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LIST OF ACRONYMS

ASR	Automatic Speech Recognition
CSS	Cascading Style Sheets
DAO	Data Access Objects
DBMS	Database Management System
FTP	File Transfer Protocol
GSM	Global System for Mobile Communications
GUI	Graphical User Interface
HTML	Hyper Text Markup Language
JSON	Javascript Object Notation
MIS	Market Information System
NGO	Non-Governmental Organization
ORTM	Office Radio Télévision du Mali
S&F	Slot and Filler
SIP	Session Initiation Protocol
SIM	Subscriber Identity Module
SMS	Short Message Service
TTS	Text to Speech
UML	Unified Modelling Language
URI	Uniform Resource Identifier
VXML	Voice Extensible Markup Language
WP	Work Package
XML	Extensible Markup Language

PREFACE AND SUMMARY

This VOICES deliverable 5.3 reports on the results of the second cycle of the WP5 m-Agro Knowledge Sharing pilot, which is deployed in Mali.

This report follows up on the VOICES deliverables D1.1, D5.1 and D5.2. In D1.1 a discussion of sixteen use cases is given, based on extensive use case and requirements analysis in the rural context in Mali. Two use cases have been selected for the pilot systems. The first use case was a local trading system, which resulted in a voice-web based system that was nicknamed Radio Marché. The second use case was on communication with rural communities. This resulted in the design of a voice-web based system, Tabale .

In D5.1 we presented the first version of the technical design of the Radio Marché system, as the first cycle 1 the m-agro pilot. In D5.2 the technical design of Radio Marché was given, and its implementation in the production environment in Mali. The first phase of user requirements validation and verification is described.

This document is structured in the following parts:

In part I we summarize the second use case for a mobile event organizer, and its requirements.

In part II we provide the technical specifications and the design of the Tabale system, which is basically a mobile/web “event organizer” that sends group voice messages out and collects messages back.

Part III looks at the pilot from the end-user’s perspective. The web and phone interfaces for the Tabale system are described. Field tests and results are presented for the systems Radio Marché and Tabale. The feedback from the users is summarized. In the annexes the questionnaires for user evaluation are presented and a mock-up for a logging system.

PART I: USE CASE SCENARIO FOR M-AGRO PILOT

This first part contains the description of the use case that has been selected for the m-agro Knowledge Sharing pilot. The first use case that was based on an existing trading system, “improving trade of shea butter and honey” has been described in detail in Deliverable 5.2. and this has also been published [1]. The second use case, “m-event organizer” is part of cycle 2 of the pilot, and is described in the following chapters.

1. Introduction to the use case and requirements analysis

In this chapter we describe the methodology that was applied for developing, testing and deploying the pilot, which is based on Living Labs [2] principles. Living Labs (LL) are experimentation and validation environments of ICT-based innovation activities, characterized by early involvement of user communities, openness, co-creation and rapid learning cycles accelerating the innovation process.

a) Living Labs

Living Labs (LL), refers to a user-centred, open-innovation ecosystem [3]. It integrates concurrent research and innovation processes [4] Wikipedia describes it as follows: *"The concept is based on a systematic user co-creation approach integrating research and innovation processes, through the co-creation, exploration, experimentation and evaluation of innovative ideas, scenarios, concepts and related technological artefacts in real life use cases. Living Lab approach involves user communities, as a source of creation. This approach allows all involved stakeholders to concurrently consider both the global performance of a product or service and its potential adoption by users. This consideration may be made at the earlier stage of research and development and through all elements of the product life-cycle, from design up to recycling..."*[5]

The pilot was informed by extensive field research. First, we employed a strategy of explicitly analyzing the local situation in the rural Malian context, and identifying use cases. In the next steps ICTs were introduced, starting from the existing workflows. Intermediate results were analyzed with respect to effectiveness and local acceptance. The results of each cycle, determined the content of the next development-test cycle. By employing this iterative methodology rather than deploying a single end-application at once, we aimed to promote local ownership and ensure that we understand local requirements.

Our approach is visualized in Figure 1 as a problem stack, where we started from the big generic question of re-greening in Africa and knowledge sharing for re-greening (for more about this topic see e.g. [6] and [7]). Next, we narrowed down the study area in several cycles of subsequent and recurring use case elicitation, co-creation, development, user verification and validation, and adjustments.

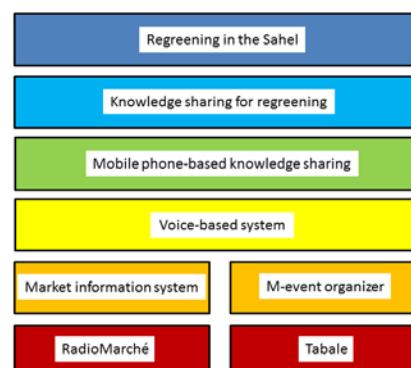


Figure 1: The problem stack of the m-agro knowledge sharing pilot.

In this co-creation environment the definition of the problem and the (ICT) solution were developed in cooperation with the end-users. This was done during informal workshops and

focus group discussions, brainstorm sessions, interviews, storyboarding and scenarios, involving all stakeholders. The stakeholders are local community radios and ICT entrepreneurs, rural extension workers and small-holder farmers. Several field trips were organized to rural regions in the Sahel. Radio stations were visited and farmers were interviewed in the field.

This was all carried out locally by this multi-disciplinary, multi-cultural team. The iterations coincided with our several field trips [8], as summarized chronologically in Figure 2. In the next sections, we will give detailed descriptions of the use case and requirements analysis, the system design and the test phases.

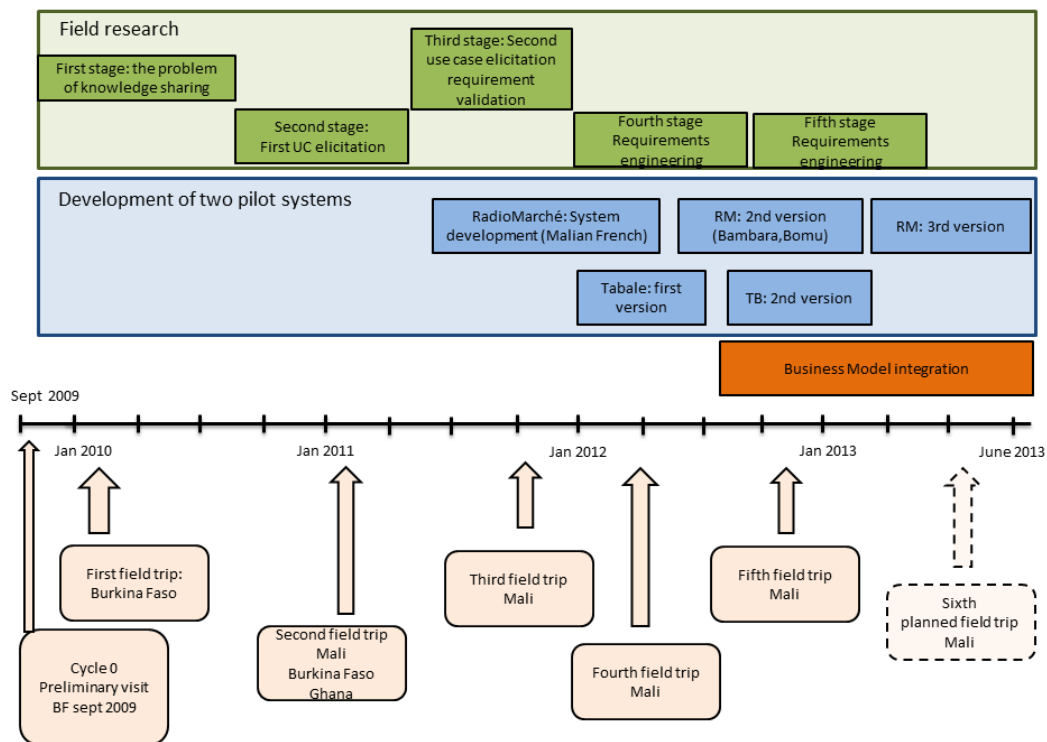


Figure 2: This visualizes several cycles of use case and requirements analysis and spiral, iterative development. The cycles coincide with several visits to the Sahel region. The visits started more than a year before the kick-off of the VOICES project.

