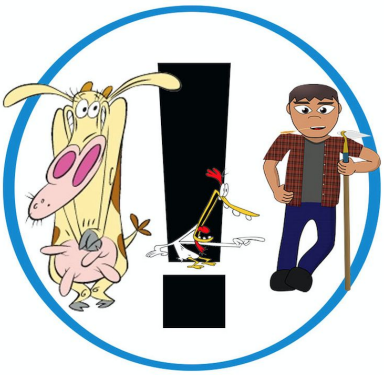

Veterpedia

Group 7

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This project report contains the extension of the voice service Veterpedia which was made during the course ICT4D. The report starts with an introduction, where the problem statement is made clear, and what for solution Veterpedia exactly is. After that, some contextual issues relevant to the context we are working with are identified, followed by some background information about ICT4D projects and voice services introduced in Africa. Moreover, this report contains information about the three phases where Veterpedia is arisen from and includes a detailed description of the service. Additionally, Veterpedia will be discussed in terms of prototypes descriptions, implementation, deployment and sustainability plans. Finally, interesting findings, issues and limitations concludes this report.

VU UNIVERSITY AMSTERDAM

1. Introduction

Most rural areas in Sub-Saharan Africa are characterized by low incomes with limited resources, poorly developed economy and markets for locals [25]. For instance, the agricultural resources, consumers goods, and livestock for farmers. Studies confirm that in communal areas people are dependent on resources from their local forest and woodlands, and especially their livestock production [7]. It is an important income and source of assets and property to rural local people, due to the rural economy [25]. For local farmers animals are a crucial income in Africa. Mortality or illness of these animals will have a major impact on their income [20]. For instance, when animals are ill, they cannot be sold or the animals cannot produce milk, manure for crops or meat for the farmers. They are also used as transportation or for transportation of goods. Farmers in rural areas often do not know what they should do when their animals are sick, which causes them loss of cattle. To prevent this loss, it would be nice if farmers could beforehand get information about their animal, as animal diseases often come with certain characteristics and/or symptoms. Farmers would like to know what the symptoms are and also how to treat the animals when they are infected. It is important to recognize whether an animal has an urgent disease and should be taken to a veterinarian or when it is a common or frequent disease and could be prevented by taking care of the animal according to simple steps.

To solve this urgent problem, a voice-based service is developed for these local farmers called the Veterpedia. The Veterpedia is a phone service that farmers can call when they need information about their animals. The service can simply be used by dialing the number of the service, so it can be used *anywhere* in the country where telecommunication is possible. Next to that the service is accessible at *any time*, the service makes use of pre recorded information. During this call the service will ask multiple questions about symptoms that are connected to the most common diseases in Africa. The animals that this service currently supports are goats, cattle and chickens which are some of the most common livestock that farmers own in Mali. For each animal the three important diseases and corresponding symptoms are implemented. Finally, it results in an advice whether the animal has an urgent disease or not.

It is important to notice that the Veterpedia is only a first aid tool. It is not developed for farmers to become veterinarians themselves. The first step of the service is to identify the most frequent symptoms that leads to illness and the additional treatments. After that an indication will be made whether the symptoms can determine an urgent disease or not and whether the farmer should plan a visit to the veterinarian or if it is treatable at home. Farmers can treat their animal at home with the right care, which mostly exist of basic treatments, like keeping the animal hydrated and shaded. The farmers will not get medicinal advice, since medicines can only be given by veterinarians. When the disease cannot be determined, farmers are advised to visit the veterinarian.

We have chosen to tackle the problem of local farmers, because we think it is important to help those who are coping with the loss of their first (and maybe) only income. Preventing contamination of an animal disease is one of the major solutions to those losses, if local farmers could be informed beforehand or even have the information at the right time. Our solution includes the recognition of the most common symptoms, so that farmers know how to treat their animals to prevent contamination. It is a simple service that could save farmers from cattle loss, which can be accessed *anywhere*, *anytime*.

2. Contextual Issues

Developing ICT solutions for development countries bring several contextual issues with it. These issues relate to the country towards the solutions.

Illiteracy

According to Unesco, 38% of African adults, converted to 153 million people, are illiterate [26]. The situation is alarming as literacy is a crucial step to acquire the basic skills needed to cope with the many challenges children, youth and adults will face throughout their lives. Illiteracy is also one of the main problems that limits the effectiveness of ICT within the wider population in sub-Saharan Africa [1].

Education

For many disadvantaged young people and adults, non-formal education is one of the main routes to learning. Non-formal education reaches people in their own context and ideally in their own local language [26].

Cultural Differences

Reaching people in their own context and own language is part of a study called HCI4D [16]. This is the study across cultural differences, which is also an issue concerned in our scenario. There are cultural differences with the western world and Africa. There are many localization issues, the cultural and linguistic adaptation of an internationalized application to two or more culturally distinct markets. Usage of certain products and services must be translated to other languages to adapt and adjust. Unesco proposed solutions to different levels of reading and writing, mainly by the use of icon-based interfaces and the use of voice interfaces. However, using icons and voice interfaces may still be a problem to be solved. For us certain use of language, structure of sentences, words and certain use of icons may seem naturally, but may not be so naturally for African inhabitants. Therefore, language will be a major challenge for our service and the local farmers.

3. Theoretical Background

The Veterpedia application could concern a number of constraints between the expectation of the application and the realisation of the application in sub-Saharan Africa. These barriers are described below.

Digital Divide

Digital divide is a term that refers to the gap between individuals and geographic areas at different socio-economic levels that have the opportunities to access and use Information Communication Technology (ICT) and to use the Internet for different activities [2, 23]. This gap leads towards the rural poor people to be increasingly excluded from the society [15]. The digital divide in communal areas is mainly because of the lack of Internet connectivity and electricity. Most people that have no access to electricity lives in the rural areas, which makes it even harder to keep up with the environmental and societal changes and the fast developing of urban people [16, 17]. These circumstances are sustained by absence of expertise, information and knowledge. In rural communities the lack of knowledge sharing is

caused by lack of expertise, gap between the rural locals people and urban experts and how to reach these people with expertise [21].

ICT problems in Sub-Saharan Africa

The impact and effects of ICT are globally noticed, however, not specifically in sub-Saharan Africa [1]. Based on this concern, there have been growing interest of the barriers of ICT in Africa.

ICT in Africa still has to conquer some barriers to grow the gains or values of implementing ICT. For instance, the political policy of the countries, lack of information about the content and learning possibilities, limited resources and lack of infrastructure. According to [1] ICT cannot solve the overall development problems of sub-Saharan Africa. ICT encourage the ability of existing organizations and infrastructure. Furthermore, ICT can help local people with increasing their knowledge, learning and eventually their education.

Another constraint is that proposed designed solution system does not match in the local environment. Most technology is developed with dust-free environments, supported network and maintenance [1]. However, you must take into account what the local resources are. Also, there is lack of management understanding with the proper knowledge. Also there is a lack of information about the use of technology or hardware device and software implementation.

One most important requirement for a farmer to use the Veterpedia is that he must have a mobile phone. Study in 2014 showed that 82% of Africa's population owns a mobile phone [3]. In four years we can only expect the usage and possession of mobile phones in Africa among the people to rise, as the law of Moore would demonstrate.

