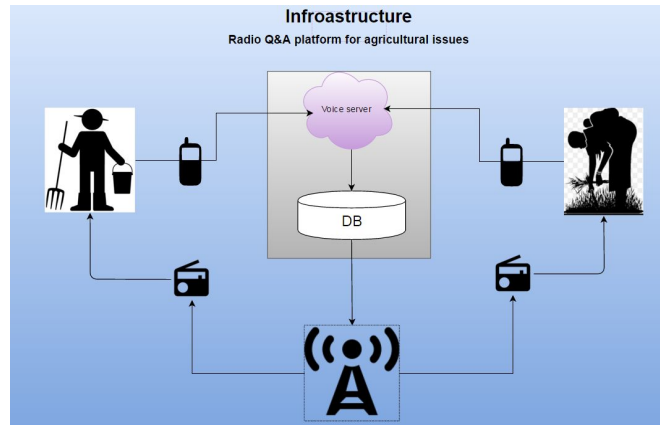
Figure 2: infrastructure

The general requirements of this infrastructures such as a) a database, b) server, c) radio stations, d) radio devices and e) mobile phones are shown above and discussed in the paper. The more detailed requirements such as technical requirement of the server will be investigated and will be a part of the next paper and referred in this paper as future work in the last chapter.

5.2 Service description

The radio questions and answers platform for agricultural issues serves farmers who want to share information regarding their agricultural issues. Farmers that would like to ask a question can call in and record their questions. The radio station broadcasts their question in order to spread it to the farmers who might have an answer to that question. Farmer with an answer calls in and let the answer get recorded. Radio station can then broadcast the questions and answers. The functionalities of our application, as described in the interaction prototype and functional papers (Jainandunsing, Bittar, & Nazir, 2016), has been extended by adding the functionalities such as a) multilinguality and b) categorization of questions by date and c) ability to provide information on general topics. In the prototype the language french is added as shown in figure 2. The data dimension makes it possible for the user to choose between the questions of a) today, b) last week and c) last month. Both, the addition of the language and the selection per date functionalities were part of phase two expounding features.

5.2.1 Feedback from Mali

The feedback received from Mali trip is very positive. The following two points evaluated during the demonstration of this application in Mali: a) they (the farmers and radio stations) were very enthousiast and wanted to use this application immediately and b) they were ready to pay for it, incase needed. Improvements could be made by offering the information providers an opportunity to provide information on general topics, even if there is no question posted on those topics. Such as a scenario where a farmer would like to provide information on rain. The farmer (information provider) calls the radio station and let his message be recorded and broadcasted later on. The functionality for the information providers (farmers) to be able to