2. Use case m-event organizer for regreening

In this chapter the m-event organizer use case is described. As a starting point we took the request of Sahel Eco for a system that can to improve communication with their stakeholders, the farmers in the field. For use case elicitation, we used semi-technical diagrams, pictures and storyboards. This facilitates communication among developers and users about the specific requirements.

a) Starting point:

Sahel Eco organizes events and workshops to create awareness about regreening, farmer to farmer visits etc. Sahel Eco sometimes finds difficulty in informing people about when the events take place. This goes often through word of mouth. The farmers that are invited only have mobile phones, but do not have email. They speak different languages: some speak French, others only Bambara or Bomu.

b) Envisaged situation *

A registered number of farmers in a certain region (e.g. Tominian area, Mali) receives an automated phone call letting them know the time and place of a regreening event. The “call for regreening event” is issued by Sahel Eco. Farmers can phone back and retrieve the info-message asynchronously. The message is (optionally) issued in several languages.

A staff member from Sahel Eco prepares a voice message telling about the event and a list of farmers, including their phone numbers. The Sahel Eco member then issues the voice message. All farmers who are on the list receive a phone-call with the message. They can listen to the message again, and leave a message. They can phone later to this phone number to retrieve the message again.

Actors and goals

Actors	Operational goals
Sahel Eco (or any other NGO or local organization)	Organize group events with farmers related to regreening
Farmers (or other stakeholders without email)	Attend the group events organized by Sahel Eco; meet other farmers and learn about regreening.

* This section describes the use case as defined originally in 2010, during the first cycle of requirement analysis. The design was adjusted in several following cycles, and is therefore slightly different from the original “envisaged situation”.

Summary of key requirements for Tabale

Functional requirements

- System has a web interface for admin or webmaster (Sahel Eco)
- Web interface allows to add/update/delete users, user profiles
- User profiles include names, phone numbers and preferred language
- System allows to enter (record) voice messages (audio)
- System allows to create an event
- An event has a date, time, associated audio file in one or more languages, to one or more invited users.
- Dialogue system (prompt) is in place to phone in and retrieve message;
- The message is issued in a default language and in a second language;
- French, Bambara, Bomu support

Non-functional requirements

- The phone prompt in the message should sound familiar (speak local dialect);

Scope and context of the system

a. In Figure 3 a simplified network configuration for the m-event organizer is given. A micro-server has both Internet access and mobile access. The m-event organizing person (e.g. the Sahel Eco Webmaster) creates a message for the gathering of farmers for a Regreening event. She creates a user-list of farmers and their mobile phone numbers. The message is then issued to the users. Users can phone back later to hear the message again.

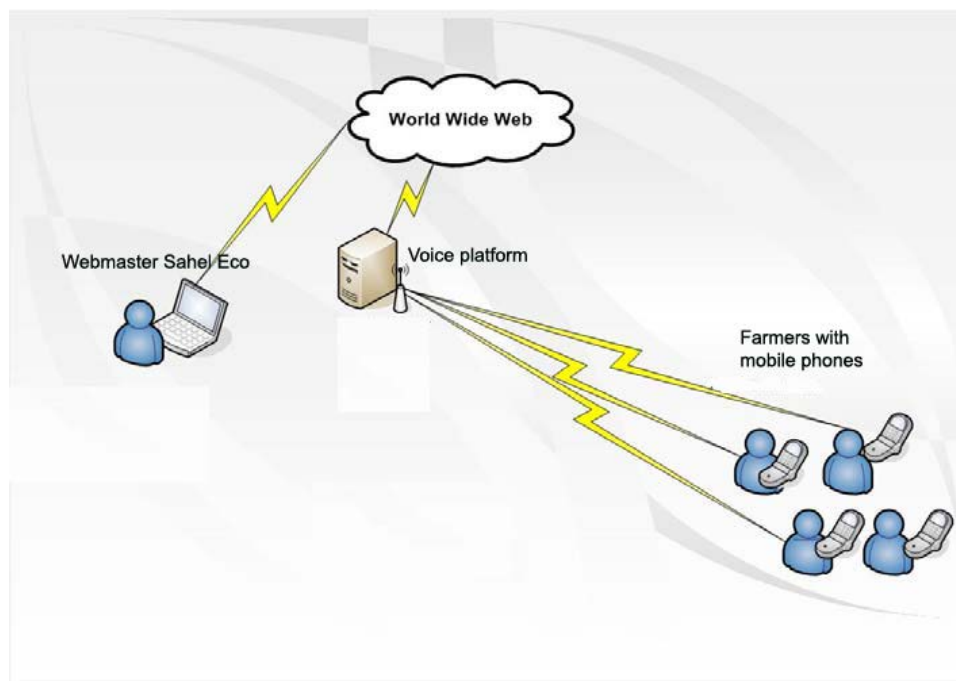


Figure 3: Layout sketch of user/system interaction for the Tabale system

b. Scope, system boundary

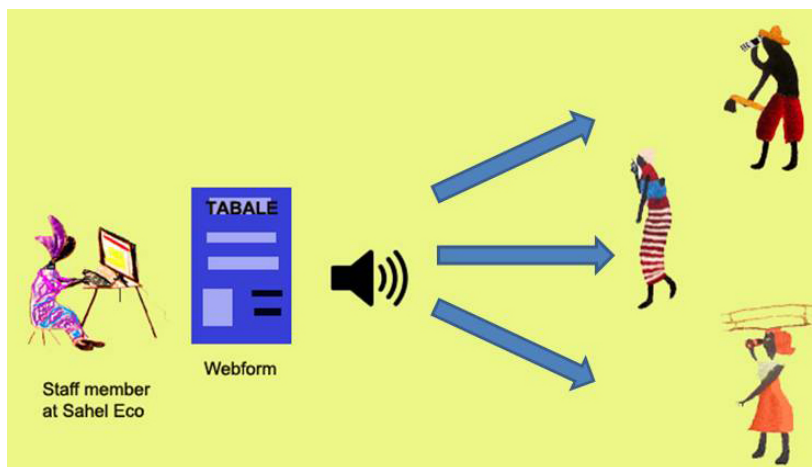


Figure 4: Scope and boundary of Tabale System

The scope of the system is a web-based environment with both internet, web text-based and mobile, voice-based interaction. In this particular use case it is a pilot for Sahel Eco to create a channel to communicate with its community of re-greening farmers through mobile phone.

c. Stakeholders and concerns

Stakeholders: Sahel Eco (staff and extension workers) and farmers, other participants of SE events.

Concerns: reach the people with a message they can understand. Be able to change the message easily.

d. Preconditions

- ☐ System allows phone access and has a reliable internet connection, reliable power supply.
- ☐ Local phone lines are used, to avoid expensive international calls.
- ☐ Good system maintenance (hardware & software maintenance, data backup, APS, emergency power supply, end-user support, high uptime (>99%).

Storyboard in ten steps

How to organize a regreening event:



Sahel Eco is organizing a meeting on Wednesday 20th of July in Tominian for farmers about regreening. Sahel Eco has a list of 25 farmers and their phone-numbers. A number of these farmers don't speak French, only Bomu. Sahel Eco can make 25 phone calls or issue a Tabale Message instead. How does this work?



Aisha, staff member at Sahel Eco is going to use the m-event system.