4. Related literature

Related literature shows that many organizations try to improve telecommunication and ICT across different countries in Africa [9]. However, by providing telecommunication and ICT solutions, problems of local farmers are not solved. As stated earlier, local farmers are coping with illiteracy, which makes it hard to find a solution for (written) verbal communication, since you cannot expect that they can all read and write.

To stimulate the communication between farmers, telecommunication contributes in order to gain additional value to them. There exists mobile applications and services that have already been developed for farmers. For instance, an application is developed that monitors cattle: this is designed with wireless sensor networks [22]. Another application called iCow, is developed for farmers who hold cows, to ease the management of dairy cattle [5, 6]. Furthermore, the application Empress-I is a global animal disease information system. It is a web based application that holds information about animal diseases like distribution and current threats. However, unfortunately many farmers cannot access the application for two reasons. First of all, there is a poor and weak Internet connection and second, most farmers are illiterate.Veterinarians, however, can obtain information, if they have access to the Internet. With access to Internet, animal diseases can be quickly detected, and early warning can prevent the death of animals and/or outbreaks [13].

The implemented diseases that are included in the Veterpedia are based on literature research. All animal diseases are located in Ghana, Mali and Burkina Faso. According to the literature papers, the most common animals; goats and cattle, are a major income for local farmers [4, 10], and according to Francis Dittoh, spokesman for African farmers, chickens are important to local farmers as well. For each animal, the most common diseases are found after which we have investigated which symptoms the diseases show and how it could be treated [8,18, 24, 28]. After identifying the common diseases and their symptoms, more in-depth research has been done on Google, to valid the information about the treatments for the animals in order to provide an advice. This of course, should be confirmed by the veterinarian first, before launching the service to local farmers.

5. Solution Design

In this section we will describe the changes we have made throughout the three cycles of developing Veterpedia. In addition, we will make design choices clear and provide our data and interaction model.

5.1 Interaction prototype

The first prototype was built on Voxeo's platform where text is converted to speech by the service itself. The idea of the first prototype was that a local farmer could go to a physical emergency phone to call the server for advice on their animals. Thus, the farmers had to visit the place in order to receive information about animal diseases. The idea behind emergency phones is that it would be easier to define regions within the country to receive information about diseases to put in a database. If there are different emergency phones throughout the country, then we would have data to compare to each other.

The voice-accessible service on Voxeo's platform used VXML. The document of this interaction prototype includes a collection of the use case description, system design, prototype description, description of prototype fidelity and conclusions and future work at this moment of the prototype. In this prototype we had implemented only two animals: the cow and the chicken. Furthermore, we had only information on two random diseases per animal, which had not been confirmed by any scientific literature. On top of that, these diseases also did not exist in Mali.

In our first prototype we have implemented confirmation questions about the chosen answers, which was one of the important functions, since we did not want the farmers to make mistakes during the diagnosis. Next to that, we have only implemented one language, English, as we wanted to see whether the service worked. What is important to keep in mind is that the service built on Voxeo's platform is responsive to voice and DTMF input.

This prototype is still accessible through the phone number +31208082848 and by entering the following pin: 9991495123.

5.2 Functional prototype

The second prototype is ported and built on the KasaDaka platform. This prototype is an improvement of the first prototype, based on the given comments. At first, we have changed the service from an emergency phone to a service that could be called by anyone owning a mobile phone, anytime, anywhere. It was important to create independency between the service and location, so that the barrier to call the service is lower for farmers. Next to that, in our first prototype a farmer could give answers, indicating

that the animal has many symptoms, but still retrieves an advice that his animal is healthy. This problem is resolved by making a more complex decision tree for the service. We established that the first symptom question is unique for the disease. It means that if the animals does not met the criteria of the first symptom, it could not have that disease and moves onto the second symptom question. The complete decision trees are illustrated in **Appendix A.**

One important thing to notice about the second prototype is that farmers are not able to use their voice to answer questions about the animal anymore. The service deployed on KasaDaka is only accessible through DTMF input.

5.3 Implementation prototype

The third prototype extends our application build on the KasaDaka platform. For our third prototype we have processed the feedback we received and added more accurate animals and diseases in Africa. Based on the feedback, we have mainly focused on performing a thorough background research. From our literature search we have found information about the most common animals African farmers are holding, which is why we have added the goat as an additional animal to our service. Moreover, we added more accurate diseases pertaining to our context in our service [10]. To expand our scope, we have also added a second language, French, as this is the official language in Mali [27].

5.4 Data & Interaction model

Throughout the three prototypes, the interaction between stakeholders and services have remained the same. Veterpedia is a voice service where farmers essentially come to for a diagnosis of their animals and at the end receive an advice of how to proceed caring for the animal in question. Currently, symptoms and information on treatment of the animals are extracted from online resources. However, the intention is for this knowledge to originate from a veterinarian familiar with symptoms and treatments of diseases with regards to the Malian context. Furthermore, due to the fact that a veterinarian probably does not have the skills to enter this information in to the database, someone with IT knowledge would have to occasionally pick this task up. Luckily, diseases and symptoms often do not change, so there is no need for this information to be continuously updated.

Below you find the interaction model of the most important actors of the service in figure 1.

The farmer interacts with Veterpedia, by asking advice and providing answers. Veterpedia interacts with the farmer by asking questions to determine what advice should be given to the farmers. However, the veterinarian should provide data first to Veterpedia before Veterpedia could ask any questions or give any advice to the farmer. Therefore Veterpedia interacts with the farmers as with the veterinarian as well. In this system the farmer and veterinarians are not in contact, however, when Veterpedia advices the farmer to contact the veterinarian, this happens outside the server.

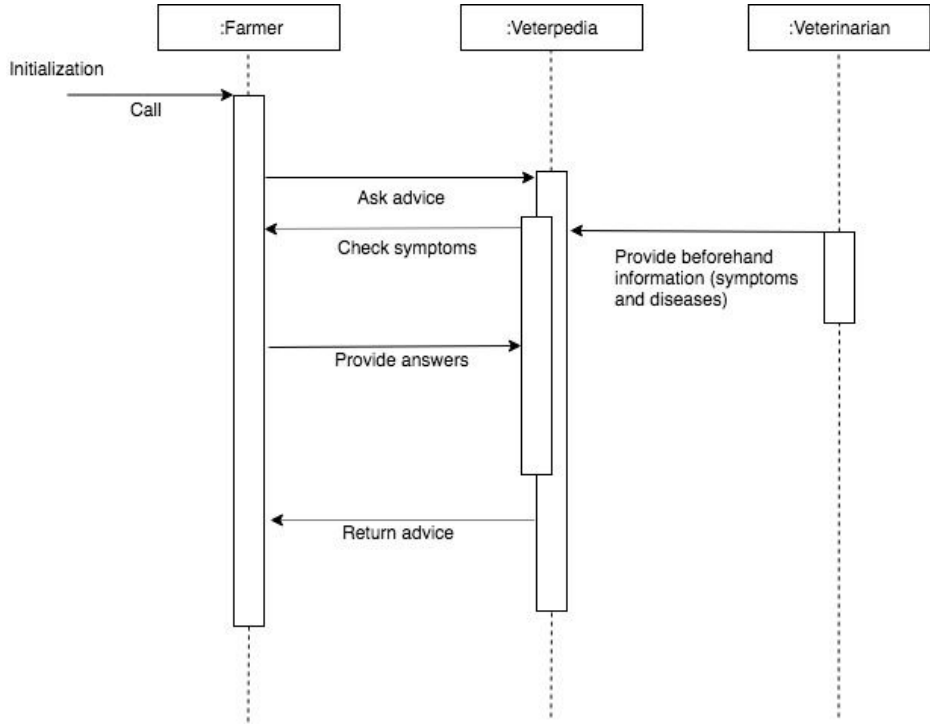


Figure 1: Interaction diagram of Veterpedia

The important actors and the service create the following data, which can be found in the data model in figure 2. When a farmer requests information about his animal, you see what information the database should have about the animal, and what information it should have about the diseases, the symptoms and how urgent the disease is. Based on the level of urgency an advice is given, which has been supplied by the veterinarian.