provide general information is added to the application based on this requirement that we received as a feedback from Mali. This way, farmers who would like to provide information, would not be required to first chose a question (see . They can also call and provide general information on for example rain. We also added two more categories that the farmers thought was essential to have, this are seed planting and animal health. In the figure below the green process boxes represent the new process which are the result of the expansion of functionalities of our solution based on the feedback received from Mali.
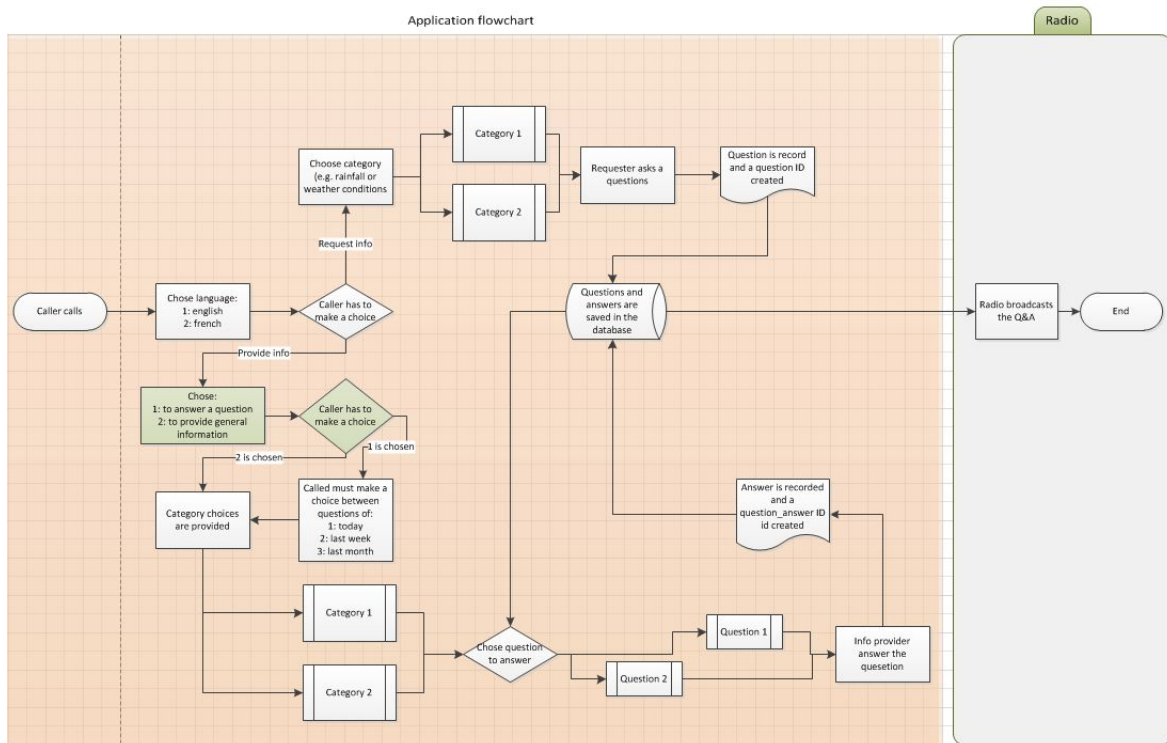

Figure 3: prototype UML inc. expansion

5.3 Data model

The data model illustrated below is based on a star scheme. The fact table contains all the necessary key fields of the tables in the database such as question table, answer table, category table, information requester table and date table. Question table contains all the questions that the farmers ask through the voice server by calling with the mobile phone. Answers, provided by farmers that provides the information, are saved in the answers table. The date dables is necessary in order to make it possible to query the data by a certain date or period. This makes it possible to limit the number of questions that information provider has to listen to before he can give an answer. By query on the date and giving him the opportunity to chose between a) questions of today, b) questions of this week and c) questions of this month. Beside the data, categories are also provided in order to categorize the data and limit the number of audio files that has to be played for a information provider.
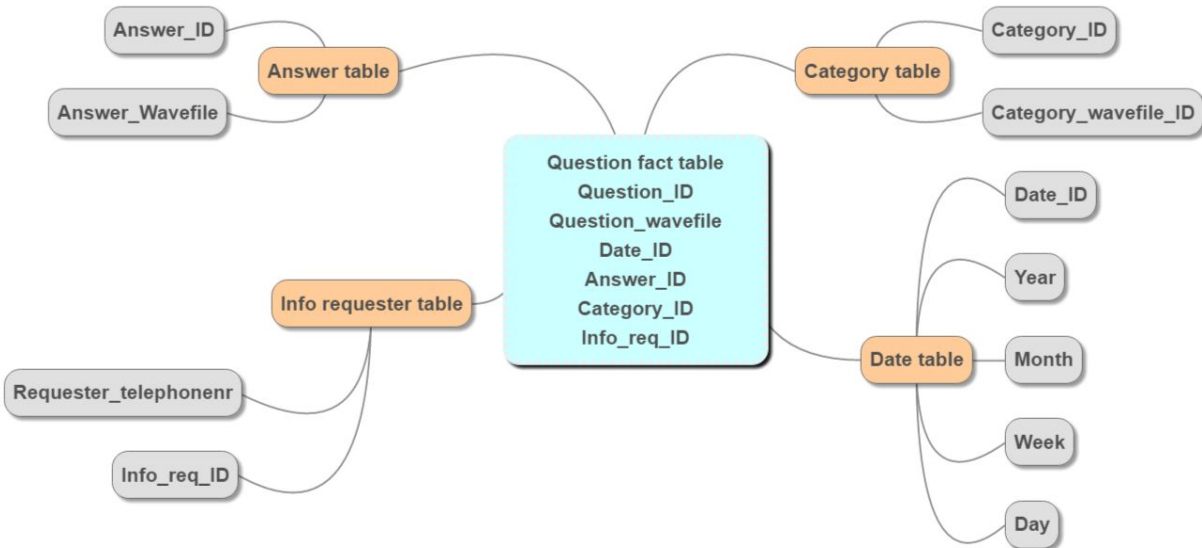
Figure 4: Data model

