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Mobile app design for sustainable agriculture in Mali-West Africa

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Mobile app design for sustainable agriculture in Mali-West Africa

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Abstract. In Mali, agricultural activities such as seeding, harvesting, and irrigation play a significant role in productivity. These activities must be carried out appropriately and above all, at an appropriate time to achieve excellent performance. Unfortunately, most farmers are unaware of the impact of these activities on the yield of their crops. This study aims to help farmers and youth people wishing to gather information needed in the field of agriculture entrepreneurship through a mobile application (mobile app). The app designed is mainly used to disseminate information to farmers on how to perform a wide range of agricultural activities such as detailed information about the type of crops, fertilizers, pesticides, selling and buying a product of agriculture, etc. This research was conducted for the adoption of the mobile application in the agricultural field in Mali. The design process followed a User-Centered Design approach to meet the users' requirements. The evaluation of the design showed that 89, 66% of the participants agreed with the designed application prototype. This app helps farmers and youth people improve their agricultural productivity and not to harm the environment. Therefore, the app helps them for sustainable agriculture to make better land management decisions.

1. Introduction

Mobile App Design for Sustainable Agriculture is conducted for the adoption of the mobile application in the agricultural field in Mali. Sustainable agriculture is a term that continues to acquire importance in the agricultural sector but with many misunderstandings, controversies and challenges. According to the World Bank in 2015, about 70% of the sub-Saharan African population is engaged in agriculture [1]. Agriculture is the foundation of human existence and it is vital to the survival of humankind [2]. Agriculture consists of several activities such as sowing, irrigation, fertilization, harvesting, etc. Nowadays, new technologies are at the core of agricultural change [3]. Information and communication technologies (ICTs) play a significant role in disseminating information about agriculture to facilitate access and the use of agrarian input information (AII). Also, farmers have been exposed to ICTs to access agricultural inputs in developing countries [4]. Mobile phone is the primary channel used to access agrarian information in Mali. Due to the proliferation of mobile phones, developing countries have experienced great technological advances with the implementation of innovative technological solutions in economic activities such as agriculture [5].

The dissemination of agricultural information to farmers in the poorest communities is facilitated through mobile phones. Nowadays, mobile phones are generally used by everyone and it is not only a communication tool [6]. The mobile application is a computer program designed to work on mobile devices such as smartphones and tablets etc. Due to declining Internet access costs and the proliferation

of smartphones, mobile applications development has increased significantly. Mobile apps are not just used for communication or entertainment, they are also needed in other sectors such as finance, agriculture etc. [7]. Agricultural sectors are currently developing a lot of modern agriculture or smart agricultural systems. The hydroponic method is developed for more manageable agriculture. Agriculture with a hydroponic system offers great benefits. The hydroponic system is designed to be used in irrigation management. Management with automatic irrigation can be controlled in real-time by mobile devices which should allow efficient use of nutritious water [8]. The mobile app for agricultural and rural development is one of the emerging areas in improving agricultural quality and rural development. They are used to provide information to farmers and help them improve their productivity [9].

Mali is a landlocked country and the second-largest country in West Africa. It is bordered by Algeria to the north, Niger to the east, Burkina Faso and Ivory Coast to the south, Guinea to the southwest, and Mauritania to the west. Mali has a northern border that extends to the middle of the Sahara desert. The majority of the population lives in the south, where there are the Niger river and Senegal [10].

Mali is an agro-pastoral zone where the climatic realities are very different. There is the Sahara in the north of Mali, and the Sahel in the center of Mali. The south of Mali is called the green zone and the majority of the populations are farmers. Mali, with 80% of its population is engaged in agricultural activities. The sector is the cornerstone of the Malian economy and offers considerable potential for economic growth [11]. Agriculture plays a leading role in the economy and society in Mali. Most regions have natural and human resources necessary for reliable and sustainable agricultural development. Despite some improvements in recent years, a high percentage of people living in agriculture depends on poverty. Income gaps between farm and non-farm households are significant. Some rural and urban populations suffer from malnutrition and food insecurity [12]. However, Agricultural activities in Mali are characterized by low productivity. Sustainable agricultural intensification is needed to achieve better levels of food security, post-harvest crop losses, underdeveloped markets and vulnerability to climate change are some of the critical challenges for Mali to have food security and broader economic growth [13].

The objective of this research is to provide necessary information needed by farmers such as seed varieties, types of fertilizer and information about various agricultural activities. In developing countries like Mali, this mobile application can be used to improve production and productivity in agriculture, increase efficiency levels and ultimately reduce the environmental impact of agriculture [14].

2. Proposed methods

In this research, we designed an application called Agro App Mali. To conduct the research, quantitative and qualitative approaches were used. For primary data collection, a Google form questionnaire was sent to the participants. In other hand, the secondary data was collected from the related research and related work guided by qualitative approach. To design a prototype, an Adobe XD application was used to design the mobile application. Whereby User-Centered Method (UCM) was used to run the application designing process. The application is designed specifically to work on all Android platform mobile devices. It targeted to the farmers and youth people wishing to gather information needed in the field of agriculture entrepreneurship in Mali. This mobile application can help farmers to identify the best crop to grow for a given area and make better decisions about land management [15].