Step1: Access Tabale application

- Aisha opens the Tabele webform
- (Her computer has a soundcard and a microphone and sound recording software)

Step2: Enter users

Aisha is prompted by the system to enter

Users, phone-numbers, preferred languages for the people that will receive her voice message...

Step 3: Aisha enters user-list:

- Moussa Sangara, 23345565, Bambara
- Sidonie Mounkoro, 23268638, Bambara
- Jean-Batiste Dembele, 23566254, French
- ###

Step 4: Aisha creates an event and enters voice message

- <<How many languages do you want to enter?>>
- 2
- <<Now enter your voice message in the microphone of your computer>>

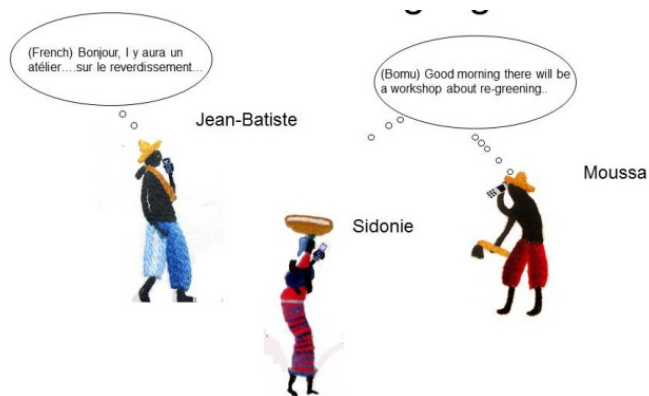
Aisha records message after the beep, press # to finish:

- "Bonjour, il y aura un atelier pour vous informer sur le reverdissement du Sahel, le mercredi, 20 juillet à 20 heures, dans le bureau de Sahel Eco, à Tominian."
- Enter the same message in the second language, press # after you finish
- "....."

Step 5: Aisha issues the mobile message

- Press <launch event> button to send the voice message to the phone-list
- "Your message has been sent successfully!"

Step 6: farmers receive message in their own language



The system asks them:

- "Will you attend the meeting, please press 1"
 - "Are you not attending the meeting, please press 2"
 - "If you don't know if you can attend, please press 3"
 - "Leave your message after the beep..."
- ..and the system logs this..
- Moussa – message delivered 12:30:45
 - Sidonie – message delivered 12:30:45
 - Jean-Batiste – <<phone switched off, message will be sent again in 6 hours>>

Step 7: User retrieves the message, later

Now Fatoumata calls to this Sahel Eco phone-number to hear the message as well. She was not on the user-list, but heard from Sidonie who gave her the phone number to call.



Fatoumata is calling the Tabale system

Step 8: Language selection

- The system receives Fatoumata's phone call and records her phone-number in the user list.
- Fatoumata's call is answered by the system
- "parlez-vous Bambara?" appuyez sur le 1"
- "parlez-vous Français?, appuyez sur le 2"

Step 9: Fatoumata's user profile is created

- Fatoumata hears the message in Bambara

- “there will be a regreening event, etc.
- Leave your message after the beep...
- Fatoumata's message is recorded:
- “My name is Fatoumata Traore from Finfini village. I will be at the workshop...”

Step10: Aisha, the webmaster of Sahel Eco accesses the system, next day

- Finds the new user Fatoumata,
- Her phone-number
- The time when she called
- Her language
- Her voice message in an audio file
- Aisha will also look at the user list
- To see who else has been reached by the message

PART II: M-AGRO PILOT TECHNICAL DESIGN SPECIFICATIONS

Part II discusses the technical design specifications of the system for the VOICES WP5 pilot cycle 2, following the UML modelling language and the "4+1 view" model of system architecture.

1. Design

In this chapter the design of Tabale is described following the UML modeling language and the "4+1 view" model of system architecture. After the first phase of use case and requirements analysis, the design of the system was made. This system was named Tabale[†], as proposed by our Malian partners.

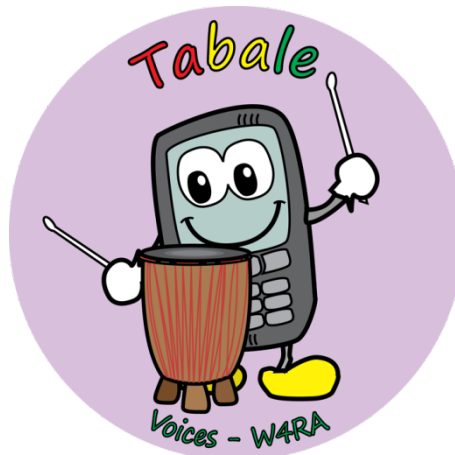


Figure 4: The logo of the Tabale system.

For describing the specifications of the Tabale system, we use the Unified Modelling Language (UML). UML can be used in three ways:

- UML as a sketch: Use UML to make brief sketches to convey key points. These are throwaway sketches they could be written on a whiteboard.
- UML as a blueprint: Provide a detailed specification of a system with UML diagrams. These diagrams would not be disposable but would be generated with a UML tool. This approach is generally associated with software systems and usually involves using forward and reverse engineering to keep the model synchronized with the code.
- UML as a programming language: This goes directly from a UML model to executable code (not just portions of the code as with forward engineering), meaning that every aspect of the system is modelled. Theoretically, the models can be kept indefinitely and use transformations and code generation to deploy to different environments. In this document we use UML as a sketch and as a blueprint. In particular we use the Kruchten's 4+1 architectural views model (1999[‡]) to provide different views capturing specific aspects of the pilot system.

[†] Tabale is the king's drum. When there is an emergency or an important event or meeting the messenger goes from village to village by horse and beats the drum, to gather people from all the villages.

[‡] 1. Philippe Kruchten's publication on 4+1 View Approach, www.win.tue.nl/~mchaudro/sa2004/Kruchten4+1.pdf

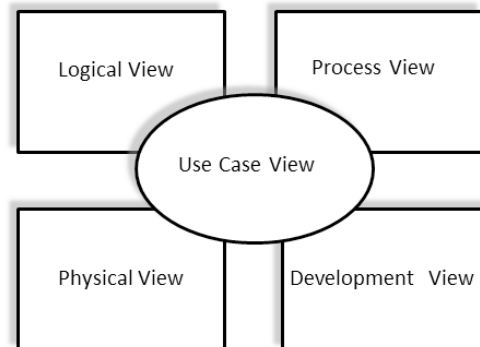


Figure 5: The 4+1 architectural views model

a) Use case view (requirements)

Starting with the use case and requirements, Tabale provides functionality to three actors, (i) an NGO webmaster, this is currently an employee from Sahel Eco,(ii) the farmer, who will receive the message, give a reaction (will attend meeting yes/no/does not know yet) and who can call back and retrieve the message at a later time(iii) the person who provides technical support of the system. Each actor needs the following functionality:

ID	Actor	Description
1	NGO	Manage users and user profiles (add new/update/delete users)
2	NGO	Record audio in several languages (French, Bambara, Bomu)
3	NGO	Create an event (add begin and end date, add users, add message)
4	NGO	Manage events (add new/update/delete)
5	NGO	Monitor incoming calls
5	NGO	Launch an event
6	Farmer	Receive phone message communicating event
7	Farmer	Respond to the message pressing DTMF
8	Farmer	Leave message
9	Farmer	Call Tabale phone number to retrieve message about event
10	Support	Monitor system; maintenance

Combining requirements, we can draw the following use case diagram:

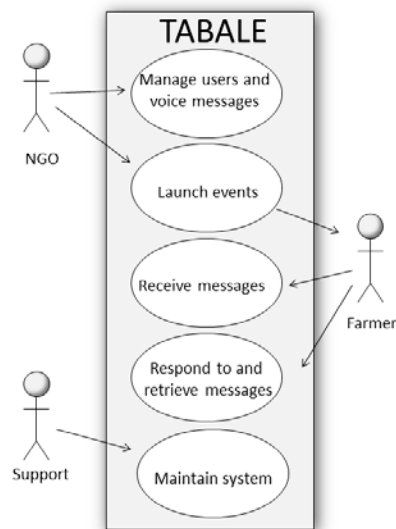


Figure 6: UML Use case diagram for Tabale system

b) Process view

A process view describes the processes within a system, and visualizes what occurs within the system. Whereas use cases show what the system should do, activity diagrams specify how the system will accomplish its goals. The activity diagram in Figure 7 shows high-level actions chained together to represent the processes occurring in our system. The two main actors (NGO and farmer) perform the following activities:

NGO (operator) has the following tasks:

1. Add new users (name, phone number, language(s); Add events: add new event (enter title of the event, venue, start date, end date, add users as participants, enter one or more voice messages in French, Bambara, Bomu);
2. Manage events (update, delete events, evaluate user feedback yes/no/don't know);
3. Launch events;
4. Monitor received calls;
5. update/delete users;
6. update/delete events

Farmer has the following tasks:

7. Receive messages of event;
8. Respond yes/no/don't know by pressing DTMF 1-2-3;
9. Leave message;
10. Confirm user profile;
11. Call Tabale number to retrieve latest event message

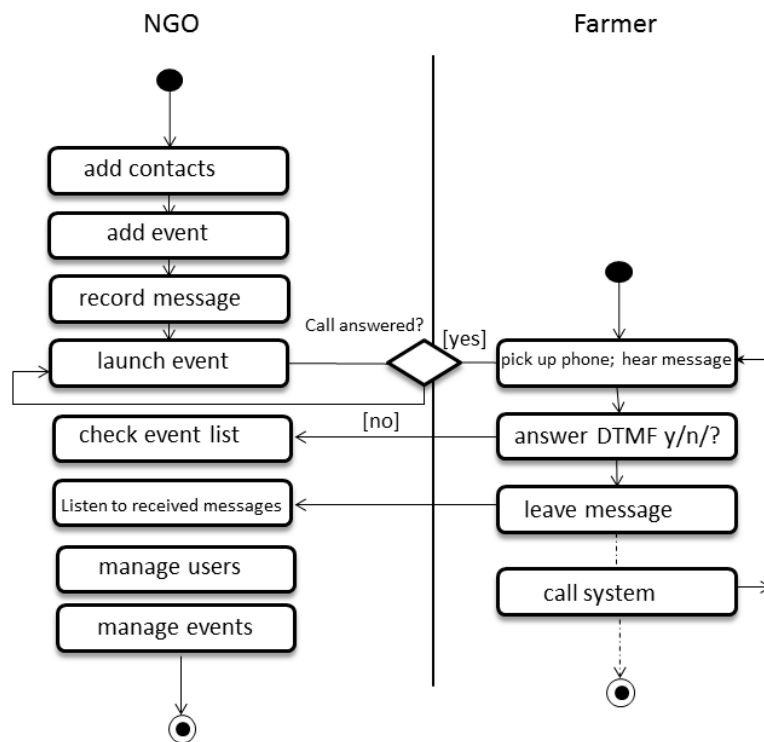


Figure 7: UML Activity diagram for the Tabale system

c) Logical view

The logical view describes the abstract descriptions of the system's parts, and is used to model what a system is made up of and how the parts interact with each other.

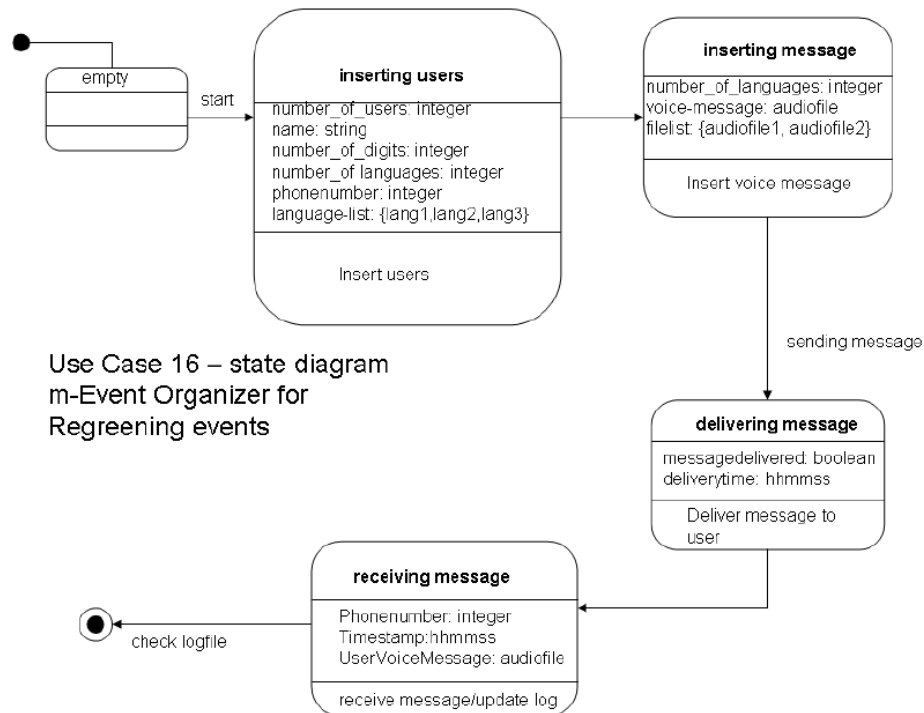


Figure 8: UML State diagram for Tabale system

Information model. For Tabale the information model, which is used for the design of the databases within the system is composed of four parts:

- User profiles (name, phone number, language)
- Events (title, starting date, end date, users, language_id, audio messages)
- Prompts: Pre-recorded fragments/frame samples of human voices, represented by the objects: Voice, Language, Language Frame, Wavfile
- Audio messages: Speech Frame, Audio File, language.

d) Development view

The development view describes how the system's parts are organized into modules and components. It is useful to manage layers within your system's architecture. This view typically contains package and component diagrams (Figure 9).

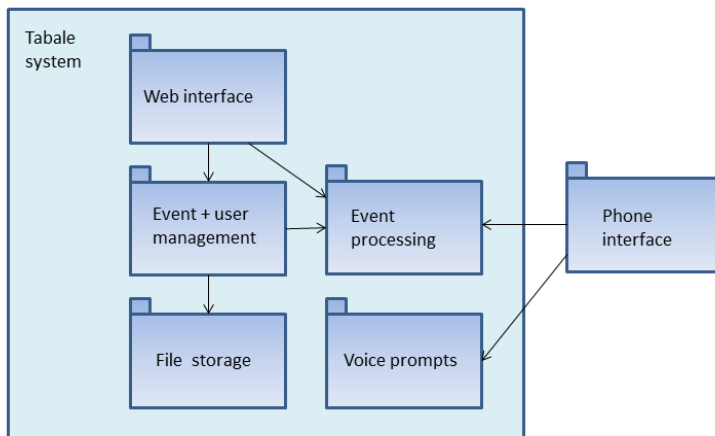


Figure 9: Development view showing packages for the Tabale system.

The Tabale system is composed of five packages:

- Web interface: to manage flow of GUI interaction with the end users
- Event and user management: user and event information and audio recordings
- File storage: database contains event and user information and audio recordings
- Event processing: launch events, stream audio, delegate audio transport to phone interface
- Voice prompts: phone interface for incoming calls

e) Physical view

A deployment diagram in the Unified Modelling Language models the physical deployment of artefacts (software components) on nodes (hardware devices).