6. Implementation & usage

The implementation of the applications is described below including the extensions made for this project. Also a usage scenario has been described in order to give insight in how to use the application and who might want to use it.

6.1 Implementation

Besides the virtual machine the application does also work on a physical KasaDaka. It also provides an approach for a web page that provides information and where inter alia recorded wave-files could be found. To install the application for the prototype in the KasaDaka follow the instructions:

1. Start the terminal emulation (Application Menu à Terminal Emulator)
2.   2.1. Type in: **mv KasaDaka/ KasaDaka_backup**
           2.2. Type in: **git clone https://github.com/mattiasbitar/KasaDaka.git**
           2.3. Type in: **sudo /etc/init.d/asterisk restart**
3. The installation is ready, you can call the KasaDaka

The web-page could be found under the map **KasaDaka** -> **www** -> **index.php.**
Under the map **www,** the database tables is also found this tables follows the database model. If it is not possible to open the file without MySQL, try another text-editor (like Notepad++). Open the php-files with any text-editor to see the code and with any web-browser to see the web-page.

Except the expanded functions and categories that have been made in VXML(XML), we have also started to develop a database, using SQL (MySQL), and a web-page using some HTML code and PHP. Now this could work if we use a lampserver (or wampserver for windows). Through this server PHP and MySQL can communicate which makes it possible to save all wave-files in a database and even present them in the web-page, this also means that every wave-files could have a date, own ID and categorized under specific categorizations. Examples of some code for a database table, PHP (for communication), and XML is presented under the appendix. Though it did not work on the Virtual Machine for the KasDaka we still believe it could fully work with a working lamp server and some further code both the PHP code and database this will be more explained under the title *scope and fidelity of the prototype*.

To install MySQL and a lamp server it is supposed to work by follow the following instructions.
In the terminal type in:
1. sudo apt-get install apache2
2. sudo apt-get install mysql-server
3. sudo apt-get install php5 libapache2-mod-php5
4. sudo /etc/init.d/apache2 restart
5. php -r 'echo "\n\nYour PHP installation is working fine.\n\n\n";'

From /var/www it shall be possible to test the PHP but every time we tried to reach or make changes within the **file system** in the virtual machine environment we got an authentication error. However it is possible to try it on a windows (wamp server) this will be explained under evaluation.

6.2 Usage

Below a use scenario has be created in order to illustrate how the application is used. It indicates the options one has to choose for performing a certain action. In this case Adisa the farmer is struggling with the drought and plans on calling the service for information.

Use scenario. Ask question about rainfall.
Adisa is working on his farm. It has not rained for several days now. Every Day he hopes it will rain the next day, since his crops are affected to the drought. He takes his basic mobile phone and dials the number for radio questions & answers. He gets a voice based system asking him to choose between english and french. He chooses english. Next he gets to hear to choose between request information or provide information. He chooses to request information. The voice based system now offers him several categories to choose from. He chooses rainfall and press 1. He asked: "will there be rain in this particular region tomorrow?". He hears questions are broadcasted at 12 and are answered around 15:00. Adisa later checks the clock and sees its 14:59. He quickly turns on the radio and listen to the broadcasting. He hears the answer he wanted and plans his work for tomorrow counting on rain.