2.1. System function

Agro App Mali is designed for Android-based mobile devices. The app targeted to farmers and young agricultural entrepreneurs in Mali. The significant operations which are performed by this mobile app are:

- The application gives information about farming activities
- User needs to log in to access the application
- The app provides necessary information about varieties of seed, fertilizer, pesticide, etc.

- Weather for each area is displayed to enhancing the understanding ability of farmers about the weather conditions
- User can seek help to the expert
- The information can be updated anytime by the administrators
- The application provides all the latest news about agricultural activities

The advantages of the proposed application:

- This mobile app has a simple user interface; farmers and youth people wishing to gather information needed in the field of agriculture entrepreneurship can use it efficiently
- Weather information is provided by considering the locations of users which helps farmers to use their resources sustainably
- This application helps farmers in farming activities to increase crop productivity
- The application gives details information about the type of crops, fertilizers, pesticides, selling and buying a product of agriculture, also agriculture entrepreneurship
- The application is easily accessible by users because smartphones are used by everyone nowadays

3. Results and discussion

From sowing to harvesting, agriculture implies some agricultural activities. The smooth running of these activities plays an important role in crop productivity and the sustainable use of resources [16]. Agricultural experts also highlight the importance of an appropriate schedule for good performance, but many farmers do not know about it or often they are confused because of the climate change. Nowadays with the availability of access to the Internet and smartphones, information about farming activities is provided to farmers easily [17].

Agro App Mali is designed for android based mobile devices targeted to farmers and young agricultural entrepreneurs in Mali. It consists of several functionalities such as:

3.1. Homepage

The homepage is the main page through which users can access to all features of the mobile app. The homepage is used to facilitate navigation to other pages of the mobile app by displaying the icons of other functionalities. To access the homepage, the user needs to log in first. Figure 1 shows the homepage and it is the main page of mobile apps.

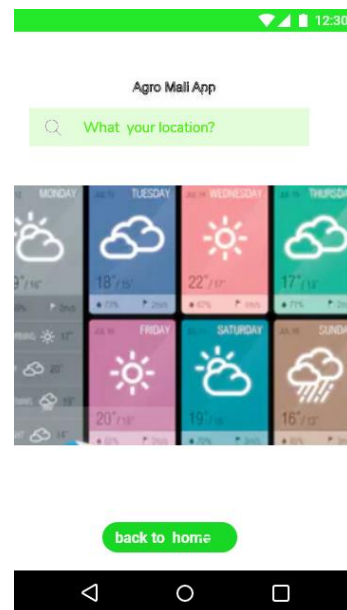**Figure 1.** Homepage.

Figure 2. Weather view.

3.2. Weather

It is a window that displays the weather conditions of each area. Users need to input their location then the mobile app displays the weather conditions of the given area. Figure 2 shows detailed information about the weather conditions.

3.3. Crop page

It is a page which allows the user to input data of the type of crop, the wanted season to grow, the chosen plant and the period of growing plant. The user can also input his localization. Through those input data, the mobile app displays the detailed information of the chosen crop, the appropriate season, and the period. If the user inputs the wrong season or wrong crop of the season, the mobile apps will suggest the best plant to grow in the needed season. The user can continue and get needed information or back to the homepage. Those actions are displayed as showed in figure 3.
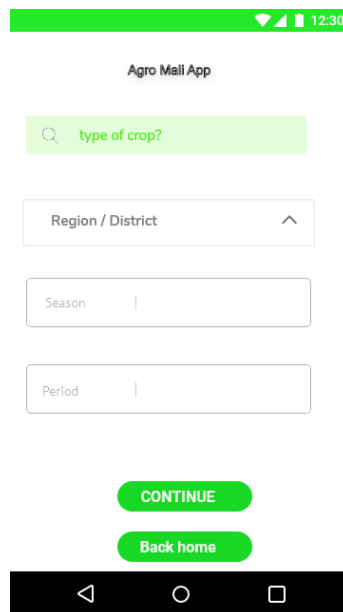
Figure 3. Crop.

This research was conducted for the adoption of the mobile application in the agricultural field in Mali. The design process followed a User-Centered Design approach to meet the users' requirements. The questionnaire composed of 16 items. To assess the reliability and validity, a five-point Likert scale was used from Strongly disagree=1, Disagree=2, Neutral =3, Agree=4, and Strongly agree=5. Details regarding the questions were properly articulated to the respondents before filling out the questionnaire. Along with using USE testing by utilizing 4 USE criteria, namely usefulness (US), Ease of use (EU), Ease of learning (EL), and satisfaction (SAT) to evaluate the prototype [18]. The evaluation of the design showed that 89, 66% of the participants agreed with the designed application prototype. With the application, the participants felt helped and could learn about agricultural activities.

4. Conclusion
In this research, we proposed mobile app designed for Android-based mobile devices that provide agricultural information such as seed varieties, types of fertilizers or pesticides and information about various agricultural activities. It targeted to the farmers and youth people wishing to gather information needed in the field of agriculture entrepreneurship in Mali. This mobile apps also provides information about agricultural entrepreneurship and market price for selling or buying food products. In developing countries such as Mali, this mobile application can be used to improve production and productivity in agriculture, increase efficiency levels, and ultimately reduce the environmental impact on agriculture. This research did only the design of mobile application for sustainable agriculture. For future work this application can be implemented and incorporate a GPS.

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