The nodes appear as boxes, and the artefacts allocated to each node appear as rectangles within the boxes. In Figure 10 the device nodes are depicted for the Tabale system as well as the execution environment nodes, which are the browser, the voice platform, the gateway to the phone network, and the mobile phone voice and DTMF interfaces.

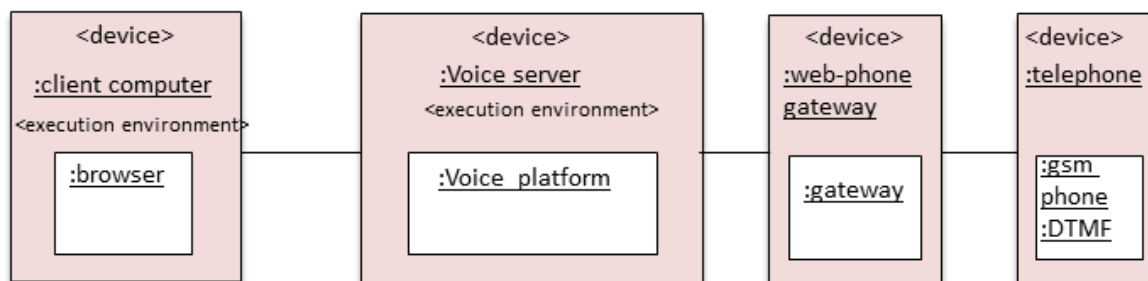


Figure 10: Physical view showing the artefacts and nodes of the Tabale system

PART III: M-AGRO PILOT USER/STAKEHOLDER CONTENT

This part discusses the user/stakeholder-oriented content and context background related to cycle 2 of the m-agro knowledge sharing pilot: the Tabale use case or m-event organizer for regreening.

In the first chapter the interfaces for web and phone are described. The screens of the web interface and phone call flow are presented. In the second chapter test plans are given for the two systems. The third chapter presents user evaluation.

1. User interfaces

In this chapter we describe the deployment of the Tabale system from the end-user's perspective. The user interfaces are described for web and phone communication.


From the user's perspective Tabale has two different interfaces: one web interface for entering data by the NGO, and one phone (voice) interface for the farmers who (passively) receive the messages by phone or (actively) make a phone call to the system to retrieve the latest message.

a) Web interface

The Tabale web interface is designed according to the description of the selected use case, and the remarks from the NGO end-user. Tabale's web interface consists of five screens: add a new contact (user), add a new event, list of contacts, list of events, list of received calls. At the moment of writing, no security has been implemented yet. In the next version of Tabale, access to the web page will be for registered users only, with username/password authentication.

Tabale

[Français](#) [English](#)



The screenshot displays the 'Ajouter un nouveau contact' (Add new contact) page of the Tabale web interface. At the top, there is a navigation bar with five tabs: 'Liste des événements', 'Contacts', 'Liste des appels', 'Ajouter un événement', and 'Ajouter un contact'. The 'Ajouter un contact' tab is currently selected. Below the navigation bar, the main content area is titled 'Ajouter un nouveau contact'. It contains three input fields: 'Nom:' (Name), 'Numéro de téléphone:' (Phone number), and 'Langues:' (Languages). The 'Langues:' field has five checkboxes: 'Anglais', 'Français', 'Bambara', 'Bomu', and 'Dogon'. At the bottom of the form, there is a green button labeled 'Ajouter le contact'.

Fig 11: Screen for adding new contact, name, phone number and selected languages.

Sahel Eco holds a list of contacts, being the people they often invite to participate in events. The names of these contacts and related data are stored in the Tabale system (in a database), so they need to be entered into the system only once. A contact can be removed or changed.

Ajouter un événement

Titre:

Lieu:

Date de début:

Date de fin:

Participants:

Langues:

Sélectionnez les langues utilisées pour l'événement, et enregistrez un message pour chacune d'entre elles.

☐ Anglais

☐ Français

☐ Bambara

☐ Bomu

☐ Dogon

Figure 12: Screen to add an event (title_of_event, venue_of_event, starting_date, ending_date, user, audio_message) and record a message in a selected language.

In this screen Sahel Eco can create a new event. Each event has a title, a venue start date and end date. From this screen the user (Sahel Eco) can record the message in one of the following languages. The system prompts the user to enter the voice message and will save this as an audio file (.wav).

The participants can be selected from the list of contacts. When all fields are filled in, the user creates the event. This will appear in the "list of events" screen.

projects.emerginov.org/VOICES_VMEETUP/

Tabale

[Français](#) [English](#)

Liste des événements Contacts Liste des appels Ajouter un événement Ajouter un contact

List of Contacts

Cliquez sur un nom ou un numéro de téléphone pour le modifier

<input type="checkbox"/>	Nom	Numéro de téléphone	Langues parlées	Liste des événements
<input type="checkbox"/>	steph	+33673848727	Français	
<input type="checkbox"/>	Max (SIP)	max.froumentin@emerginov.org	Français	
<input type="checkbox"/>	mary	+22374158436	Anglais Français Bambara	
<input type="checkbox"/>	Aman	+22372060817	Anglais	
<input type="checkbox"/>	steph_mali	+22374409276	Français	
<input type="checkbox"/>	steph_bamb	+33673848727	Bambara	
<input type="checkbox"/>	Anna_anglais	+31205989074	Anglais	En anglais
<input type="checkbox"/>	Anna_français	sip:anna_bon@getonsip.com	Français	Une visite à Radio Segou En Anglais et Français

Figure 13: List of contacts and their attributes. A contact is a person that receives notifications of an event organized by Sahel Eco. Sahel Eco knows the contact's phone number and his or her preferred language.

projects.emerginov.org/VOICES_VMEETUP/

Tabale

[Français](#) [English](#)

Liste des événements Contacts Liste des appels Ajouter un événement Ajouter un contact

Liste des événements

Cliquez sur n'importe quel champ pour le changer.
Pour appeler le système et laisser un message, composez le +22344970003

Pour mettre à jour l'état des inscriptions, rechargez la page.

<input type="checkbox"/>	Titre	Date de début	Date de fin	Lieu	Langues	Participants	Annonces
<input type="checkbox"/>	Une visite à Radio Segou	12/11/2012 00:00	12/11/2012 05:31	Segou	<input type="button" value="afficher ou modifier"/>	Total: 2 Viennent: 0 Ne viennent pas: 0 Pas sûrs: 2 <input type="button" value="afficher / modifier / appeler"/>	Français
<input type="checkbox"/>	Testing Event	09/01/2013 00:00	25/01/2013 00:00	Event for testing the service	<input type="button" value="afficher ou modifier"/>	Total: 1 Viennent: 0 Ne viennent pas: 0 Pas sûrs: 1 <input type="button" value="afficher / modifier / appeler"/>	Anglais Bambara
<input type="checkbox"/>	bambara	07/11/2012	07/11/2012	somewhere	<input type="button" value="afficher ou modifier"/>	Total: 0	Bambara

Figure 14: List of events. From this screen the events are actually launched, by clicking on the "call" button (appeler).

Liste des appels

Effacer la liste et les messages

- 30/7/12 14:59 - Une personne non identifiée a appelé et a laissé [un message](#).
- 30/7/12 15:15 - Une personne non identifiée a appelé et a laissé [un message](#).
- 22/8/12 09:40 - Le numéro [21320122](#) a appelé et a laissé [un message](#).
- 22/8/12 09:42 - Le numéro [21320122](#) a appelé et a laissé [un message](#).
- 22/8/12 09:43 - Le numéro [21320122](#) a appelé et a laissé [un message](#).
- 17/10/12 07:47 - Le numéro [51440931](#) a appelé et a laissé [un message](#).
- 30/10/12 11:14 - Une personne non identifiée a appelé et a laissé [un message](#).
- 6/11/12 09:45 - Une personne non identifiée a appelé (numéro: [nana.baahgyan](#)) et a laissé [un message](#).
- 8/11/12 16:31 - Une personne non identifiée a appelé et a laissé [un message](#).
- 9/11/12 10:14 - Le numéro [15268852](#) a appelé et a laissé [un message](#).
- 14/11/12 14:50 - mary a appelé et a laissé [un message](#).
- 14/11/12 14:53 - mary a appelé et a laissé [un message](#).
- 14/11/12 15:20 - mary a appelé et a laissé [un message](#).
- 24/11/12 10:30 - Tangara a appelé et a laissé [un message](#).

