Voice-Based Marketing for Agricultural Products: A Case Study in Rural Northern Ghana

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ABSTRACT

We present a study conducted in rural Northern Ghana about issues around the marketing of agricultural products and the need of mobile-based ICT solutions. The need for the spread of information and web access to communities in developing countries has given rise to the design and development of numerous ICT solutions, many of which have focused on the recent increase of mobile usage in developing countries. The contributions of this paper are: 1) Empirical results from a field survey run in Northern Ghana, which points to issues of a lack of buyers, low price offers and lack of transportation to sale points as the main issues in marketing of agricultural products and also points to the potential for mobile-based ICT solutions to mitigate the pertinent issues within the case study, but also in other areas. 2) The development of a voice-based prototype that allows medium to large scale farmers in rural areas to place advertisements on the World Wide Web. The prototype was evaluated based on functionality and feasibility, including financial sustainability.

Categories and Subject Descriptors

K4.2 [**Computers and Society**] Social Issues; H.1.2 [**User/Machine Systems**]: Human Factors; H5.1 [**Multimedia Information Systems**] Evaluation/methodology; H.5.2 [**User Interfaces**]: Voice I/O; H.5.2 [**User Interfaces**]: Evaluation/methodology

General Terms

Design, Economics, Experimentation, Human Factors, Standardization, Languages.

Keywords

voice-based interfaces, agriculture, rural development, mobile, case study, e-agriculture

1. INTRODUCTION

There are various rural challenges with regards to agricultural development in Africa. These include *lack of land tenure, particularly for women, and shrinking plot sizes; limited use of irrigation and fertilizer; unreliable water supplies; and inadequate access to credit[1]*. In Ghana, projects in rural development [1] and [2] look into organization and provision of training and know-how. The research concentrated on how to connect these farmers in Ghana to markets; *production of food without a means to market and sell is counterproductive and does not aid the development of the individual, farmer groups or the region*.

Ghana, with a population of 24 Million [7] and having recently attained middle income status [12], has the potential of spearheading most of the technological advancements in Sub-Saharan Africa. Due to its relatively stable economy and absence of the unfortunately usual political and/or ethnic conflicts, it provides a suitable testing ground for research. Northern Ghana covers $97,702 Km^2$ (40.96% of the nation's surface area) [11]. We select this area for our case study because its rural areas fit the targeted group, being an agriculture-production region and more deprived of infrastructure. This gives the opportunity to find solutions that can capitalize on the former quality and mitigate the latter.

In addition, the extreme increase of mobile telephony in Africa [9] and its use even in rural areas has led to the emergence of ICTD projects, research and solutions that aim to research and/or utilize SMS [5][8], Mobile Web [3] and Voice Technologies [13] to aid various aspects of development.

The aim of the research is to investigate the requirements and design of a service which NGOs, local companies and/or institutions can host to aid rural farmers; as such it must be developed so it is easily maintained and modified. An initial overview of the characteristics of the target group suggests it must also support multiple users as well as language integration, should be reachable, robust, simple and able to handle errors.

It is also imperative that researchers and software developers benefit from this research and as such a vital outcome is the reusability of the methodology. This paper therefore outlines the process used in detail and provides suggestions on innovative

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[1] http://www.reuters.com/article/2012/05/02/us-hunger-africa-greenrevolution-idUSBRE8410GY20120502

software design for rural Africa with regards to mobile and voice technologies within a specific socio-economic context.

2. RELATED WORK

2.1 ESOKO

Esoko is an agricultural profiling and messaging service managed on the web and delivered via mobile. The Esoko platform provides automatic and personalized price alerts, buy and sell offers, bulk SMS messaging, stock counts and SMS polling [6].

Esoko is text-based and therefore shifts its focus to a more literate group. In addition, the technology is complicated as opposed to the simple call-making that most of the rural farmers are conversant with. This research therefore investigated the literacy levels and use of SMS within the target group so as to decide on which communication mode(s) were best suited for the region. Esoko however has issues due to lack of education and high rates of illiteracy [5].