7. Scope and fidelity of the prototype

What is fully implemented in the prototype is the voice application, except the recording is still malfunctioning for some reason just when we thought we had solved the problem. It probably is a minor fault. The database table is created and some tables have been inserted values, what we will need for the database is some functions that is we need to create so called procedures that will for example check the dates for the wave-files to be displayed both for the web-page and the voice application, and to insert right data for the tables whenever a new wave-file is recorded (or when an application is made from the web-page). What we focused on what to get an apache (or lamp server) working but this could not be accomplished with the instructions given under the title *implementation*. Try to fix the authentication problem and with another server. When everything is accomplished the web-page or rather the PHP code has to be fixed so it can connects to the server and send data to the database. We would need to use POST-methods in the same way as we tried to do in the PHP-files (see appendix) to send over the data both from the web and voice application. Except the mentioned the voice application is fully working with the old and new features.
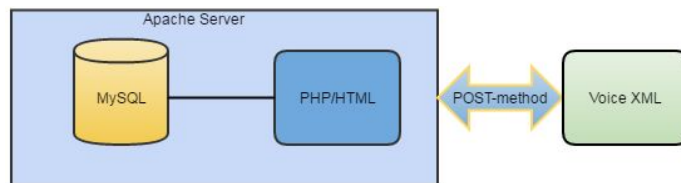

Figure 5: apache server

8 Implementation, deployment and sustainability plan

This chapter elaborates on the implementation, deployment and sustainability plan of this application that serves farmers to share information, regarding agriculture issues, by calling and letting their questions and answers be recorded and broadcasted by the radio station later on. The implementation plan elaborates on how this application will be deployed and transformed into an operational system. The deployment plan focusses more on the deployment of this platform in Mali. The sustainability plan discusses particularly how this system can stay up and running, usage stimulation and the scalability of this application to other rural areas.

8.1 Implementation plan

This chapter, as described above, discuss the general implementation of this application. Before jumping into the details, it is necessary to know who the stakeholders are, what their role is, how can they contribute, who is paying for what and which resources are needed in order to successfully implement this application.

8.1.1 Stakeholders

As discussed above, for a successful implementation of this project an extensive collaboration with the stakeholders is essential. Below, a list of the stakeholders is provided with several essential attributes of it: a) stakeholder in the use-case of Mali, b) general description of the stakeholder in a broader term and its role and c) the type of involvement. The stakeholders in the use-case of Mali is separated from the general description of the stakeholders of this platform to take the sustainability and scalability of this application into account, which will be discussed in the chapters below further in details. The type of involvement is divided in direct and indirect stakeholders as some of the stakeholders are the actors taking direct part in the information exchange.

Table 4: stakeholders

Stakeholder In case of Mali	General description/role	Type of involvement
Farmers (with a question)	Information requester	Direct stakeholder
Radio station	Q&A broadcaster	Direct stakeholder
Farmer (with an answer)	Information provider	Direct stakeholder
NGO's	Budget holders	Indirect stakeholder
Advertisers	Promoters	Indirect stakeholder
Telephone companies	Mobile telecommunication provider	Indirect stakeholder
Government	law and legislations	Indirect stakeholder

