Faculty of Exact Sciences

ICT4D: Information and Communication Technology for Development (X_405101)

Rain Forecasting Service For Rural Ghana

Implementation Prototype Report

Group 15

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CONTENTS

1. INTRODUCTION

The service we are developing is a voice-based mobile system for distributing rain forecast and climate information, intended for the farmers of Ghana to more accurately plan their agricultural activities. Weather information usually also incorporates temperature data, but in this particular use case, the farmers interviewed did not express interest in that. Rain patterns are more unpredictable, variable and important for crop production in this region, which is why we have chosen this as our main focus.

2. USE CASE DESCRIPTION

2.1. Summary of Key Idea

As mentioned in the introduction, the aim of the service is to provide accurate rain forecast information for the farmers of Ghana via a mobile voice-based system. Currently, the majority of farmers are using traditional knowledge, such as signs of plant growth, to assess the probability of rain. While this works to some extent, the reliability is not high enough to make good decisions regarding sowing, harvesting, financial investment etc. The weather patterns are also becoming more volatile with accelerating climate change, which makes traditional knowledge increasingly less relevant. Currently, weather information is sometimes broadcast on the radio, but this is not region-specific, nor is it announced at set intervals, which again makes it difficult to rely on.

Our service includes an option to narrow down the region and also choose which time frame the caller is interested in. In building such a system, it has to be kept in mind that the locals may quickly develop a dependence on the system for their sustenance, but ongoing tech support might be infeasible if the project gets one-time funding only, so the system is intended to work autonomously after deployment and initial testing. In addition to farmers, this service could potentially be of benefit to other locals in everyday life and also to enterprises that are weather-dependent, such as logistics, tourism and emergency services.

2.2. Context and Scope

Ghana is a developing country, in which agriculture still constitutes a significant part of the economy. The agricultural sector makes up 23% of the GDP and employs 53% of the labour force. Although seeing significant economic growth in the period between 2005 and 2012, over a quarter of the population still remains under the poverty line of 1.25 USD per day. The agriculture sector has also grown significantly in the last decade due to exports of appreciating goods, such as cocoa, but nevertheless, 80% of the agricultural ventures are still rain-fed and subsistence-based (Ghana…, 2015, p. 1). This means that our potential user base will be very poor and will in all likelihood not be able to afford even the cheapest of services. In turn, this implies that the service will at least partially need to be sponsored or reimbursed by a third party.

The government of Ghana is actively working to achieve the UN millennium development goals, which means there are multiple programs in place to increase food security and raise the agricultural yield of the population (fertilizer programme, mechanization centres etc.)(Ghana…, 2015, pp. 2–3). Agricultural information input services could also be considered something that help reach these development goals, so the interests of this project and the interests of the government are aligned. Therefore, one part of our business plan is to seek governmental subsidies for our service, so that the end user could get it free or very cheaply.

Ghana was one of the first African countries to reform its ICT industry and since the liberalization of the telecommunications sector in 1990, the country has seen great increases in access and coverage of communications technology (Alemna & Sam, 2006, pp. 236). While Internet penetration is still quite low, mobile coverage has increased rapidly, with some recent reports indicating that as much as 87% of farmers owned or had access to mobile phones (Owusu *et al.*, 2017, p. 42). This is an indication that a GSM-based voice-operated system is a good fit in the context of the lives of these farmers.

Contextually, it is important to bear in mind that the potential users of this system might not be literate and may speak a host of different languages. Their knowledge of information systems may be very limited and some training may be necessary for the system to be adopted. The farmers are bound to have a social network with neighbours and nearby village/town members, which will both raise challenges and provide opportunities for word-of-mouth marketing and self-sustaining knowledge diffusion. The weather data collection and forecasting services are not as developed as we might be used to, accurate information being available only in certain towns, so this may constrain our region-specificity to larger regions or estimates may have to be given by the proximity of the user to a town. Another question to probe would be the willingness of local weather stations to release their data to our back-end.

The scope of the project is to consider only rain forecasting, divided into regions and time periods. The time periods include short-term information, such as the daily and weekly forecast, but there is also an option to listen to pre-recorded paragraphs that describe in a little more detail the climatic and seasonal variations of that particular region. This would also include some basic information about the best times to sow and harvest the most widely used crops or perhaps a few sentences on how to deal with climatic extremes, like drought or flooding. Other than that, the service does not include any further measures (atmospheric pressure, temperature, sunrise/sunset times, historic averages etc.), as it is hard to estimate how much use the locals would actually have for that. We will, however, allow and account for the possibility of adding further functionality in an iterative fashion. If the rain prediction system does well as a proof of concept, we can work with the farmers to evaluate which further measures are needed to effectively improve yield. Due to financial constraints, lack of know-how and for the sake of robustness, the scope should at least initially be as limited as possible.