2.2 Radio Marché

The project [13] is a voice-platform that helps farmers to broadcast their offerings of produces like sheabutter and honey on the local radio using innovative Voice Technologies. The Service marks the first phase of the pilot of the VOICES Project [4].

Apart from the difference in location, which creates a whole new context, this project tackles the use of Interactive Voice Response (IVR) with Dual-Tone Multi-Frequency signaling (DTMF) to provide direct access to the system and also focuses on inter-connectivity with the web. These are yet to be implemented in Radio Marché, without which, scalability remains a challenge.

An important lesson learnt from the VOICES Project is the ineffective nature of solutions based on SMS within the context of rural Africa. Therefore, although the possibilities of using SMS were investigated by assessing its use by the target group and their literacy levels; it is worth mentioning that the research was biased against the use of SMS. This also applies to smartphones and PCs. Radio Marché therefore directed the research of applicable technologies toward Voice technologies.

3. MARKETING OF AGRICULTURAL PRODUCTS IN RURAL AREAS OF NORTHERN GHANA

3.1 Survey

In order to understand issues related to marketing and sales of agricultural products we developed a questionnaire[2] which was administered in three rural areas in Northern Ghana [11] to medium to large scale farmers. This selection is meant to concentrate on rural farmers that have the potential to market their produce.

The field survey was designed based on several hypotheses that theorize the issues surrounding sales of agricultural products from rural areas, what is currently done with regards to selling agricultural products and the current trend of ICT usage by farmers in relation to the topic at hand. This was necessary to confirm findings from the reviewed literature [3] [4] [14], determine those that have not been answered by the review (i.e.

mostly context-based issues) and effectively answer the research questions. Some questions, such as type *the willingness to use an IVR-based service*, were meant for requirement elicitation for the prototype in the specific context, while other questions that probed the *ability and willingness to store, package and sell* were meant to assess situations that will have an impact on the business models needed to facilitate an implementation of the developed system.

3.2 Qualitative Data Gathering

Open-ended questions were included in the questionnaire in order to lead the field workers in short discussions on certain key points. Examples are reasons for not selling produce and problems faced finding buyers. These, and other similar factors, are analyzed qualitatively as well in an explanatory fashion so as to better understand the factors without forcing predefined answers or limiting the responses.

A combination of interviews with members of The VOICES Project [4], secondary information from various NGO-run projects in Northern Ghana and personal experience of the region and context was used as secondary data. These interviews and open-ended questions led to two key findings. Firstly, the emphasis on mobile telephony was strong. Secondly, the need for a well-structured sustainable model was a recurring concern.

3.3 Data Analysis and Findings

We present the most important findings from the field survey. A copy of the complete results is available online[3].

3.3.1 Demographic Profiles

There were a total of 108 respondents of which 75% were male and 25% female. Respondents ranged from ages 19 to 80 with a mean age of 42.20. A total number of 90 were married constituting over 80%. This is significant, in that, majority of them have families and therefore providing a means for them to make financial gain will affect not only them, but a wider range of people. The ability to educate their children due to financial gain will go a long way to improve the livelihood of the entire community and country in the future.

3.3.2 Marketing of Agricultural Products

Respondents interviewed consisted of crop farmers (25.0%), animal farmers (2.8%) and farmers that had both animal and crop farms (72.2%). The data shows that, with access to more buyers, farmers are willing to produce more. Surprisingly, a considerable number of farmers are willing to change the crops they produce to suit buyers (56.5%), willing and able to provide transportation for medium to large scale buyers (42.6%), willing and able to store crops for sale (48.1%) and willing and able to package crops for sale (57.4%). This is further solidified by answers obtained for the major issues in obtaining buyers. This also gives some insight into creating a good business model for a marketing solution.