8.1.2 Implementation project team

In order to successfully implement this project, a team should be established with a team leader and developers. More important, this team should consist at least one stakeholder per category with a direct involvement property, as presented in the stakeholder table. The structure proposed for the implementation project team is illustrated in the figure below.
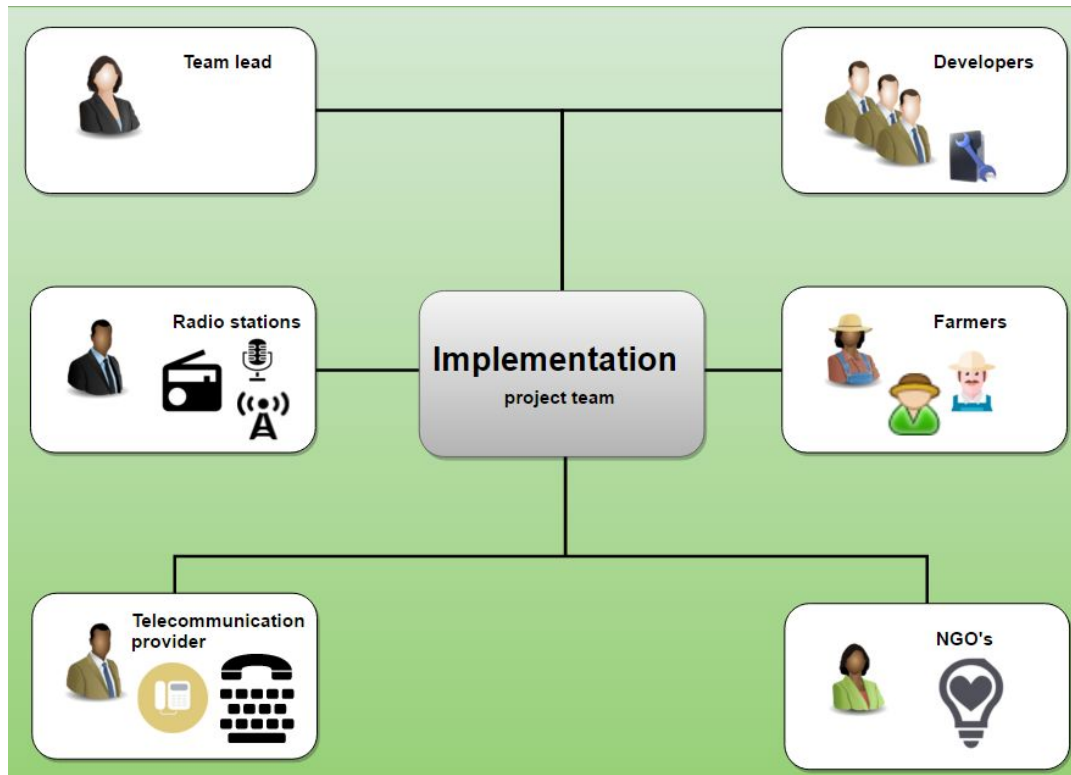
Figure 6: implementation project team

8.1.3 Business model

To keep any application or information platform up and running, the financial aspect, including the costs and payment factors are essential to take into account. In the business model below, a list of various possible scenarios are presented. It is necessary to discuss all these scenarios as a part of the implementation and deployment with the stakeholders. In the next chapters the different phases required for the deployment is discussed in details. During the first phase while conducting awareness workshops, the business model and the different scenarios presented here should be discussed with all the stakeholders in order to decide on the best and most realistic scenario. Before presenting the payment scenarios below a list of the transactional costs expected for this application is presented.

Transactional and maintenance costs
Cost 1: Farmer (information requester) calls the radio station to post a question regarding agriculture.
Cost 2: The radio station broadcasts the questions daily.
Cost 3: Farmers (information provider) calls the radio station to answer a question.
Cost 4: Radio station broadcasts the questions and answers of last day.
Cost 5: the costs for Kasadaka including maintenance of it.

(Possible) income sources

Income 1: telecommunication providers charges money per minute for each call made by the farmers and therefore they are benefiting from this system. In return they should a certain percentage (should be agreed upon during phase 1: awareness workshops).

Income 2: advertisements by promoters could become a part of the broadcasting program and this way they should also pay a certain amount per advertisement (should be agreed upon during phase 1: awareness workshops).

Income 3: NGO's and government provide a certain budget for this application.