2.3. Technology Infrastructure

The current technological infrastructure of the proposed system comprises of two distinct parts: the part that interacts with the user (the farmer who calls in) and the system that responds to the caller's choices. Currently, the part that handles user interaction is an IVR (Interactive Voice Response) system designed and developed using the philosophies behind KasaDaka Voice Service Development Kit (VSDK). KasaDaka VSDK is designed and developed using Python and its popular web applications development framework called Django. This SDK has been developed using a popular open-source PHP web framework called Laravel. The SDK has been developed specifically to run on the minimal computing power of portable computing devices, such as the RaspberryPi. This allows for IVR services to be provided to remote locations in underdeveloped and developing countries and has been proven to be instrumental in affording ICT services for social and economic development of such regions.

Like KasaDaka VSDK, our implementation using the Laravel framework provides a basic groundwork for developing voice-based services. The integral service it provides is the generation of a VXML document which dictates how the caller interacts with the IVR. VXML documents are the standard form of implementing IVR which allows interaction between a human caller and computer generated responses through interactive media like Text-to-Speech and/or recorded sound files. This kind of implementation is typically encountered when calling customer service numbers of various banking companies, telecommunication helplines and public services, among others. VXML provides a flow for the caller via which the caller and the implementing application can direct interaction according to their choices and system rules.

Although the functioning groundwork has been done on the PHP application, the part of the application that is responsible for user interaction has to be integrated with a service that redirects users to this IVR when they call a particular number. For a proof of concept, a functional prototype has been implemented using PHP's inbuilt SimpleXmlElement library and has been hosted on http://ict4d.gotamey.com/vxml.

The second part, which deals with responding to the user's choices, has to obtain weather and climate information about the particular region the user is interested in. A particularly reliable weather API is provided by Open Weather Map, which not only provides weather data by city names but also by geographical coordinates. This weather API is practically free of charge because their free-tier solution provides about 60 calls per minute for current weather, as well as a 5-days-forecast which is more than enough to provide valuable predictions to the caller.

2.4. Cost Considerations

Even though the weather API is priced relatively low, considerable costs may incur when a quickly growing number of callers wish to access the weather API. If the number of callers need to be scaled up, OpenWeatherMap can cost up to USD 500 per month which allows 30,000 calls per minute which could be enough to serve around 12 million rural population in Ghana (this is just an optimistic estimate at the moment). This solution is just a prototype at the moment. A completely feasible solution would involve a development team of specialists which incurs additional personnel costs. This would also include the cost of maintenance of the solution, Internet access charges and power supply bills.

2.5. Feasibility and Sustainability

As mentioned in the context section, the GSM coverage of rural Ghana reaches 90% nowadays. Therefore, GSM connectivity can be considered as a viable medium of implementing the IVR solution described in this proposal. Although telecommunication services can be expected to reliably serve its purposes, the application which is intended to run in a portable device can encounter multiple points of failure, which are as follows.

Firstly, there is the the problem of power supply. The device has to remain powered-on, ideally, continuously to serve its purpose. If there are power outages (which can be expected to happen is developing countries) then the service will be offline. If the device depends on batteries to power itself, then a technician has to constantly monitor and swap the power source to maintain its uptime.

Secondly, the IVR interaction depends on the Internet to provide results for the caller's query. The device can be placed in a city where the power supply and the Internet connection can be expected to be relatively stable to avoid service outages. Increase in dependency on services other than itself increases the probability of failure when those services are offline.

Thirdly, we can encounter the hurdle of maintenance and troubleshooting of the solution described in this proposal. A solution depending on third-party APIs is bound to fail at points when the API provider updates its services. A local (or remote) focal person trained and assigned to mitigate such failures can be appointed for the task. Another sustainable route to reduce the cost of the solution as well as service failures is for the government to provide weather services and APIs.

2.6. Key Requirements

Req ID	M/S/C/W	Requirement
1	M	The system shall have a nested list of voice-activated menus.
2	M	The user shall be able to call a number and access the menu.
3	M	The user shall be able to select preferred options from the menu by choosing a number on their keypad.
4	M	The system shall return weather data according to the selected options by the user.

3. THEORETICAL BACKGROUND

In this section we will provide an overview of some of the theoretical underpinnings that may influence the success of our service. The research will be categorized topically and a brief account of how we could utilize this information to facilitate our development will also be given.