Figure 15: The call list shows the messages that have been received. The recorded audio can be accessed by clicking the [un message](#) hyperlink on each line.

b) Phone interface

The Tabale phone interface was designed according to the description of the use case, and following the remarks from the end-users. Tabale's call flow starts with a standard pre-recorded welcome message to Sahel Eco in Malian French and Bambara. After the welcome message the user is prompted one of the voice messages that has been recorded by the Sahel Eco webmaster for the given event. Each user hears the voice message, according to her user profile, in her own language.

After the message the user is prompted to press a DTMF key, 1 for yes, 2 for no, 3 for don't know yet, if she will or not attend the event. After the DTMF choice the user is asked to leave a message or hang up. After the message the user is asked if she want to hear the message again, y/n repeat the sequence and record the message again or end call.

From the point of view of the user the call flow is identical for those who are calling the system as for those being called by the system.

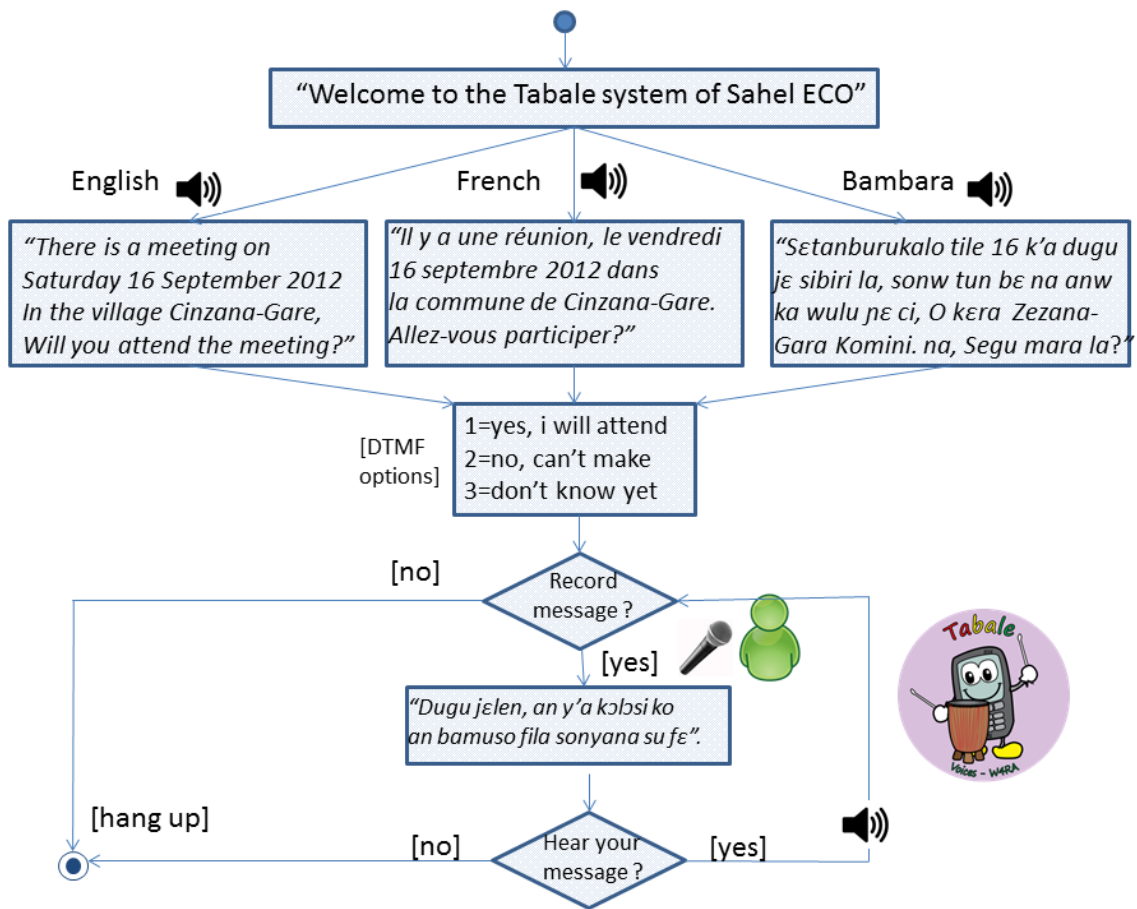


Figure 16: Call flow for Tabale system for a message issued in e.g. French, English and Bambara. Each user will get the message in his/her own language only.

2. Test plans

A test plan is a document prescribing the scope, approach, resources, and schedule of the testing activities. It identifies the items and features to be tested, the testing tasks to be performed, and the personnel responsible for these tasks. Testing and validation, as described in this document follows the user-centred Living Labs approach. The field tests were performed during the field trip in Mali, 10-19 November 2012.

To make sure that the final system is designed according to the requirements, verification and validation is done by the users, through acceptance tests. The field tests described in this test plan are meant for black box testing, i.e. functional or specification-based testing, without concerning about the underlying technical systems [1]. The lab tests, including coverage-, error- and fault-based testing, are performed for each module separately, and are therefore not included in this document.

The user tests have been performed in face to face meetings in Mali. Prior to this testing, some feedback is collected from the users through written questionnaires (see annexes B and C). The user tests confirmed the outcomes of the questionnaires.

a) Users

There are three categories of end-users of the voice systems Radio Marché and Tabale. Each group had specific requirements and tasks.

1. Sahel Eco staff members
2. Radio journalists
3. Listeners/ Potential buyers/ Sellers of products
4. Farmers receiving invitation messages from Sahel Eco

b) Test procedures for Radio Marché and Tabale systems

Radio Marché

User	Function	Interface type	critical	involvement	Questions to ask
Sahel Eco	General feeling	Web+ phone	high	direct	Is Radio Marché a useful tool for farmers in the Tominian region?
Sahel Eco	Data entry	Web	high	direct	Interface intuitive?
Sahel Eco	Communiqué creation	Audio TTS Slot & Filler French TTS Bambara TTS Bomu Voice of the communiqué	high	direct	1. audio quality in general 2. French S&F language understandable; sound natural? 3. Bambara language understandable? 4. Bambara language sounds natural? 5. Bomu language understandable? 6. Bomu language sounds natural?
Sahel Eco	Monitoring	Web	medium	direct	Is the logging and monitoring system

	usage				useful and does it contain the necessary information?
Radio station	General feeling	Web + phone	high	direct	Is Radio Marché a useful tool for the radio? Does it facilitate your work?
Radio station	Retrieval of communique	Voice prompts; Web interface	high	direct	? Broadcast quality audio: See detailed test procedure in Annex A
Farmer	Beneficiary	Radio	high	indirect	Is the Radio Marché system leading to more trade of honey and sheabutter?