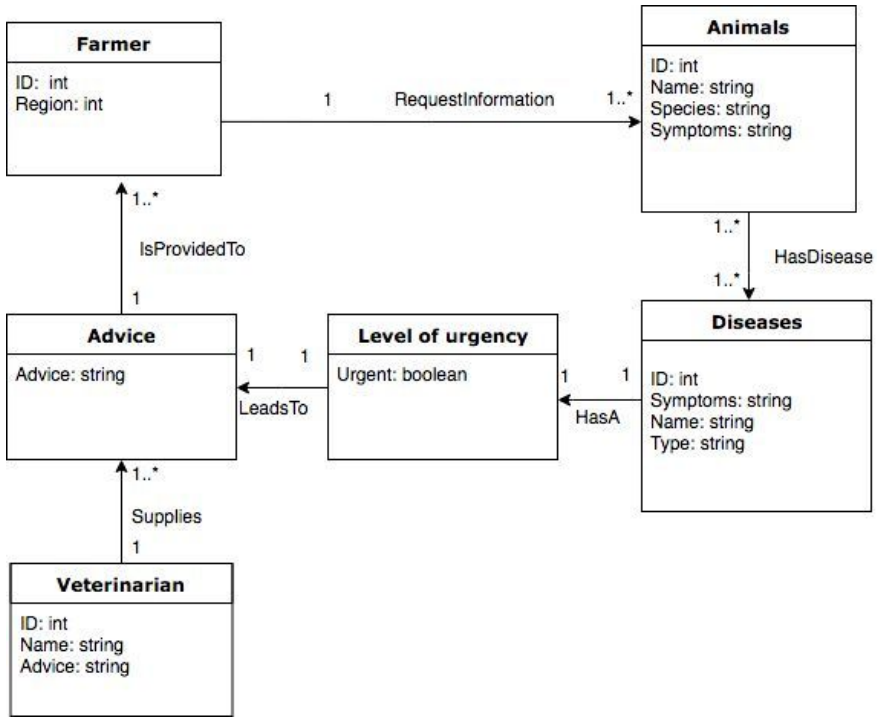


Figure 2: Class diagram of Veterpedia data

6. Prototype Description

In this section we will further elaborate on the previous section by giving a more detailed description of Veterpedia and providing a call flow diagram to illustrate how the voice service currently works when you call it and what it offers.

Veterpedia is a voice serviced application that currently uses information obtained from online sources to identify diseases and provide advice/treatments. At this moment the application offers three different animals to choose from: cow, chicken and goat. Additionally, for each animal, three diseases can be diagnosed. Table 1 depicts the diseases in relation to the animal.

Animal	**Animal disease**
Cow	- Trypanosomosis - Lumpy skin disease - Anaplasmosis (Gall-sickness)
Chicken	- Infectious Bronchitis - Newcastle Disease - Fowl Pox
Goat	- Helminthosis (roundworms) - Peste des petits ruminants (PPR) (Goat plague) - Contagious Ecthyma (CE) (Orf)

Table 1: Overview of animals and diseases

The number of symptoms to diagnose a disease ranges from three to four. Currently, the symptoms are hard-coded which means that based on a ‘yes or no’ answer, a specific symptom is next in-line (see decision trees in the Appendices). The ‘yes or no’ answers can result in three different outcomes:

1. A voice message identifying one of the diseases and the advice/treatment for it.
2. A voice message stating that the animal is most likely sick (in the case where the service is inconclusive in identifying a disease) and to contact a veterinarian for further assistance.
3. A voice message stating that the animal does not have one of the currently identifiable diseases and to contact a veterinarian for help identifying this disease.

In figure 3 a call flow diagram is illustrated where the service as a whole can be seen.

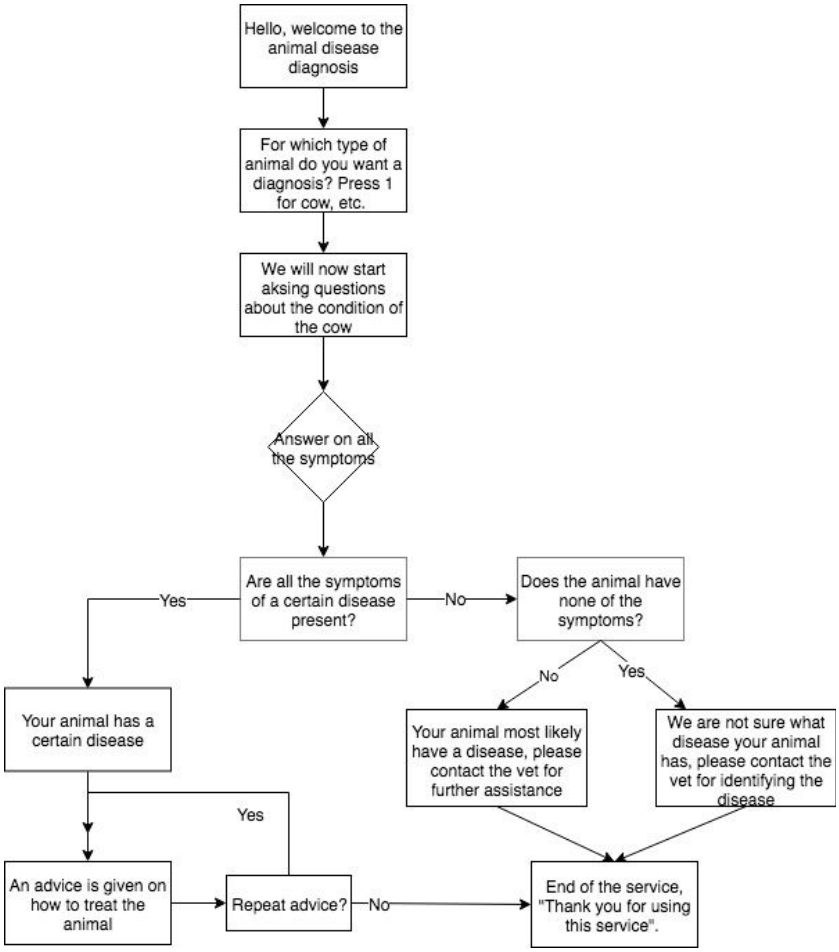


Figure 3: Call flow diagram of Veterpedia

6.1 Installation Guide

In order to obtain this application and use it, please find a detailed installation guide to Veterpedia in **Appendix B**.

6.2 Usage Scenario

The following scenario describes a possible scenario of the prototype in Mali.

Local farmer Mark living in Mali, owns a couple of animals that provides him his first and only income. Illness amongst these animals would mean a bad thing for Mark. One day one of his cows seem to be acting weird. Using the thermometer which was once handed out during a local meeting when Veterpedia was introduced, he measures the temperature of his cow every hour. The thermometer shows that the cow has irregular fever.