Proposed scenarios

Scenario 1: information requester pays the costs (1000 fCFA) for calling a radio station and the broadcasting. Radio station pays the information providers the costs (250 fCFA) for calling to answer a question (see figure below).
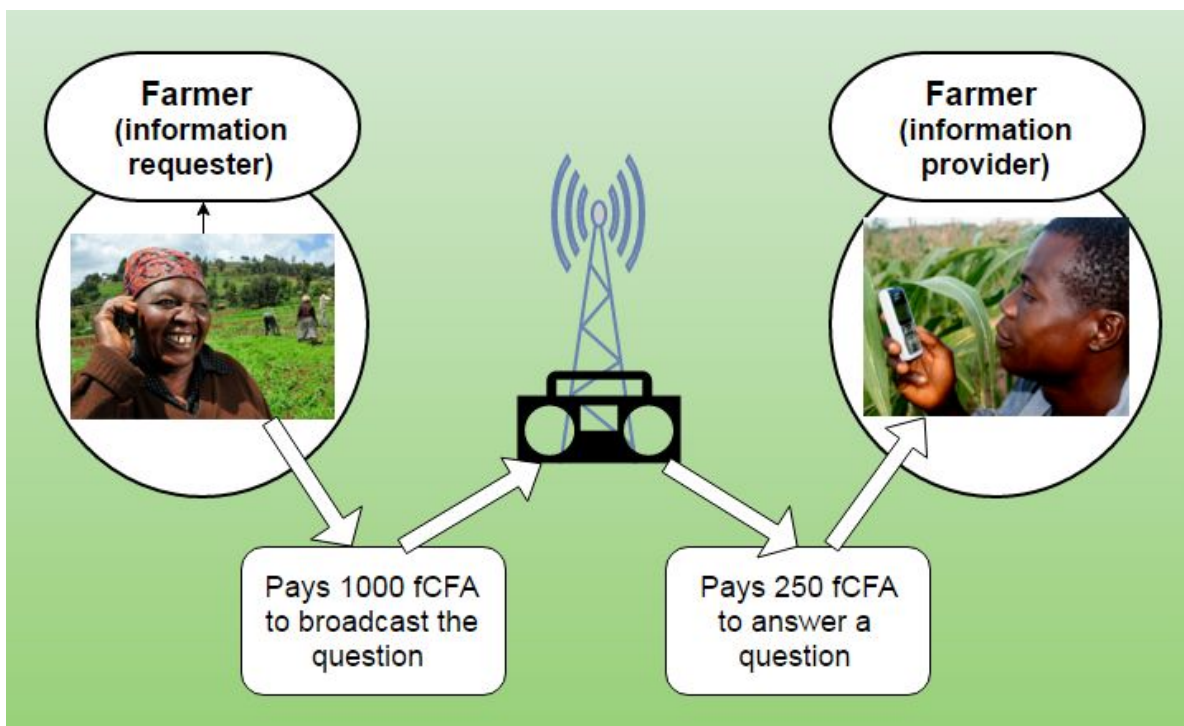

Figure 7: value chain scenario 1

Scenario 2: cost of the information provider is covered by the NGO, costs of calling and broadcasting are covered by information requester.

Scenario 3: All costs are funded by an NGO.

8.2 Deployment & sustainability plan

In order to make sure that the deployment goes as smooth as possible, It is necessary to have a detailed planning including project stakeholders, which activities are planned, what is the duration of it (per activity) and which resources are required. Now that we already know who our stakeholders are (see chapters above) and we have a project team for implementation, we can

identify the phases and timeliness of deployment in Mali. The project timeline presented in this chapter is best on an estimation. Also based on the availability of the implementation project team members can the starting point differ in practice, but the timeliness in terms of duration should stay as described below.
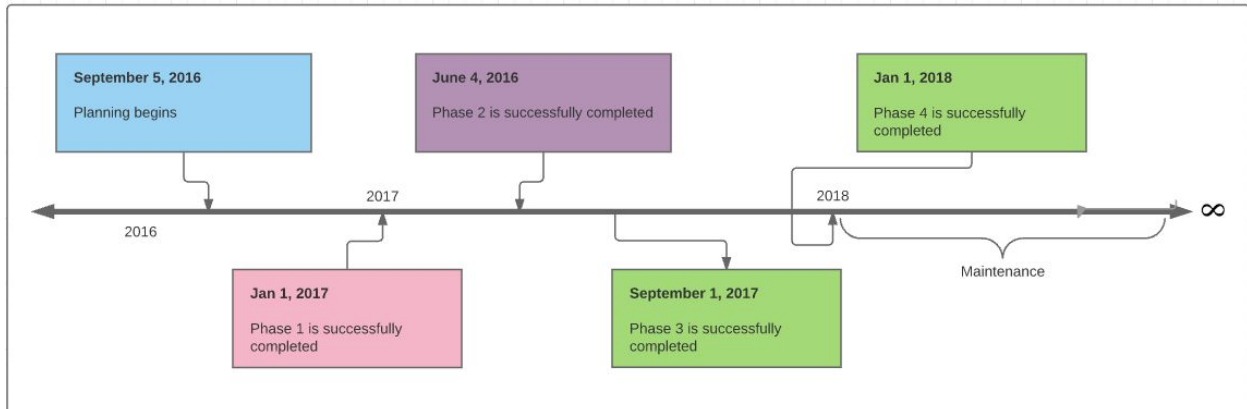