3.1 Language barriers and the digital divide

An important consideration when creating ICT services in developing countries are the potential language barriers. In the Western world, we are used to personal troubleshooting of everyday problems through the use of the Internet. However, none of the three languages, English, Chinese and Spanish, which constitute 80% of the Internet information stores is well-spread in the majority of African countries and Internet coverage itself is widely deficient (Grazzi & Vergara, 2012, p. 162). Although English is the official language of Ghana, the rural countryside is still dominated by smaller local languages. Our service currently operates in English and Dutch. For efficient reach of local communities, we would need to slowly add support for the local languages in order of importance. The best way to ascertain this order of importance would be to combine public statistical language data with insight from the field, which calls for collaboration with NGOs/government or the short-term recruitment of a market analyst. Another issue related to language barriers, is the increasing digital divide among the populations of developing countries. As Grazzy and Vergara (2012, p. 162) put it:

> "*...familiarity with English language – the de facto language of the Internet – is generally low and highly concentrated in well-educated and high-income population segments, widening the digital divide. The discrepancy between the population current language and ICT language may create not only a cultural and technological mismatch that disincentives ICT use at individual and household levels but also creates a gap in the perceptions of ICT benefits.*"

It is important to foster any existing initiatives for lessening the digital divide and also collaborate with telecommunications companies who are seeking to improve their reach. The idea of our service could also be sold to investors or patrons on the merit of contributing to the narrowing of that divide. The government might be interested in that merely for the socioeconomic and educational gains that come as collateral benefits.

3.2 Facilitation of technology adoption

One of the critical reasons why ICT projects in developing countries often fail, is that project leaders erroneously assume that once a technology exists, it will also be adopted with open hands. Frequently, this is not the case for several reasons, including adherence to traditional ways, prohibitive costs, infrastructure unreliability, poor training, technological illiteracy and poor marketing reach.

There are many different theoretical approaches that cover the intricacies of technological diffusion. We will make use of two of them that Aleke, Ojiako and Wainwright (2011, p. 72) considered the most relevant to ICT adoption by small-scale agribusinesses in developing countries: the Technology Acceptance Model (TAM) and the Social Network Theory (SNT). The TAM framework looks at all the different variables that affect technological acceptance and two of the most significant parameters include "perceived usefulness" and "perceived ease of use". It is not sufficient to make the service easy to use and provide real benefits, it also has to be so *perceived*. This means that in order to improve the chances of our service being accepted we have to demonstrate these values to the end user. Due to the remoteness of the farmers and the illiteracy concerns, this could be difficult to achieve by ordinary means of marketing and outreach. This is where the second framework (SNT) comes in to play. We wish to build self-perpetuating social networks that carry the message for us. One prong of this approach would be to find the change agents (village chiefs, crop market leaders etc.) and convince them of the usefulness and ease-of-use of the service, who would in turn spread the message in their communities. The second prong would be to establish word-of-mouth marketing tactics, so that the farmers who have already learned to use the service, would be incentivized (discounts, free service for a period, social brownie point system etc.) to pass the knowledge forward. A referral system could be monitored by the referrer providing the system with phone numbers of the future users that they have brought to use the service and when those numbers are detected as using the service with a certain regularity, then the referrer is automatically assigned the reward.

Kante, Oboko and Chepken (2016, pp. 322–324) provided and overview in their article about the factors that positively or negatively affect the adoption of agricultural input information services in developing countries. By their analysis, cost of service is the main negatively affecting factor and the the main positively affecting factors to take into consideration are as follows:

1. Relative advantage – perceived benefit of the new system compared to it superseded. This would be covered by the SNT approaches detailed above.
2. Compatibility – the accord between the values of the users and the new technology, the reasoning being that more familiar products are better accepted. We might cover this by incorporating familiar symbols and iconography (perhaps religious or tribal sentiments) in the service or marketing materials.
3. Simplicity – the user-friendliness of the system. This will be covered by intelligent requirement elicitation and good design choices in development.
4. Observability – the degree to which would-be clients see other users utilizing the service. This could be covered by iconographic advertising on local market places and promoting word-of-mouth marketing on village gatherings.
5. Social influence – the degree to which people see that other important people are in favour of the service. Again, achievable by reaching out to the local change agents.
6. Information quality – the completeness, accuracy, relevancy, timeliness and appropriateness of the information provided by the service. In order for the service to grow and reduce customer defection, we need to guarantee that the forecasts are as accurate as possible. It would be wise to establish a quality assurance mechanism that compares given forecasts with actual weather measurements to ascertain the best meteorological information providers and see how small do the geographical areas need to be for the weather prognosis to still hold true.