3.3.3 Current Trends

Almost all sales currently (January 2013) are to individuals (36.5%) or at the local markets (41.7%). A few of the sales are to high-end buyers (19.2%) which include NGOs, The Government and other companies. This is most likely a result of farmers hardly

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advertising outside their communities but relying on personal contacts (59.2%) and friends (26.5%). 59.3% of respondents indicate avoiding the use of middle-men and among those who have middle-men in their value chain, 86.5% would rather do without them. One should note that considering the nature of value chain in Ghana the "middle-men" as noted by respondents are just but one of the many in a long chain [14].

The profits made by the farmers are still affected by this chain of middle-men and shows in the data obtained; 66.7% of respondents are unsatisfied with what they make from sales with the major reason being *low price offers*.

3.3.4 ICT as a Solution
In light of the above, it is imperative that we determine if an ICT solution will be suited for the region based on the relevant technologies identified for a project in this context since there was virtually no use of ICT solutions in the region.

A total of 76 respondents, representing 70.4% have mobile phones. Using the analysis of a Likert scale [10], which assigns numerical values to ordinal data by giving each a value on a scale (the most common scale is 1 to 5), the mean of frequency of voice calls of mobile phone owners is 3.04 (Regularly) whiles the mean value for the frequency of the use of SMS is 1.37 (Never). This gives a confirmation that mobile telephony provides a good platform for a rural-based application but it must rely on voice technologies.

Delving further into the issue, 91.7% of respondents are willing to utilize a mobile-based advertisement service, including farmers who did not have mobile phones. Encouragingly, 81.5% are also willing to pay for this service and 95.4% are willing to receive calls from buyers.

After a further explanation that the proposed system would utilize Interface Voice Response (IVR) by showing its similarity to the credit recharge voice prompts, 64.2% are still willing to use such a service and 26.4% would consider using it.

3.4 From Issues to Requirements

The information gathered from interviews and field survey enabled the elicitation of requirements for the proposed solution.

The system must be accessible by mobile phone through a local number to allow farmers to call in at optimum cost. The phone call must be answered by the voice system using Interactive Voice Response (IVR) with DTMF. Furthermore, the system must support the integration of local languages, utilize an online database for data storage and be accessible online by means of a Web Interface. It would also be advantageous to use familiar voices and/or local accents for the needed voice prompts, have a local database for offline data storage and provide privileged access to an administrator.

The prototype's non-functional requirements are Maintainability, Scalability on total number of users and languages, Reliability, Robustness of the software and Compatibility.

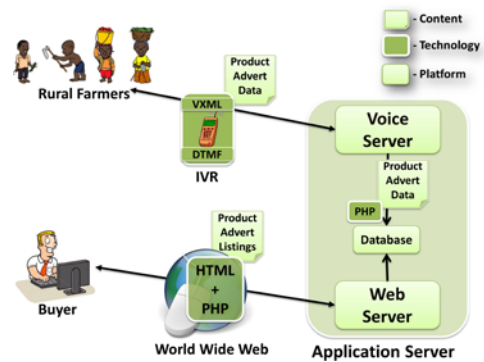## 4. SYSTEM DESIGN OF VOICE-BASED PROTOTYPE

Figure 1: Conceptual Design of the Voice-Based Prototype

We designed the system to reduce the value chain by providing farmers, through the use of Interactive Voice Response (IVR) in their local language(s), with the use of Dual-Tone Multi-Frequency signaling (DTMF), the ability to place ads directly to the internet.

As shown in the design concept (Figure 5), a rural farmer with products from his farm for sale, places a call to a local phone number. A Voice Server connected to this number answers the call and asks for data pertaining to the ad which the farmer must input using the keypad.

The inability to utilize functions such as phonebooks on their phones has forced the targeted users to become conversant with the number pads on their phones. Coupled with the ability to relate to amounts in numbers due to the general understanding of the country's legal tender, the problem of illiteracy does not affect using DTMF for data input. The voice system then asks for a confirmation and when given transfers the information obtained to a database. A webpage that hosts the web interface of the system accesses this database to provide the product listings to people with access on the World Wide Web.