Mark decides to call the Veterpedia for advice. Once he has called the service, Veterpedia has remembered the last time he called, and also the last chosen language. In this same language, Veterpedia welcomes Mark to the service, and asks for which animal he wants a diagnosis. As Mark chooses the cow as animal, Veterpedia asks him a couple of questions about the state of his cow. Depending on his

answers, Veterpedia gives him advice about his animal. As a result of the symptom checker, Veterpedia has identified that the cow has one of the diseases, so Veterpedia advices Mark to hydrate and nutriate the cow, to make sure not to inflict stress on the cow and to keep it shaded.

After a few days the cow seems to be feeling better. Mark is happy he did not went all the way to a veterinarian, as he already were advised by Veterpedia and he recommends other farmers to use Veterpedia before deciding to visit a veterinarian.

7. Prototype scope & fidelity

During the whole course most of our proposed application is implemented. The service is a quick check on symptoms to determine whether an animal has a disease. Next to that the service covers the symptom checker for local farmers in two languages, English and French, which was a must have for our service, as English is not the main language in Mali.

Nonetheless, there are features that are not implemented, but is very interesting to add for this service. The first one is an interface for the veterinarians, so that they could easily add new diseases and symptoms. This interface must be easy to use, veterinarians should not spend more than half an hour for adding a new disease and corresponding symptoms. The interface should contain an option to record files on the spot in African language. French is spoken in Mali, however, French is not spoken by everybody. French usage is gender weighted in Mali, but most locals do speak local languages, like Bambara [27]. Therefore it is important that voice recordings should be done in the local language, so that every local has the chance to use Veterpedia. Next to that it is important to use the same language (sort of language, but also grammar and sentences wise) as farmers speak, to lower the barrier between the service and the farmers.

8. Implementation, Deployment & Sustainability Plan

In order to ensure the success of Veterpedia in Mali, an implementation, deployment and sustainability plan should be in place. In this section we will elaborate on them.

8.1 Implementation Plan

An implementation strategy is important to identify how the success of Veterpedia will be achieved. This includes identifying aspects such as funding and personnel/stakeholders etc. We will do this by illustrating Veterpedia's business model.

Below you find the business model canvas of Veterpedia depicted in figure 4. The business model canvas depicts the important aspects of the voice service. The voice service is developed for local farmers in Africa, by third parties and with help of veterinarians. The main and only activity of Veterpedia is to provide advice to farmers and therefore farmers are supported by their caretaking. Using Veterpedia prevents widespread contamination of illness, but also prevents cattle loss and thus loss of income.

Veterpedia will be filled with knowledge of the veterinarians, who puts information in the service its database which consists of diseases with corresponding symptoms and advice. For the development of Veterpedia, we are counting on third parties to fund the project, launch the project and want to spread the word in the country.

At first, the service will be free. Whenever the service is fully developed, we will ask farmers to pay the usual costs for a phone call. Veterpedia will be introduced to farmers during (local) meetings and we are hoping that word of mouth will do its work in Africa, especially since there are no other way of marketing possible. This means that the relationships with customers will also be kept verbally during information meetings held once in a while.

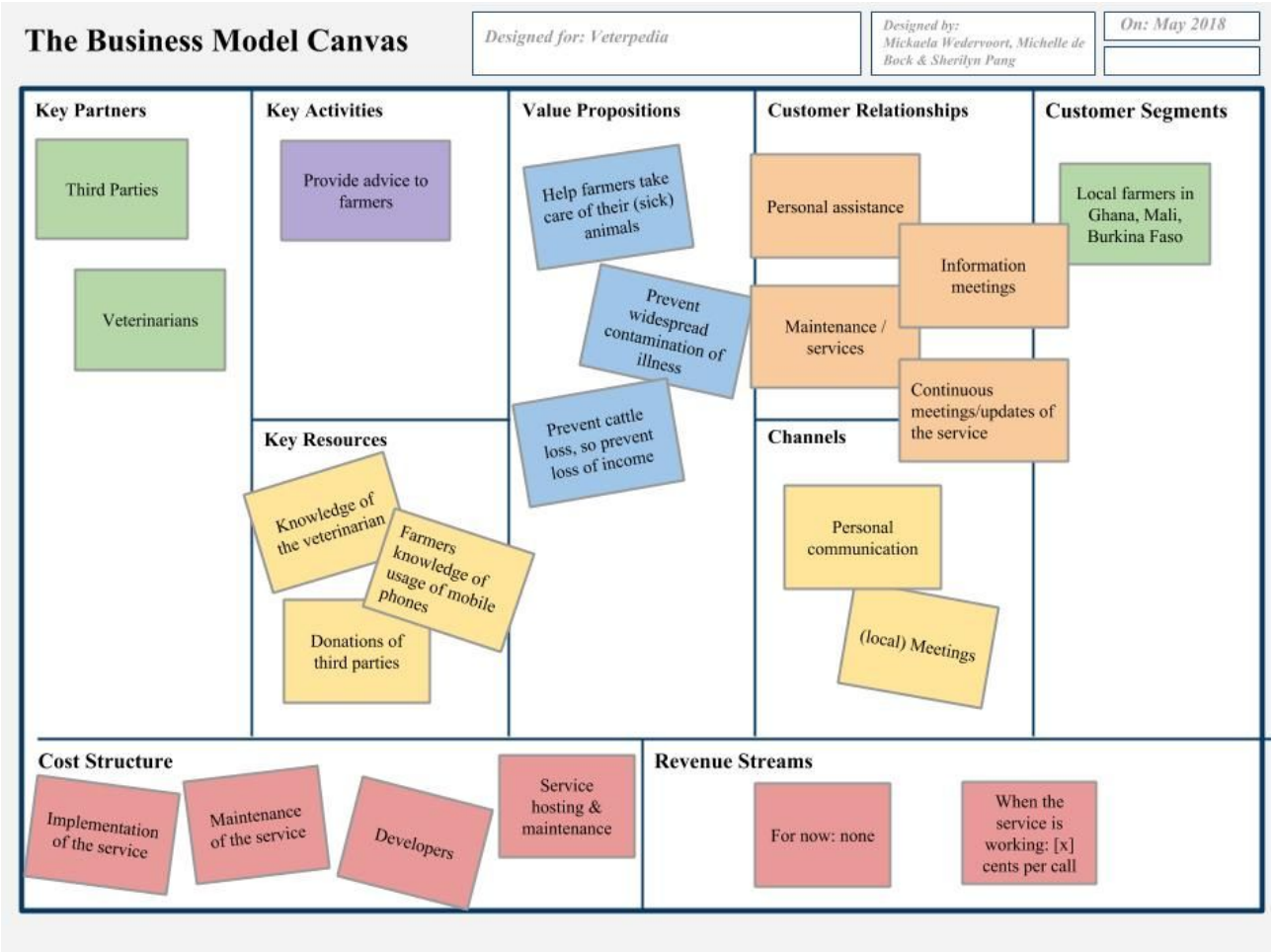


Figure 4: Business Model Canvas for Veterpedia

In figure 5, the interaction model is depicted, including the stakeholders and customers. This model describes the flow between stakeholders, customers and the use of the service and data.