3.3 Factors contributing to ICT project success in Ghana

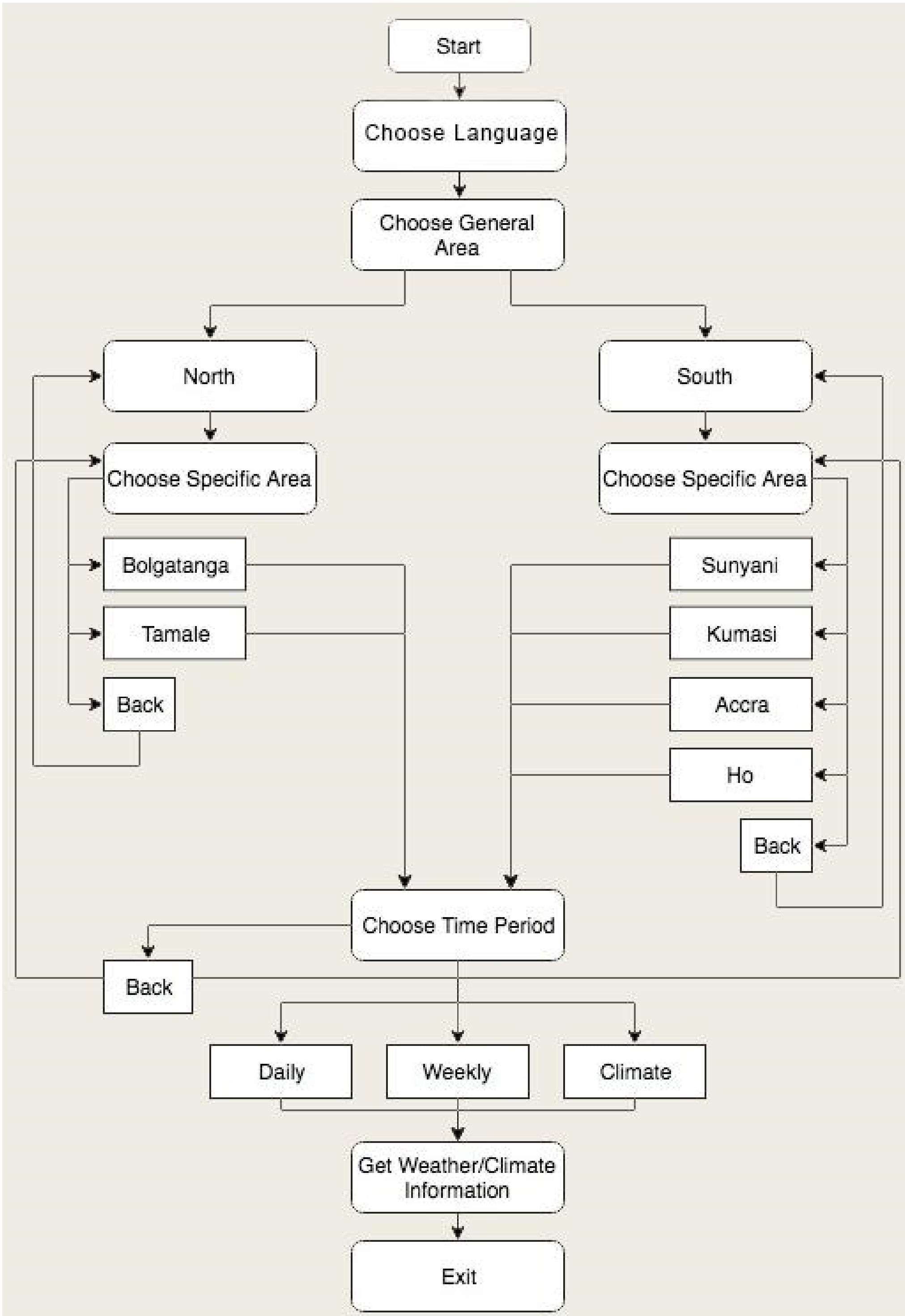
Atsu *et al.* (2010) compiled a study of the factors that lead to the success or failure of ICT projects in Ghana. They analysed the results and listed the factors in order of relative importance. These will be provided in the table below with explanations on how they may be relevant to the current project.