Implementations of the web interface[4] and a database dump[5] are available online as well as all source code[6].

5. TEST AND EVALUATION
The prototype was evaluated based on the requirements to ensure that its function serves the needs elicited from the survey and interviews. A feasibility analysis was carried out to ensure that implementation is technically, economically, legally, operationally and schedule-wise possible without major issues.

Finally, we analyze the financial sustainability of the project and drawing from other similar projects, outline possible financial models that can sustain the project after implementation. These include a model that is NGO-run and one that is based on operation by a local ICT company. These financial models will be further evaluated and fine-tuned during and after implementation.

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[4] http://fsd.netau.net/eAfr.php

[5] http://fsd.netau.net/data.php

[6] http://fsd.netau.net/Source Code.pdf

6. CONCLUSION AND DISCUSSION

The research looked at how to boost sales of agricultural products from rural areas in Ghana using the voice technology. This paper makes two main contributions: (1) Empirical data from a field survey and (2) The development of an architecture and prototype.

6.1 Empirical Findings

The data survey conducted in Northern Ghana, which provides empirical data to verify the need for an ICT solution and subsequently obtain specific data needed for requirements of the software showed that the underlying issues in marketing of agricultural products from rural areas are a *lack of buyers*, *low price offers* and *lack of transportation* to sale points.

The current solutions are sales to individuals and at the local market. These solutions are not adequate because these buyers are not sufficient to purchase in large quantities and as such do not reach the full capacities of the farmers. Furthermore, the analysis showed that farmers do not have access to ICT solutions. The findings also showed the availability and use of mobile phones by these farmers. It however shows that rural farmers never use SMS. The data also confirms a willingness to use and pay for a voice-based ICT service for advertising.

An important lesson that was reemphasized by the survey is one of mobile telephony. Mobile telephony has the potential to provide web access to rural areas, albeit in a different form/manner than we are used to. Providing unidirectional access to the World Wide Web through proxy is currently doable and can be modeled to aid various areas.

6.2 Prototype Development

The development process resulted in an architecture and prototype that meet the immediate needs of the target group and stakeholders and is financially feasible. This was as a result of the process used, which capitalized on the initial requirements obtained from the target group coupled with the socio-economic situation of the location and an adaptation of the available technologies to fit the proposed solution.

The research showed that the design of applications in the ICTD context has significant differences as opposed to 'normal' software development; the design phase is greatly impacted by the specific context situation and as such the context must be analyzed in-depth prior to software design. The mixture of issues such as lack of infrastructure, illiteracy and culture in developing countries present unique conditions that must be considered with similar approach as shown in this paper. Furthermore, the design should take matters of financial sustainability into account and attempt to include modules and/or functions that can be used to create a business model (e.g. registration).

Furthermore, ICTs can be utilized to aid numerous aspects of other fields of study and endeavors in developing countries and even in rural areas. It is necessary however to gain in-depth knowledge and analyze these fields in order to understand the situation properly. As such, involving experts from these other disciplines is necessary to facilitate a multi-disciplinary approach.

6.3 Limitations

The survey focused on medium to large scale farmers and is therefore not generalizable to small scale farmers. This is however necessary since in deployment, large amounts of product sales are needed for its running to be financially sustainable. Also, the prototype was developed and evaluated in a test system and without the target users. There is a possibility of missing certain minute but vital concerns when tested on a fully setup system. These will however be investigated in the future.

6.4 Further Work

The next stage of the research involves field deployment of this innovation. This is meant to be carried out in collaboration with Non-Governmental Organizations working in the target region. These NGOs have programs that include both aiding the marketing of agricultural produce from rural areas and the inclusion of ICTs as solutions to their needs. There is the need for further research based on specific interventions and/or locations and the subsequent implementation of the solution which will yield even more data that will be channeled into building solutions for other rural-based issues.

7. ACKNOWLEDGMENTS

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