Tabale

User/group	Function	Interface type	critical	involvement	Questions to ask
Sahel Eco	Organize events for farmers	Web+phone	high	direct	Is Tabale a useful tool for organizing event?
Sahel Eco	Manage events	Web	high	direct	Is this web interface intuitive? Easy to use?
Sahel Eco	Launch events	Web/phone	high	direct	Phone connection: does it work?
Sahel Eco	Monitoring	Web	high	direct	Is this list of users useful? Is anything missing?
Sahel Eco	Monitoring	Web/Phone	high	direct	Were there any messages left by farmers/ Were you able to receive/understand them?
Farmer	Attend meetings about greening	Phone	high	direct	Is Tabale useful for you? Does it work?
Farmer	receive message	Phone	high	direct	Are voice prompts OK language/instruction? Are the voice messages understandable? Is the DTMF procedure easy/understandable?
Farmer	Call back to the system; retrieve message leave message	Phone	high	direct	Does the phone number work? Are the voice prompts understandable? How is the audio quality For French? For Bambara? For Bomu? Is the DTMF procedure easy/understandable? Could you leave a message?

3. User-Based Evaluation Studies

In October and November 2012 user evaluation studies were performed for Radio Marché, that was operational since early 2012 and Tabale, that became operational in November 2012.

NGO Sahel Eco made a tour through Mali in October 2012 and visited five radio stations and collected feedback on Radio Marché through written questionnaires (See annexes A and B), and talked to buyers triggered by the Radio Marché announcements.

In November 2012 the WP5 team made another tour in Mali, and held face-to-face interviews, demonstrations, production tests and focus group discussions related to the Radio Marché and Tabale systems. In the following sections the user feedback is described.

a) User-feedback for Radio Marché

Five radio stations were interviewed about the Radio Marché system: These were Radio ORTM Segou, Radio Sikidolo, Radio Koutiala, Radio Mopti, Radio Seno Bankass. The questionnaires are included as annex A and B. Additionally, a number of farmers were asked them their opinion on the usefulness of the Radio Marché system to improve communication and trade.

General feedback on the usefulness of the Radio Marché system

In general it can be said that the Radio Marché system improves the communication between the producer of non-timber forest products (e.g. honey and sheabutter) and its customers and therefore their trade. The communiqués broadcasted on the radio are heard by many potential customers. There have been many phone calls to the producers and to the radio stations by buyers who were interested, the past four months, since the communiqués were regularly broadcasted.

Interfaces of RM

The system is easy to use for Sahel Eco who collects the information from the farmers. The automated communiqué creation is simple and effective. The radio stations find it easy to use the RM web and the RM phone interface and download the communiqué and broadcast the message. Up to present this has been done for French language only.

Side effects of the RM pilot on local trade

The radio broadcasts of Radio Marché communiqués create a demand of honey that cannot be met by the producers. This same feedback is given by radio Mopti, Koutiala and Tominian. The radios ask Sahel Eco to stop the broadcasts of communiqués about honey unless a stock is readily available. They also suggest to create sales points for honey in the villages of Segou, Tominian etc. to take the burden off the radio stations who are called by buyers interested in buying honey. Sometimes the buyers want 100 liters of honey, but this cannot be delivered at once. The transport of the honey is also an issue. The value chain behind the system is not yet organized. The demand for nere seeds is also good. The demand for high quality shea butter does still not exceed the RM offerings.

b) User-feedback on logging system for monitoring RM and TB systems

A good tool for monitoring the usage of the voice systems Radio Marché and Tabale is requested by the main user of the systems: Sahel Eco.

This should be a logging system, accessed on a web page, in a table form and downloadable as excel/csv (preferably an Excel-style) with all possible information that is available about the activity that took place on the systems.

Sahel Eco wants one view only. This must covers **all systems**, **voice platform and web stuff**. A mock up table is given in Annex C of this document.

c) User-feedback on language packs for Bambara and Bomu

In November 2012 the first version of the Bambara language pack and the Bomu language pack (as part of the VOICES WP3 developed by the North-West University) have become available for the Bambara language. This is a TTS system that can translate a French written text into Bambara written text or Bomu written text. It can also read the Bambara or Bomu texts. With this tool, the RM system is enriched with the option of providing automated Bambara and Bomu communiques.

Bambara: feedback on TTS-generated communiqué

The written text contains a few grammatical errors. Two native speakers (Fousseyni and Tangara) correct this text for us. They find it possible to understand the spoken communiqué. However, this quality of speech is still not good enough for broadcasting. There are not enough pauses between the words and sentences. The intonation sounds unnatural.

Bomu: feedback on TTS-generated communiqué

The written text contains grammatical errors. Native speaker Bakary corrects this text for us. Five Bomu native speakers comment on the TTS generated Bomu communiqué:

They are able to understand the communiqué in Bomu. The communiqué does not sound completely natural, "it is like the speaker is not breathing between the sentences". Still, the voice quality is acceptable.



Figure 17: User evaluation in November 2012 at radio ORTM Segou in Mali

d) User-feedback for Tabale

In November 2012 the first phase of the Tabale system was deployed in Mali, tested and evaluated by the end-users. User feedback was collected from: main users Sahel Eco (Mary Allen, Amadou Tangara, Drissa Gana) and five contact persons of Sahel Eco in Tominian.

Issues detected in Tabale during test with end users in Mali

Issue	Request for change
<p><u>General</u>: There are currently three reply options: Yes - attending, No - not attending, Don't know. Don't know can mean either i) the farmer does not know if he will attend and pressed DTMF option 3 or ii) the call was not answered yet (no reply, hung up, etc.);</p>	Different status for: (a) yes (b) no (c) received message but still pending (d) has not received message;
<p><u>Web interface</u>: Dates in the web interface are currently in US style;</p>	dd/mm/yy
<p><u>Web interface</u> Event list: messages are sorted, first one at end of the list;</p>	Latest event should be on top of the list of messages (default);
<p><u>Web interface</u>: Usernames for accessing the site.</p>	Request for usernames for Mary, Drissa, Tangara etc. so that we know who issued a message (+password protected login);
<p><u>Phone interface</u>: When voicemail picks up the phone, TB does not register this as an unanswered call. Many people here never used their voicemail and don't even know it is there.</p>	We would like the system to perceive "no answer" or "voicemail picked up". And set this as status in the system; then calls again after x hours.
<p><u>Phone interface</u> On the phone display "incoming call" the Tabale system shows a different phone number which is the general entry number to FB and RM.</p>	This is confusing. People should see the correct number to call back to Tabale and be able to retrieve the latest message.

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ANNEXES

- A. Detailed test procedures for Radio Marche and Tabale systems
- B. Questionnaire about Radio Marché
- C. Questionnaire about Tabale
- D. Logging system mock-up as requested by Sahel Eco to evaluate system usage by farmers and radio stations.

Annex A Detailed testing for Radio Marché

a) *Testing phone connection quality*

Synopsis	Test procedure	Participants	Material	Time	Contingency plan
Testing the quality of phone signal and quality of the audio sent and received from a mobile phone	(i) Listing to recorded communiqué and asking opinion by radio people; (ii) Recording a short message and listening it;	Radio people who can drive the voice application, (at least 2 to get different opinion).	Phone+simcard with credits+speaker for the phone	15-30mn	
Result					
Quality of a simple GSM phone audio is acceptable for broadcasting when an audio cable is used between phone and broadcasting equipment.					

b) *Testing broadcast quality*

Synopsis	Test procedure	Participants	Material	Time	Contingency plan
Asking the radio people to record a broadcast they were	(i) Record through phone interface the	Radio people who can drive the voice application.	Phone+simcard with credits+speaker for the phone	1h-1h30mn	in case radio people feel uncomfortable to do that,

ready to do live through a mobile phone, and then ask them to broadcast it live through the phone	broadcast; (ii) Listen it to check quality; (iii) Broadcast it; (iv) Query radio people and some listeners for feedback		All possible cable adaptators to plug phone to radio For contingency plan: GPRS dongle or usb key		download on their computer the recorded audio file (step 1 of the procedure) and have them broadcasting from computer (radio segou)
Result:					
This was done without our presence. Quality was reported acceptable by 3 radios. Segou, Moutian, Sigidolo.					