Success factor	**Description**	**Relevance**
Available funds	Getting adequate funding is the cornerstone to finishing any ICT project.	Before starting any sort of work on the ground, we will focus on securing investors. Private, public and NGO investments are all under consideration.
Top Management Support	Alignment of the project with the vision of top management.	Not very relevant to our project, since we are our own top management. Guarantee of support from the top management on the funding side will be of importance, though.
Training	Training of personnel on best practices of project management or end user on how to use the service.	We hope intensive user training will not be necessary as the user-friendliness of the services has been set as top priority. In case of abject technological illiteracy, we will provide the first key training sessions with translators and/or iconographic imagery. The rest will follow suit by

		way of the locals teaching each other to gain rewards through the referral system.
Motivation	Motivation of the development team is key to the successful finishing of a project.	Not relevant at first, as our core group is highly motivated. Will be taken into account once the team grows.
Proper Planning	Poor planning leads to a bleeding of the resources in a country with chaotic bureaucracy.	All legal, technological and fiscal concerns will be carefully considered before putting boots on the ground.
Minimized Scope	Large projects tend to fail more often than small ones. Setting small milestones will be beneficial, considering the high uncertainty avoidance culture of Ghana.	This is why we start with a minimal scope of only rain forecasting and will only expand after the pilot project has been proven successful.
User Involvement	End users have to be involved in the development process, because it's very easy to get the requirements wrong and end up with a product that nobody is interested in.	Currently, this is our biggest drawback as we are developing the code from afar, without really consulting any of the end users. Further development would take place in collaboration with the farmers to pinpoint their actual needs and desires.
Firm Basic Requirements	It is important to have the basic requirements set concretely. Projects that experience feature creep do not do well.	We are deliberately not expanding the scope of our service before it is fully tested on the ground.
Formal Methodology	Organizations tend not to have a culture of documentation in Ghana. This may result in losing "lessons learned".	We will do project management according to Western IT standards.
Ownership	Project managers in Ghana often do not want to take full responsibility due to lack of motivation.	If we hire locals, we must account for a fair salary in the budget to avoid such problems.
Culture	Beliefs and cultural norms can affect ICT projects.	We will take religious and superstitious beliefs into account when marketing or deploying the product. The cultural norm of bribery is not expected to influence our project much.
Political Interference	Quickly changing political situations may influence the project life cycle as the next administration may abort previous ventures.	This will be taken into account if funding is sought from a governmental body. Otherwise, it should not affect our project.

4. SOLUTION DESIGN

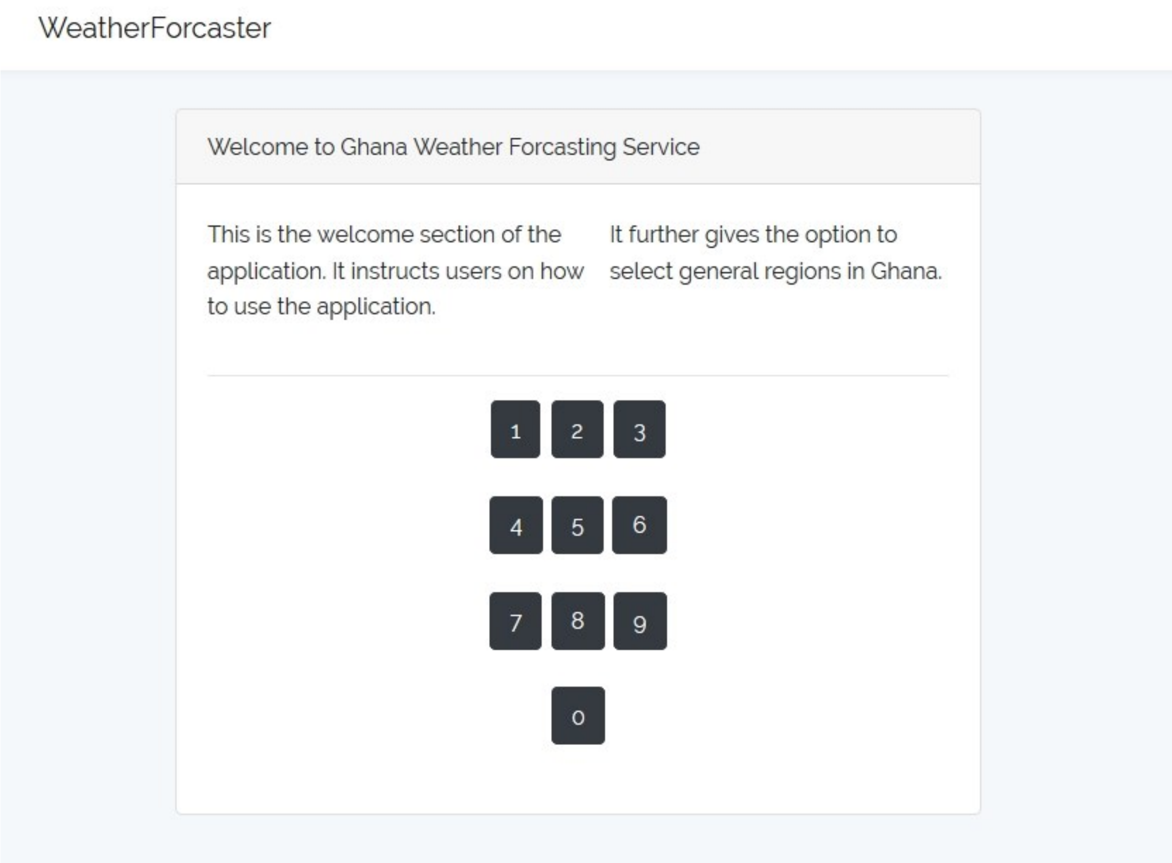
Below is a call-flow diagram of the options presented to the user on calling the dedicated number.