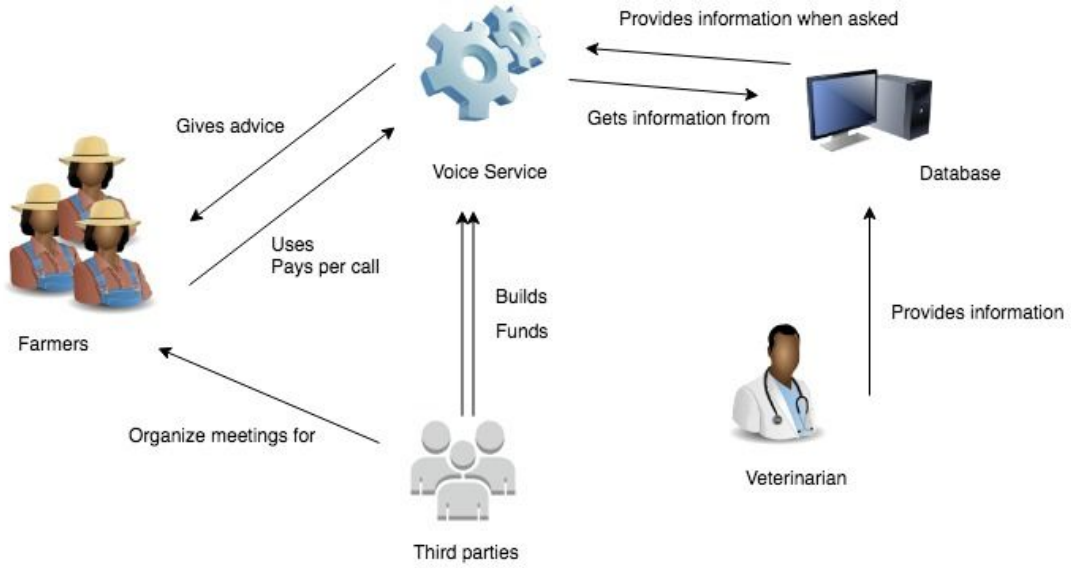


Figure 5: Interaction model

8.2 Deployment plan

The problem in sub-Saharan Africa communities is the lack of the accessibility to have quick advice on animal diseases for local farmers. Farmers using Veterpedia will at least be able to make a quick diagnosis of the animal its disease without the presence of a veterinarian.

To come up with an deployment plan, first we created clear user stories. These were described from the viewpoint of being a local farmer, veterinarian, third party or IT developer. User stories create a more specific definition what the purpose is of what you really want to achieve. Furthermore, the scope of the Veterpedia service was determined. This is also crucial that you make sure what the boundaries are of the application and also what could be interesting for a following version of the Veterpedia.

The process of further developing the Veterpedia should be collaborative, iterative and adaptive. When you have a clear notice of what you want to improve, you have to take into account what the circumstances are of the users. The motivation and purpose of the Veterpedia must fit into the local environment. Thus, the collaboration between them and also gathering feedback is important. The process is also iterative, due to the fact that we will develop small valuable products that need the feedback in order to continue building stuff that they want. You must adapt the ideas and solutions with context-specific approaches.

The most common used management method to implement services is using the Agile Scrum management method. Even though it is mostly done in software engineering, it could also apply for this case. You will work in weeks of two, and this is called a sprint. In this sprint you will create certain user stories that you will execute. It includes the gathering requirements phase, developing phase and testing phase. After every sprint of two weeks, you will demo you work in order to receive feedback. This can be used for further implementation or to increase some work. The benefit is that you will deliver a working valuable product every two weeks. Consequently, make sure the product that you make is in line with the context of the users, what they need and want, so that there is no misunderstanding or miscommunication.

It is interesting to invest in the Veterpedia service, because it will reduce loss of animals eventually. These livestock are not only crucial to local farmers, but also crucial to other people in that area. For now it may not gain profit, but it could be the case that it will in the future.

8.3 Sustainability Plan

After implementing and deploying the service, it has to become sustainable so that the service will be used as well in the future. To make sure local people will still use it, it is interesting to provide a training about how to use the service and also make sure everyone knows that it is available. This also stimulates to make the local people more collaborative to the project and more involved. Eventually they will become more independent, which adds value towards the project and will cost less money to invest. Transferring knowledge and the skills about the project will also contribute towards the education of the locals. To create awareness the word must be spread. The idea is to hold meetings in different regions, so that locals can experience and test the service.

9. Evaluation

In order to receive feedback about the Veterpedia we held three sessions with three different persons. These sessions lasted about 15 minutes, where the tester could test Veterpedia a few times first, and after that four evaluation questions about Veterpedia were asked.

Question 1: *Did you find the Veterpedia useful?*
Question 2: *What did you like and not like about the Veterpedia?*
Question 3: *What would you improve?*
Question 4: *Would you pay for this service?*

The transcript of the interviews can be found in **Appendix C**.

9.1 Outcomes

The outcomes of the interviews are useful for further extension of Veterpedia. The first interesting finding was that in order to have a functional service, you have to make sure that the symptoms really matches the disease. For a next version of the Veterpedia, it should be taken into account that diseases could also be caused by other external factors, like food or dirty water.

Secondly, it would be better to slow the speed of the spoken advice or implement an option to repeat the question. The spoken text is too fast to understand and keep up with what has been said, especially when the disease is explained to the user. Based on this feedback we have added the option to repeat an advice.

Next to that, it is interesting to figure out what the expectations of the local farmers are of the Veterpedia. By understanding their demand, you can better adapt the Veterpedia to what is useful to them. Perhaps by asking another question after every advise, whether the the local farmer is satisfied by the help.

Another statement was that the text-to-voice could be replaced by spoken text by people. It sounds better when it is not a voice created by a computer and it could cause misunderstanding among local people.

10. Discussion

During the development and evaluation of our service, we have encountered different issues and limitations, but have also gained insight of interesting findings.

The first issue we encountered is that the use of text-to-speech in our service made the sounds very robotic and inhuman and thus less appealing. When the diseases and corresponding symptoms are recorded again, with the right information, we should make sure that someone with a warmer and friendlier voice do the voice over. This ensures that local people feel connected to the service, and does not give them the feeling that -another western world-solution- is getting implemented and trying to help them.

Next to the quality of the speech, the quality of the audio files were also very bad. Recording the audio files while playing them from a converter made sure that the recorded audio files interfered. To make sure that this does not happen again, we would like to invite someone from the village in a quiet room to do the voice over. This ensures familiarity, but also the use of same words, grammar and sentences, and thus the same “common knowledge” in Africa.

There are also a couple of limitations in our service. Based on literature research, we have found a couple of common diseases among the animals a farmer holds, however, we have had to use Google to find the common symptoms and treatments for the animal. The information we gathered might not be accurate enough for the animals in Africa. Hence, we have built the “skeleton” of the application, so that local veterinarians can add the diseases and corresponding symptoms to the application and more when needed.

However, at this moment, it is only possible for animals to have one disease. Based on the symptoms and the simplicity of our decision tree the service is only able to record one disease (yet). The decision tree should be improved, so that animals are able to carry more than one disease. To achieve this, a more complex decision tree should be build, which asks for a simpler interface to tie the ends together.

During the progress report lecture, Francis Dittoh explained to us that the service could be very useful to farmers, however, we should keep in mind that farmers might make mistakes, which leads to misdiagnosis. We expect farmers only to call when his animal shows certain symptoms, so animals must be sick, or have something, before they call. When a farmer calls and is given the wrong advice, animal might still get more ill. It is therefore very important that farmers are able to let the system repeat questions. Our service does not have the possibility (yet) to go back to previous questions.