Figure 8 : timeliness deployment Mali

Phase 1 – POC and PID: this phase focuses on awareness workshops for the stakeholders and should deliver a proof of concept at the end. All processes and procedures, agreements on who pays what and other practical issues should be solved and agreed upon in this phase by all stakeholders. Finishing this phase successful is a pre requirement for starting the next phases. Main deliverables are: a) POC (proof of concept) and b) PID (Project Initiation Document).

Phase 2 - Testing & rollout: as soon phase 1 is successfully implemented and has resulted in a proof of concept and project initiation document including all processes and agreements between stakeholders, phase 2 can start. The rollout of the application and transformation of the prototype to an operational and productive system is what this phase aims. During this phase, the application should be tested by involving all actors/direct stakeholders.

Phase 3 – Training & feedback: training the users and trying to find out what can be improved in order to make the application more suitable for its target group, in these phase some sessions with the end-users are required.

Phase 4 – Evaluation & aftercare: as this application is already rolled out in the prior phases and it is being used, it is necessary to evaluate the usage and existing issues. Solving the issues after go-live and monitoring the usage of the application is the main goal of this phase.

9. Evaluation

The application works relatively good for being a prototype, of course it needs further work and it still needs some perfections. If we compare the English versus the French in the voice

application we would hear that the French has a more clear voice, and sometimes especially with the English voice it hacks or stumbles so that the words don't come out. The French language is thru the google translate text-to-speech but have been converted to 800Hz wav files, maybe that is something to go with? With further development it should be possible to have a fully operational radio question and answer for agricultural application. The problem as mentioned before is with the apache. If this as we think will in someway not work or collide with the KasaDaka apache it could be possible to have it locally on a windows based operating system and use a wamp server (but with right experience with linux it should work there too), and then send the wav-file thru POST to the local server. Except this and the hassle with the recording the prototype works rather good.

10. Discussion

While designing, developing and prototyping any information system, there are most probably some limitations and interesting findings to point out. Also during developing this application, the project team faced some limitations and had some interesting findings. Mainly these findings and limitations are categorized into the following aspects: a) technical limitations, b) distance limitations and c) language limitations.

In the design phase of this application, the platform was designed to be enriched with the functionality to send sms alerts to the farmers as soon as their questions were answered. Finding out, after the Mali trip, that this functionality is not something that the farmers can really use in Mali was an interesting finding for the project team The reason behind this is that most of the farmers can not read. Therefore, the project team decided to stay with the broadcasting functionality which is supposed to be performed by the radio by broadcasting the questions and answers during a Q&A program.

Recording the voice messages as designed on a server, was one of the major technical limitations that the project group faced during the developments.

Even though, the project team did get a short feedback from the stakeholders in Mali, it wasn't comprehensive enough. By having more sessions with the stakeholders during the prototyping process, the developers could get more insight in what even more realistic solutions could be. A good example of this is the functionality for which the project team designed a functionality to for sending the farmers (information requesters) an sms alert to let them know that their question is answered. From the feedback they got from Mali, they learned to know that this functionality is not that much preffered there as most of the farmers can not read. If the project team had more opportunity to meet with the stakeholders, they could have added more suitable functionalities. As any other ICT project for development, also this project faced these kind of distance limitations.

While using the application, the farmers can let their questions be recorded in any language that they want. The project team aimed to add a local language to the final prototype, but due to the language limitation, as no member of the project could speak the local African languages, this part couldn't be done for now.

11. Conclusions and Future work

The final projected is reviewed and concluded. The parts that are working and are implemented are discussed together with parts that still could be implemented as future work.