The application works in two fronts: as an interface on the browser and as a voice service.

4.1 Web GUI:

The Web GUI works as a demonstration on how the weather forecasting application works. It can be used to quickly demonstrate its usage while training users, testing out the application and various other presentation scenarios. Since this user interface also works on the same principles as the voice service, it can also be used to debug the application and root out points of failures in the application.



The Web GUI is available at http://ict4d.gotamey.com.

4.2 Voice Service

Along with the Web GUI, the application also has a Voice service. This is available at *http://ict4d.gotamey.com/vxml*. This is the main part of the application and is expected to be the most used part of the application since farmers in Ghana do not have easy access to the Internet and modern browsers or literacy to utilize GUIs. Therefore, a Voice service which can be ultimately implemented in their local language appears to be the best method for the farmers in Ghana to interact with the system and reap the benefits of a weather forecasting application.

5. SERVICE DESCRIPTION

As an added functionality compared to the initial prototype, we added a second language (Dutch) to the menu-system, which you can choose in the beginning when calling into the service. Then the service provides a welcome text and a short explanation of how to use the system. Firstly, the user will need to select the general region they are in (South / North). Then the location is narrowed down to six sub-regions, which are based on the proximity of the user to the largest towns which have weather data available that our service can retrieve. After that, the user is presented with three major options: 1) rain forecast for the day and the following day, 2) weekly rain forecast, and 3) general climate information. For the daily forecast, the service will be able to provide the intensity of the expected rain (light, medium, heavy) and the times of day of it occurring (morning, afternoon, evening). The weekly forecast will specify the days of the week that it is expected to rain on. The climate option will give a general outline of the seasonal patterns of different regions. For a more detailed overview of the menu, see Appendix 11.1.

6. INSTALLATION AND DEMONSTRATION GUIDE

6.1 Installation

To install this application, follow the instructions found in the *README.md* file at the root of the following GitHub repository containing the source code of the application: https://github.com/kishanterry/kasadaka-php.

It is a PHP Laravel application, developed from scratch, based on the work done on KasaDaka VSDK (https://github.com/abaart/KasaDaka-VSDK).

6.2 Demonstration

A running version of this application is hosted on an Ubuntu server at:
http://ict4d.gotamey.com/vxml

Call this Skype number: 020-3697664 to interact with the application. If this number is not accessible then please use the API endpoint:
https://guarded-sea-64793.herokuapp.com/vxml/start/2

This endpoint returns a VXML document starting the interaction between the caller and the application.

7. SCOPE AND FIDELITY

We have focused our efforts in implementing the Web GUI and the Voice service in PHP and the Laravel framework. As KasaDaka VSDK was previously only available in Python and Django, this addition of a new technology stack might increase chances of new developers contributing to and developing the field of ICT4D. PHP is quite a popular language and over the past few years it has seen a lot of performance improvements. There are a lot of good open-source developers in the community. The current status of application just shows what the public facing side of the application looks like. There is still a lot of work to be done on the backend. A fully functioning and complete KasaDaka implementation in PHP remains to be completed.

8. IMPLEMENTATION, DEPLOYMENT AND SUSTAINABILITY PLAN

The deployment of the service would take place in three distinct phases. Firstly, we would choose a fairly small pilot region and disseminate the word about the service to roughly 100 farmers. This would be the beta-testing phase, where we have people in the field, who collect qualitative data from a test group farmers and the other early adopters that the first group refers to our service. People in the office would simultaneously gather quantitative data to see if there are any technical issues, how the devices fair under the load and environmental conditions, and if there is any adoption pattern to be abstracted. Based on the metrics and the feedback from the interviews, we would enter the second agile development phase to redesign parts of the service if need be.

After the tweaking of the service is completed, we enter the second phase which is to release the service to the general population. Depending on the success of the pilot, we might go straight to nationwide or with less stellar feedback, start with a county-wide approach. During phase 2, we will also start developing the additional features detailed under the section “Conclusions and Future Work”. The third phase of the deployment will simultaneously include expansion to neighbouring countries and the beta-testing of the new features in the already cemented pilot region.