11. Conclusion & Future work

11.1 Future work

Due to the cultural differences between the Western world and Africa, it is a great challenge to develop an application or service for local farmers. Communication between both parties must go smoothly, so that both parties understand each other. Without the understanding between parties, an application cannot be build. However, for our service, we have built a “skeleton” where veterinarians can add their own interpretations of sentences in own language and add more diseases to the database.

For our service it is important that local farmers understand the questions asked. Therefore, it is important that veterinarians record the questions themselves, since they are able to formulate questions understandable for local farmers, so that the cultural barrier is broken.

As mentioned before, it is important to constantly confirm answers of farmers to make sure the system does not misdiagnose. Next to that, an option to repeat or go to the previously asked question would also be a nice functionality that is missing right now.

The addition of more animals to the service would also be ideal and useful. Currently, the service supports the diagnosis of cows, chickens and goats. Ideally, adding other livestock animals such as sheeps and donkeys would be preferred. However, before adding more animals to our service the focus should be on other more important aspects, for instance, ensuring proper function of the service in agreement with farmers and the other already mentioned improvements to be made.

In the future we would like to add a dashboard where all the results of the calls are being collected from a database. This information can be showed in overviews where a veterinarian can see very quickly what kind of diseases are prevailing right now so he can be properly informed. Next to that we could also collect information per region, when these are splitted in a comprehensible way, for example, which diseases are prevailing in which regions. Which animals are carriers of what diseases, or what factors are causing what diseases. When these are monitored, SMS alerts can be send to farmers in the concerned region and adjacent regions to warn them. Information about farmers can be collected with GPS information that is exempted when farmers make the call to the service.

In figures 6 and 7 examples of how our dashboard can look like when the service is able to collect information can be seen. The dashboard can be accessed at **veterpedia.000webhostapp.com**.

In figure 6 the overview of diseases per animal and the timelines of the diseases is displayed. With this information we could predict when a disease might occur again for example.

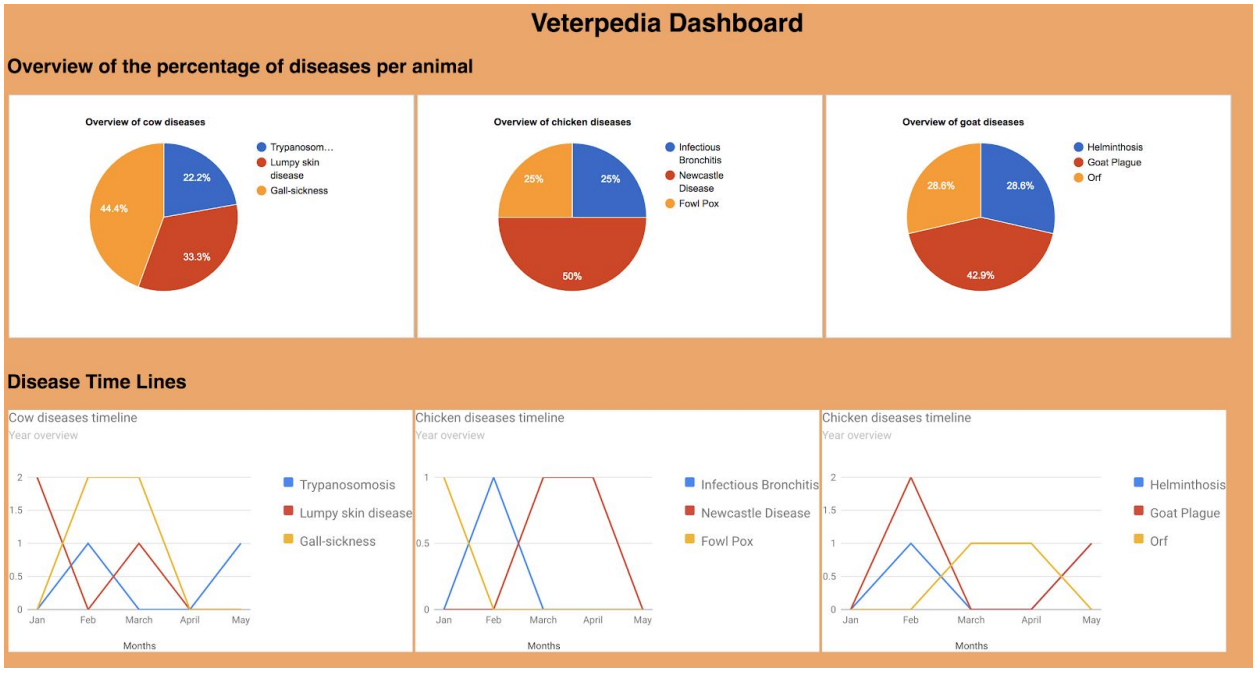
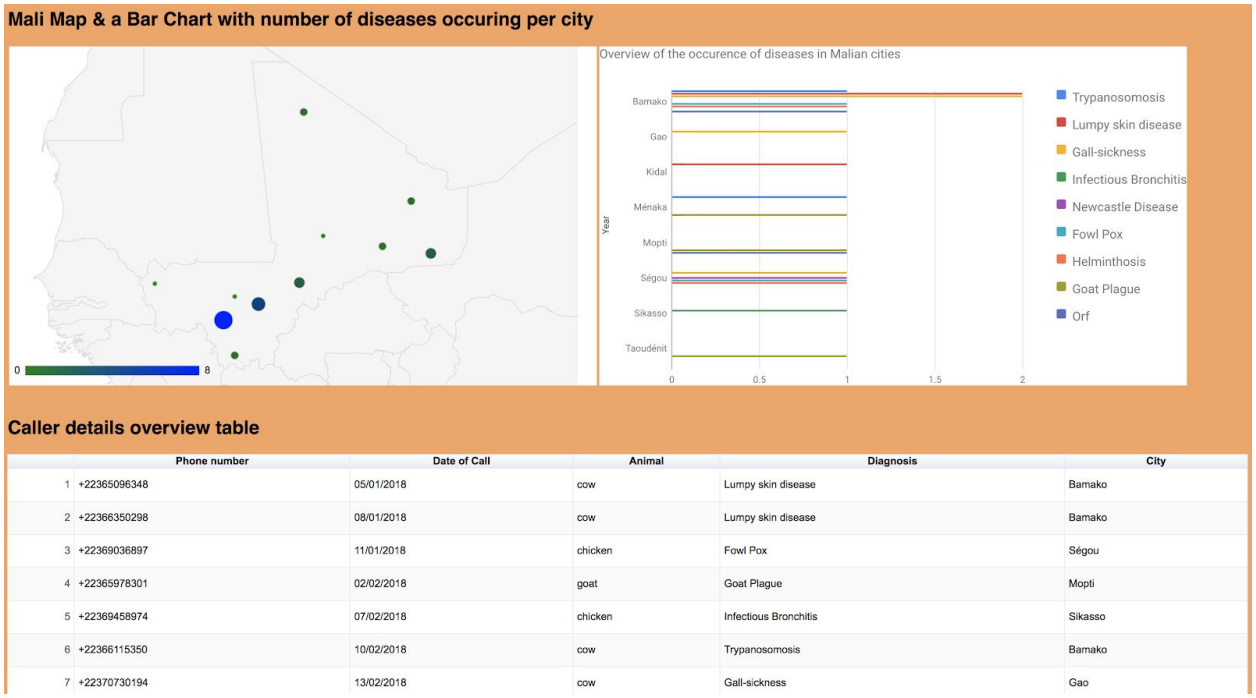


Figure 6: Dashboard screen 1

In figure 7 you see an overview of the number of diseases occuring per region and chart with more details on which diseases occured in a particular region. This information gives us an overview where the diseases are spreading or beginning, so that we can beforehand alert farmers. The details of the callers are also displayed in a table accompanied by the necessary data to compose the charts.