c) Testing authentication interface

Synopsis	Test procedure	Participants	Material	Time	Contingency plan
Testing 4 different authentication procedures for the radio Providing an authentication code (user id) Selecting a radio in a	Show the 4 interfaces and show pro and cons, and get feedback	Radio people who can drive the voice application.	Phone+simcard with credits+speaker for the phone	15-30 min	

menu					
Detecting caller_id					
Using different phone numbers per radio (less scalable, most costly)					

d) Testing broadcasting interface

Synopsis	Test procedure	Participants	Material	Time	Contingency plan
Testing 2 broadcasting interface One with a count down One with the broadcast starting on a key press	Show the 2 interfaces and get feedback, Observe in practice what is the live broadcasting procedure taking place at the radio	Radio people who can drive the voice application.	Phone+simcard with credits+speaker for the phone	30-45 min	
Result					
Option B was preferred by radios Moutian and Ségou					

e) Testing the communiqué quality

Synopsis	Test	Participants	Material	Time	Contingency
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	procedure				plan
Testing the quality of the generated communicate	Generate one or two communiqués and have radio people listening them and providing feedback	Radio people who can drive the voice application.	Laptop with the communiqué generation script+speaker	30 min	

f) Testing notification procedure for new communiqué

Synopsis	Test procedure	Participants	Material	Time	Contingency plan
Testing 2 notification options One through flashing (with number recorded in phone book) One through sms with a message containing the phone number to call	Send manually from a remote place a sms Send manually from a remote place a flashing signal Get feedback	2 people from the team (1 to talk to the radio people, 1 to send the sms/flashing), radio people	Phone+simcard with credits	30 minutes	

g) Internet connectivity in Mali over GPRS

Synopsis	Test procedure	Participants	Material	Time	Contingency plan
Testing GPRS availability and	Detection gprs signal and strenght	Anybody in the team (no need for radio people)	A GPRS dongle (to check with	Testing download time of a 1MB file (3	

bandwidth	downloading 3 times a 1MB file to be put on the Web and measuring time		Mary)	times)	
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h) Recording audio samples from the radio speaker

Synopsis	Test procedure	Participants	Material	Time	Contingency plan
Ask the radio speaker to sit down in a quiet room and record some audio samples. It is about reading a couple of pages. See details at http://www.mvoices.eu/radio_mali/references/french_numbers_record_procedure.txt		Anna, Radio speaker	Audio recorder Good quality microphone Pages to be read by the speaker	1h to 1h30	

Detailed testing for Tabale

i) Testing web interface for Tabale

Synopsis	Test procedure	Participants	Material	Time	Contingency plan
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Testing usability of the web interface	Enter new users; Create event; Record messages in several languages for on event; Hear/evaluate messages Manage users/events; Retrieve messages	Sahel Eco employees	Laptop Internet connection	2 hours	
Results are in the next section 3.d					

j) *Testing phone interface for Tabale*

Synopsis	Test procedure	Participants	Material	Time	Contingency plan
Testing phone interface	Launch one event to two or more users in different languages; Test phone interface; Test prompts and DTMF procedure	Sahel eco employees Farmers	Mobile phones with Malian simcards	30 minutes	Sip phone

	Test leave message.				
Results are in the section 3.d					

Annex B Questionnaire for the evaluation of the Radio Marché system

Questions pour le personnel des stations radio

1. Quelle interface utilisez-vous pour faire les émissions Radio Marché ?

L'interface téléphone mobile ☐ l'interface internet ☐
 Pourquoi ?

2. Quelle est votre opinion sur l'interface de diffusion des communiqués Radio Marché?

☞ Donnez une note (de 1 à 5) sur l'interface de diffusion des communiqués Radio Marché?

Notes : 1 = très difficile ; 2 = difficile ; 3 = peu facile ; 4 = facile, 5 = très facile

- ☞ Expliquez votre note :
- ☞ Quels sont les aspects de l'interface qui rendent difficile la diffusion du communiqué sur la radio ?
- ☞ Quelles sont vos suggestions ou recommandations pour supprimer ces difficultés ?
- ☞ L'interface vous paraît-elle logique et intuitive?

Oui ☐

Non ☐

☞ Explications et suggestions ?

3. Quelle est votre opinion sur la qualité de la voix des communiqués?

☞ Donnez une note (de 1 à 5) sur l'intelligibilité des communiqués de Radio Marché?

Notes: 1 = très mauvaise ; 2 = mauvaise ; 3 = assez bonne ; 4 = bonne, 5 = très bonne

- ☞ Expliquez votre note et faites des suggestions :
- Donnez une note (de 1 à 5) sur l'aspect naturel de la voix de Radio Marché?

Notes: 1 = très mauvaise ; 2 = mauvaise ; 3 = assez bonne ; 4 = bonne, 5 = très bon

☐ Expliquez votre note et faites des suggestions :

4. Quels sont, selon vous, les aspects positifs et négatifs de Radio Marché à l'heure actuelle ?

<i>Aspects positifs</i>	<i>Aspects négatifs</i>

5. Avez vous des suggestions ou des recommandations pour améliorer Radio Marché?
6. Avez-vous reçu des commentaires de vos auditeurs concernant Radio Marché? Si oui, lesquels ?
7. Si les communiqués de Radio Marché s'arrêtaient, quelles seraient les conséquences pour la radio? Pour les auditeurs?

Annex C Questionnaire for the evaluation of the Tabale system

Questions au personnel de Sahel Eco

8. Quelle est votre appréciation de l'interface Web pour utiliser Tabale?

☞ Donnez un note (de 1 à 5) à l'interface de m-événement?

Notes : 1 = très difficile ; 2 =difficile ; 3 = peu facile ; 4 = facile, 5 = très facile

☞ Expliquez votre note :

☞ Quels sont les aspects de l'interface qui rendent difficile l'ajout de contacts et d'événements, ou qui rendent difficile l'enregistrement de messages ?

☞ Quelles sont vos suggestions ou recommandations pour supprimer les difficultés ?

☞ L'interface vous paraît-elle intuitive et logique ?

Oui

Non

☞ Explications et suggestions ?

Questions pour le groupe cible du Tabale

9. Quelle est votre appréciation de l'interface mobile pour recevoir des message du système Tabale?

☞ Donnez un note (de 1 à 5) à l'interface de Tabale?

Notes : 1 = très difficile ; 2 =difficile ; 3 = peu facile ; 4 = facile, 5 = très facile

☞ Expliquez votre note :

☞ Quels sont les aspects de l'interface qui rendent difficile comprendre les commandes?

☞ Quelles sont vos suggestions ou recommandations pour supprimer les difficultés ?

☞ L'interface vous paraît-elle intuitive et logique ?

☞

Oui

Non

☞ Explications et suggestions ?

Annex D Mock-up for Logging system

WARA VOICE Services LOG									
Session Id	Date	Heure	Numero teleph	utilisateur	utilisateur web	Service	Activité	Success	Erreur
#38	1-feb-12	2-feb-12 5:00 pm	" +2335447654"	Radio Segou		RM	laisser message		
#52						FB	Créer evenement		Bambara
#52						m-event	enregistrer message		BO; FR
						m-event	ajouter des participants		Bomu
	3-3-2012		" +2335447654"			RM	Publier communiqué		
						RM	ecouter		
						RM	telecharger	non	connecti
						RM	émission		on coupé
			" +23358757576"	Jean-Baptiste		FB	record message		
						FB	Listen		
						Radio Moutian	Download		
						Sahel Eco	Créer communiqué		
						Sahel Eco	m-event événement créé		
						Sahel Eco	m-event Message left		
Annex C : Mockup of log for evaluation and monitoring of the Voice Systems by Sahel Eco									