Due to the extreme poverty of our user base, we can't expect the farmers to afford paying for the service enough to make it financially viable. Therefore we will need to involve third parties for funding. There are three major options for this. Firstly, the financial backing can come from the government as a subsidy for creating a service that also helps them along with their own development plans for rural areas. Alternatively we may build a requirement into the service that would benefit the government in other ways. One example of this would be to make the service free to use for the farmer, but include the condition that they need to send in data about crop yield or pest outbreaks to the statistical body of the government. Secondly, the funding can come from collaborations with private businesses. Perhaps telecommunications companies want to extend their reach and get new clients, or perhaps we can have affiliations with sponsored products (everything from fertilizers to seeds). The third option is to find an NGO initiative that wishes to achieve goals that are aligned with ours and see if they are willing to offer a grant.

Another part of the business plan is to establish a referral program. The program would serve as a way to get new clients and a self-organizing training program (neighbour teaches neighbour). The referral program would have to have incentives, which could for example be tied to a two-tier system of services. The basic rain forecasting service would be free to use for everybody, but advanced features (see Conclusions and Future Work) would be available for a fee, which is rescinded when a farmer refers an X amount of other regular users to the system.

9. CONCLUSIONS AND FUTURE WORK

In conclusion, we developed a prototype for a voice-based mobile system for distributing rain forecast and climate information, intended for the farmers of Ghana to more accurately plan their agricultural activities. The prototype was first realized as a web application, but can also be implemented on a standalone RaspberryPi call-in device.

There are various improvements and expansions we are thinking of for the future. For example, we can add multiple ways to accept input from the user and use GPS to precisely narrow down the location to provide even more detailed information of the rain patterns in the area. As an added functionality, we added a second language option for the service. Dutch was chosen for demonstration reasons, but the actual service would implement a handful of the local languages in the order of their occurrence in our user base.

It is also important to keep in mind that although our current user base is predominantly severely under the poverty line, this need not be the case forever. With better information and the help of other ICT and engineering diffusions, it is conceivable that the farmers will be able to start producing surpluses and slowly increase their purchasing power by taking those surpluses to the market. This would allow slightly more complex and expensive services to be offered to the same solidified client base. One idea we currently have is to implement the all-in-one model, the likes of which we can most prominently see in the Asian markets (e.g. WeChat). Although smart phone penetration will take a long time in rural Ghana, a lot could still be achieved with a clever combination of feature phones, radio and communal Internet points.

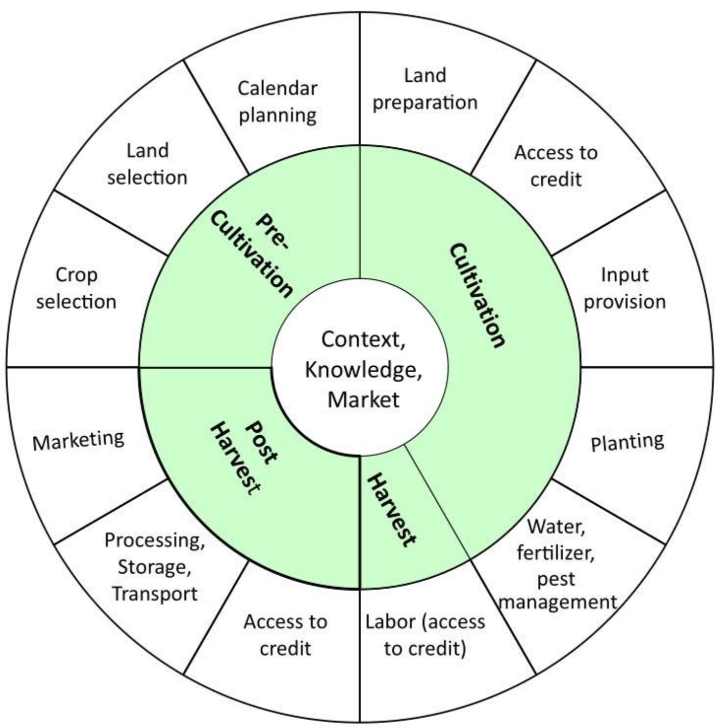


Figure 1. Annual agricultural cycle (Aker et al., 2016, p. 36)

At the moment we are only offering rain forecasting, as this offers the biggest benefits on the ground for the least amount of issues in development. This will serve as a proof-of-concept and an anchor to the user base. Yet, doing traditional agriculture right requires so much more than just knowing what time it will rain. As we achieve higher market penetration and solidify our business processes, we want to slowly add features to "horizontally integrate" all necessities related to farming.