	Phone number	Date of Call	Animal	Diagnosis	City
1	+22365096348	05/01/2018	cow	Lumpy skin disease	Bamako
2	+22366350298	08/01/2018	cow	Lumpy skin disease	Bamako
3	+22369036897	11/01/2018	chicken	Fowl Pox	Ségou
4	+22365978301	02/02/2018	goat	Goat Plague	Mopti
5	+22369458974	07/02/2018	chicken	Infectious Bronchitis	Sikasso
6	+22366115350	10/02/2018	cow	Trypanosomosis	Bamako
7	+22370730194	13/02/2018	cow	Gall-sickness	Gao

Figure 7: Dashboard screen 2

11.2 Conclusion

In conclusion, Veterpedia is a service for local farmers in Africa that is reachable *anywhere* and *anytime*, on one condition: if and only if telecommunication is available. Farmers are able to access the service through a phone call and ask advice about their animal. The service is built to function as a first aid tool to help farmers check on symptoms, to see whether it is an urgent disease that can be treated at home or that they should call the veterinarian for advice.

The main issues we have been coping with during development of the service is the cultural difference. Language is part of that cultural difference, but also knowledge. What seem common to us, may not be common to them. What is logical grammar in English for us, may not be so logical to them. In order to develop a service that is useful for local farmers, we should really dive into their culture, customs and research their language. Spoken text is the main communication source for them, as most of them are also illiterate. Therefore it is important to do ethnographic research before coming up with a solution to a problem that seems to be urgent to you. During such ethnographic research the use cases and requirements are investigated in a collaborative, iterative and adaptive way. Researchers should be working together with the farmers or spokesman, to discover what the requirements are. Collecting these requirements are not solely done by interviewing users, but by really being in the field. And this should be done several times to make sure that it is done right, new requirements can appear any time, any place. It is important to adapt to the context and/or local needs, to make sure the service will be useful for users.

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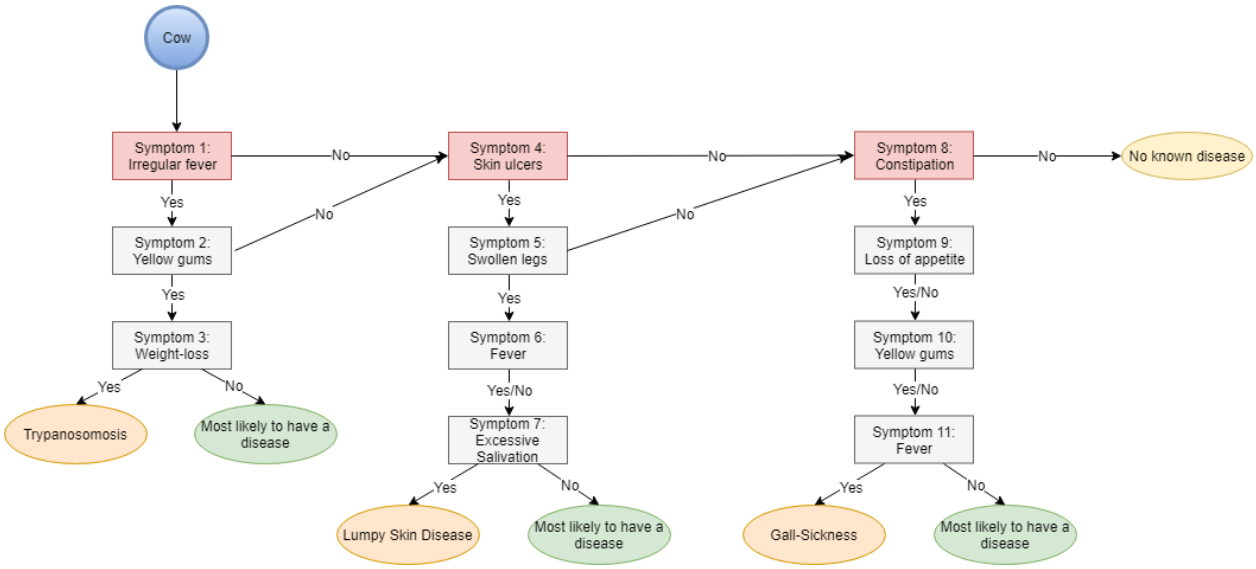
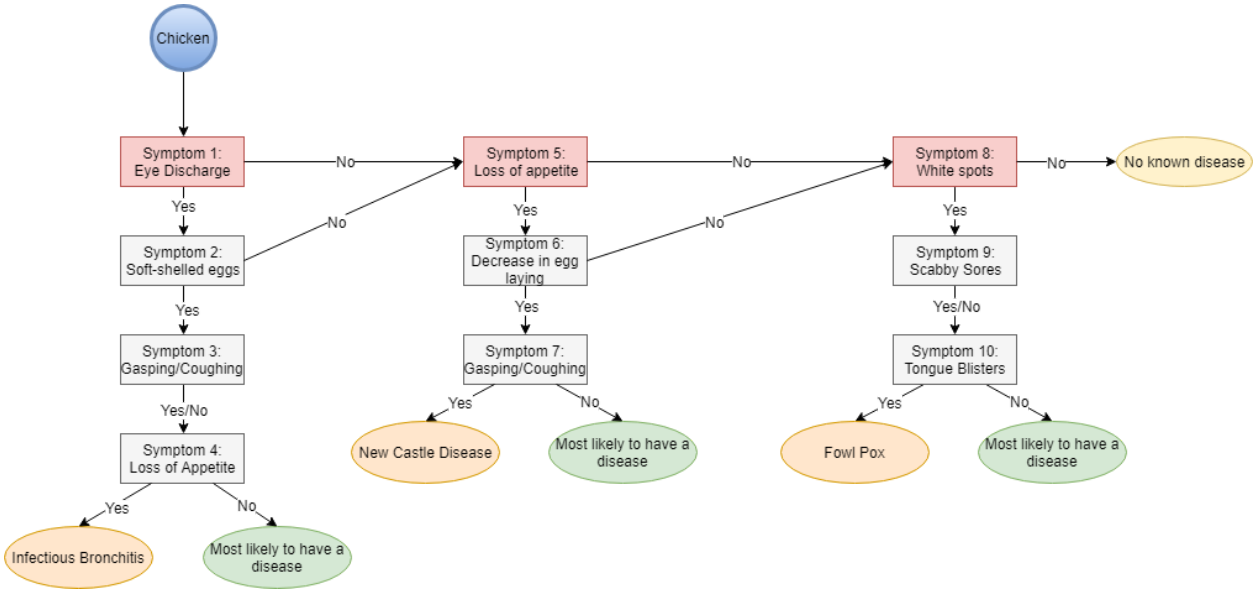
Appendix