11.1 Conclusion

The project offers two different languages, english and french. The Mali feedback indicated that the service is indeed useful and beneficial for them to use and are willen to pay for it. Also the service provides different categories to choose from. The feedback indicated that rainfall, harvesting, seed planting, animal health and calendre de pluvio are subjects which are the most interesting. These are indeed categories available in the project.

Even Though the application could be more developed, it promises a great opportunity for those in rural regions to improve their lifestyle since information sharing is something they actually want and need.(see more in future works)

The exact costs of the project such as how much the service cost in order to ask a question is still discussable since interviews need to be conducted in order to establish how much people want to spend on the service. Furthermore the application is promising and people in Mali are certainly interested in it.

11.2 Future work

For future work more languages could be implemented. The best solution would be using the languages that are more used in rural regions instead of large languages such as french. This is only something that is difficult to achieve. Some library should be made where words from a different language are pronounced as it should be to implement in the voice based system. It has been stated that during the lectures that people are more willing the listen to a service where they recognize their own accent.

Another extension to the project could be farmers calling the service again to confirm the solution to their question worked. Or this could be written in some kind of forum to a webpage. Giving motivation to other user to actually call the service.

The project is now focussed on categorizing in different topics, but it can also be categorized in different regions. Before a caller ask the question, he can choose in which region he wants the answer to, for instance the rainfall is different in each regions. Making it region dependable.

Except the voice application the database(MySQL) and web-page (PHP/HTML) should be further developed. Under the topics 6. *Implementation, 7. Scope and fidelity of the prototype* and 9. *Evaluation* this issues are pointed out. So in summary what is needed is: the PHP-code

for POST-method "saving" shall not hassle, Database Procedures, Apache server shall be working on KasaDaka and the web-page completed (mostly page-3), this was not continued when the apache did not work, lack of time and much time spended on fixing it and other issues.

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Appendix

This picture represent MySQL code for creating a table with the same values as shown in the data model. Here a table is created where values could be inserted that is the ground for the whole database. The rest of the code could be found in the file RadioQueAns Table in the map www under the KasaDaka..

```sql
CREATE TABLE QuestionFactTable(
    Question_ID INTEGER NOT NULL AUTO_INCREMENT,
    Question_Wavefile VARCHAR(50),
    Date_ID INTEGER,
    Answer_ID INTEGER,
    Category_ID INTEGER,
    Info_req_ID INTEGER,
    PRIMARY KEY (Question_ID),
    FOREIGN KEY (Answer_ID) REFERENCES AnswerTable(Answer_ID),
    FOREIGN KEY (Date_ID) REFERENCES DataTable(Date_ID),
    FOREIGN KEY (Category_ID) REFERENCES CategoryTable(Category_ID),
    FOREIGN KEY (Info_req_ID) REFERENCES InfoRequesterTable(Info_req_ID)
);

CREATE TABLE AnswerTable(
    Answer_ID INTEGER NOT NULL AUTO_INCREMENT,
    Answer_Wavefile VARCHAR(50)
);
```

This is PHP-code from the web-page that establish a connection with the server, for our case the localhost where we have the server. The rest of the code could be found in the PHP-file page.2 in the map www under KasaDaka.

```php
<?php
$servername = "localhost";
$username = "root";
$password = "";
$dbname = "RadioQueAns";

// Create connection
$conn = new mysqli($servername, $username, $password, $dbname);
// Check connection
if ($conn->connect_error) {
    die("Connection failed: " . $conn->connect_error);
}
```

For the XML files it is the same kind of code that is used in the previous assignment but two functions has been added the listen to answers choice and the provide general information. See Pic ----->

```xml
52
53    <elseif cond="question1 == '3'" />
54      <prompt>
55      <audio src="listenchoice.wav"/>
56      </prompt>
57    <goto next="listen.xml"/>
58
59
60    <elseif cond="question1 == '4'" />
61      <prompt>
62      <audio src="provideinfo.wav"/>
63      </prompt>
64    <goto next="provideinfo.xml"/>
65
66
```

24

We have also included two more categories to choose betwee.