As seen from Figure 1, our service covers only a tiny fraction of the whole agricultural cycle. We could also collaborate with financial institutions and have them use our database of farmers in exchange for sponsorship. The farmers would benefit, because they would get easier and more reliable access to credit at the critical parts of the annual cycle and also get the service cheaper, because credit institutions are in all likelihood willing to cover some of the costs of the service in exchange for guaranteed customers. We could offer advice about which crops are the best to grow in which regions in which type of soil. There is opportunity to provide information about fertilization and pest management, but also cooperate with local agribusinesses that offer such products. There is a huge opportunity in providing information about logistics and market prices, as currently the market is very inefficient due to geographical distances, dilapidated roads, lack of information systems etc., which results in the farmers losing a lot to arbitrage. Each section would require its own in-depth business analysis to work out the details, but the general idea stands: start from weather information and expand to cover the whole informational space of agriculture.

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11. APPENDICES

11.1. Detailed script of the voice-menu

1. Welcome to the rain forecasting service. You can choose your options by pressing numbers on the keypad of your phone.

2. If you are in North Ghana, press one.

2.1. Which is the closest town to you?
2.2. For Bolgatanga, press one.
2.3. For Tamale, press two.
2.4. To return to the previous menu, press nine.

3. If you are in South Ghana, press two.

3.1. Which is the closest town to you?
3.2. For Sunyani, press one.
3.3. For Kumasi, press two.
3.4. For Accra, press three.
3.5. For Ho, press four.
3.6. To return to the previous menu, press nine.

4. For weather information about today and tomorrow, press one.
4.1. No rainfall is expected for…
4.1.1. …today…
C1. <or>
4.1.2. ...tomorrow.
4.2. Today you can expect light rainfall.
4.2.1. Rain is expected in...
4.2.1.1. ...the morning…
C2 <and>
4.2.1.2. ...the afternoon…
C2 <and>
4.2.1.3. ...the evening.
4.3. Tomorrow you can expect light rainfall.
4.3.1. Rain is expected in...
4.3.1.1. ...the morning…
C2 <and>
4.3.1.2. ...the afternoon…
C2 <and>
4.3.1.3. ...the evening.
4.4. Today you can expect medium rainfall.
4.4.1. Rain is expected in...
4.4.1.1. ...the morning…
C2 <and>
4.4.1.2. ...the afternoon…
C2 <and>
4.4.1.3. ...the evening.

4.5. Tomorrow you can expect medium rainfall.
4.5.1. Rain is expected in...
4.5.1.1. ...the morning…
C2 <and>
4.5.1.2. ...the afternoon…
C2 <and>
4.5.1.3. ...the evening.
4.6. Today you can expect heavy rainfall.
4.6.1. Rain is expected in...
4.6.1.1. ...the morning…
C2 <and>
4.6.1.2. ...the afternoon…
C2 <and>
4.6.1.3. ...the evening.
4.7. Tomorrow you can expect heavy rainfall.
4.7.1. Rain is expected in...
4.7.1.1. ...the morning…
C2 <and>
4.7.1.2. ...the afternoon…
C2 <and>
4.7.1.3. ...the evening.

5. For the weekly weather forecast, press two.
5.1. No rainfall is expected for...
5.1.1. ...this week.
5.2. It is expected to rain on...
5.2.1. Monday
C2 <and>
5.2.2. Tuesday
C2 <and>
5.2.3. Wednesday
C2 <and>
5.2.4. Thursday
C2 <and>
5.2.5. Friday
C2 <and>
5.2.6. Saturday
C2 <and>
5.2.7. Sunday

6. For general information about the climate and seasonal patterns, press three.

6.1. Generally, winter is the dry season and summer is the rainy season. In the North, there is one rainy season, which lasts from May to September. In the South the rainy season lasts from April to November. Along the coast, the rainy season is shorter, but divided into two. The first period lasts from April to June. In July and August, there is less rain. Rainfall increases again in September and October.

7. To return to the previous menu, press nine.

8. Thank you for using our rain forecast service.

Menu duplication table

The recording for this menu can be reused…	*…in these menus.*
2.1.	*3.1.*
2.4.	*3.6., 7.*
4.1.	*5.1.*
4.2.1.	*4.3.1., 4.4.1., 4.5.1.*
4.2.1.1.	*4.3.1.1., 4.4.1.1., 4.5.1.1., 4.6.1.1., 4.7.1.1.*
4.2.1.2.	*4.3.1.2., 4.4.1.2., 4.5.1.2., 4.6.1.2., 4.7.1.2.*
4.2.1.3.	*4.3.1.3., 4.4.1.3., 4.5.1.3., 4.6.1.3., 4.7.1.3.*