Appendix A: Decision trees

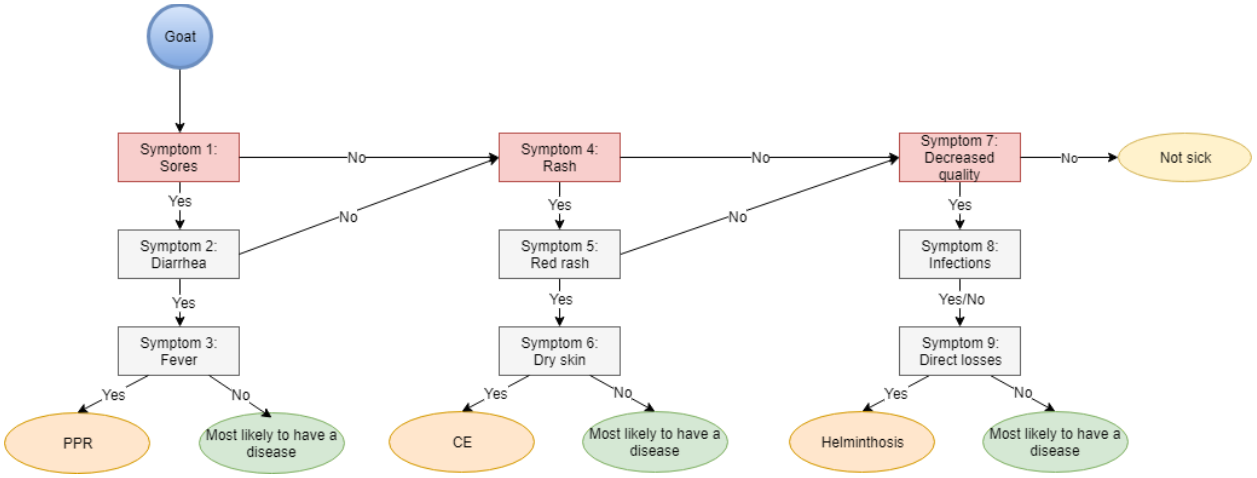
Cow decision tree



Chicken decision tree



Goat decision tree



Appendix B: User manual

In this detailed installation instruction, we have summed up every step that need to be done to setup the application. These steps are thus thoroughly described, so that the service is usable by anyone else. Please omit steps if these are not applicable to you.

1. Install Git on your desktop. This is the link https://git-scm.com/downloads.
2. Use the PowerShell or Terminal on your computer to run these commands.
3. Clone the repository for the application on your computer. This makes sure you have all the files local on your desktop. Run the command: > Git clone https://github.com/Mixxiee/KasaDaka-VSDK.git
4. **Ensure you have python and python-pip installed (Python 3.6) and install the required libraries (in your local directory where you put the clone of the repository).**
5. > pip install -r requirements.txt
6. **Change DEBUG to True in 'vsdk/settings.py'.**
7. Set up the database and a superuser and load our database data:
8. > python manage.py makemigrations service_development
9. > python manage.py migrate
10. > python manage.py createsuperuser
11. **Enter some username and pass, you use this to login later**
12. > python manage.py loaddata db_data_backup.json
13. Run your local development server:
    > python manage.py runserver
14. **Next, create an account on Heroku, select Python as development language. Install the Heroku toolkit: https://devcenter.heroku.com/articles/heroku-cli. Open a terminal/cmd.exe in the directory where you've cloned your forked repository and run the following commands:**
15. > heroku login
16. > heroku create --region eu
17. > heroku config:set SFTP_PASS=<password>
18. > heroku config:set SFTP_USER=<username>
19. > heroku config:set SFTP_HOST=django-static.vps.abaart.nl
20. > heroku config:set SFTP_PORT=22018
21. > heroku config:set HEROKU=True
22. **Make sure that when you are pushing your code to Heroku, you set DEBUG = False**
23. > git push heroku master (This will take a while, as all static files are uploaded through FTP)
24. > heroku run bash
25. > python manage.py makemigrations service_development
26. > python manage.py migrate
    (First time only) create a superuser to login to the admin interface
27. > python manage.py createsuperuser
28. > python manage.py loaddata db_data_backup.json

29. > exit
30. **After this the application should be reachable at the URL provided by Heroku.**

You can call our application through your normal phone or Skype: 020-3697664 and it is accessible through this URL: http://ict4d.kasadaka.com with the log-in mali:bamako. The URL to call our application is **http://enigmatic-river-36081.herokuapp.com/vxml/start/1**.

Appendix C: Interviews

Veterperdia Interview 1

Interview conducted on May 23rd, 15:15 pm, with a matron.

Question 1: Did you find the Veterpedia useful?
Yes, I think it could really help local farmers for quick advice. However, I am wondering if three diseases are enough.

Question 2: What did you like and not like about the Veterpedia?
I like the idea that you can call this service any time in order to have quick advice. It is also nice that you have it in two different languages. What I did not like was that the advice is quite fast. It is better if this text was spoken more slowly, so that you have more time to really understand it.

Question 3: What would you improve?
It would be nice if the service told me what the factors are that caused the disease, so I can take that into account, to prevent contamination. Maybe it would be nice to give a menu, to choose what you want to hear, how the disease is spread, how to prevent contamination or how to treat the disease.

Question 4: Would you pay for this service?
Yes, especially if I was a farmer and I needed quick advice or a diagnosis whether if the animal shows urgent symptoms.

Veterperdia Interview 2

Interview conducted on May 24th, 15:15 pm, with a student.

Question 1: Did you find the Veterpedia useful?
I think a service like the Veterpedia, it would add some value to the local farmers. However, not for now to be honest.

Question 2: What did you like and not like about the Veterpedia?
I liked the part where you can hear your advice. However, not sure how valid it is to say that these symptoms really end up in having that particular disease. In my opinion it could also be caused by other factors that you are not taking into account.

Question 3: What would you improve?
I would improve the quality of the service. Find a way to figure out what really would have the farmers. What kind of advice they are looking for. Thus aks after using the service a simple question like: are you satisfied with the advice? This that should be gathered and used for further improvements.

Question 4: Would you pay for this service?
Depending on my status as a farmers. As me being me for now, I would not pay for this service, however, I do not know the farmers their situation. The service might add value to their situation, if that is the case, I would pay for the service a s a farmer.

Veterperdia Interview 3

Interview conducted on May 24th, 16:00 pm, with the team manager of Maandag Service Desk.

Question 1: Did you find the Veterpedia useful?
It might be useful for farmers, as it adds extra value. Farmers can call the Veterpedia whenever they need advice, without visiting a real veterinarian. It is like a Google for farmers in Africa, but over the phone.

Question 2: What did you like and not like about the Veterpedia?
Really liked the overall idea, the intentions are good. However, there are some improvements in the functionally. I would add more animals and make sure that the symptoms are really unique for that disease. Or you should provide some kind of risk analysis, for instance, that you have 50% change that you have disease 1 and 25% change you have disease 2 and 25% disease 3.

Question 3: What would you improve?
I would like to see an option to repeat the question, so that I could hear the question again, since the quality of the recorded files are not that great. Next to that it might be more interesting when more diseases and animals are added.

Question 4: Would you pay for this service?
Yes, I probably would pay for this service, however not much. And only if there are more improvements added to the service. When calling a few times, I might know all the answers already, so I probably will not need the service after a few times. But as said already, when adding more diseases, animals and more complicated cases, it might be more interesting.