M-learning for Promoting Advancements in Agriculture: An Innovative Educational Model for Ethiopian Farmers

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***Abstract*— ICT is bridging the gap for most of the farmers all over the world. The agriculture sector provides not only employment opportunities but also, it's a very important source of livelihood for farmers. ICT and Agriculture is an important combination nowadays for any country. Rapidly changing in the technologies opened a wide scope in the agriculture sector. Smart farming, Weather prediction, Satellite imaging, Vertical farming, Use of Drones and many other farm automation technologies fascinated for effective farming. It has been observed that farmers in various regions of Ethiopia are unaware of the latest emerging trends and technologies for effective agriculture processes. Apart from that, farmers are suffering economically and socially due to illiteracy. Some of the other challenges include lack of market knowledge, unpredictable climatic conditions, lack of enhanced practices and lack of crop disease knowledge.**

Learning comprises of knowledge acquisition, knowledge management, and knowledge augmentation. The learning contents include crop cultivation, use of pesticides, water management, harvesting and so on. An appropriate farming knowledge base is required for better functioning and future predictions. Based on the knowledge base, Mobile learning will provide innovative services, reduces the time, improves efficiency and increase the sustainability for farmers and other agriculture stakeholders for a longer period.

This research will propose an educational model for all the farmers to learn and expose the latest technologies in agriculture as well as peer to peer interaction for solving critical issues while farming. In context to the same, we are also focusing on eliminating the language problem for understanding better farming practices. The implementation will improve agricultural productivity and hence, the economy.

***Keywords*— ICT, Smart farming, Knowledgebase, Mobile learning, Cloud Computing**

I. INTRODUCTION

Eastern Africa is considered to be the most vulnerable region in the world due to its high dependence on agriculture for subsistence, employment and income [1]. Ethiopia is a country where the government plays a strong leadership role in not only setting policy for the farm sector but in organizing support at the local level. Because of its huge geographical extent, and the great variations in altitude between and within regions, Ethiopia now offers an extraordinary diversity of climates and crops and models of rural production [2]. Nowadays, the basic condition for the development of any country is the up-gradation in technology. The agriculture sector in most of the countries has been digitized using ICT to overcome various challenges and it plays a critical role in the global economy. As the human population increases, pressure on the expansion of the agriculture system also increases [3].

In most parts of the world, modern technologies motivated the learners to switch from teacher-centric to learner-centric approach. The learner-centric model designed by the researchers (2017) in which teachers are the course owners or experts who incorporate entire contents into the online system. Online education resources created in Gnomio (Moodle), videos created using Screencast-O-Matic uploaded on YouTube and YouTube links embedded in Gnomio. For editing any video, any free software tools can be used. The entire model uses ICT and open source tools and technology for a better outcome. The role of the instructor is to use pedagogy, course management, student management, adding activities; evaluation based on using designed activities, interaction and optimize solutions given for the problem [4].

Intelligent Tutoring System (ITS) application has changed the traditional teaching mode and improves teaching efficiency. It helps students' intellectual development and the cultivation of students' abilities.

The intelligent teaching system has become the hot spot for computer-aided teaching research and application[5].

Mobile cloud learning positively influencing the learning process from both educators and learner's perspective. The biggest benefit of using Moodle on cloud for the off-campus users in Khalifa university is that it can be accessed from mobile devices and other smart devices [6].

A very useful initiative by CSA (Climate Smart Agriculture) project team [7] in which they have identified 1000 lead farmers to test and adapt CSA techniques for boosting their agricultural growth and market trends. This project is especially designed for managing resources and protecting the farms at the time of climatic changes and promoting latest techniques and methodologies. To drive this project in a correct way, they have used SMS text, Radio shows, Websites, Mobile apps to distribute the information about agriculture techniques with corresponding weather events and market trends.

II. CHALLENGES IN AGRICULTURE

The major challenges that Ethiopia facing since 2004 are diseases such as rinderpest, trypanosomiasis, foot and mouth disease, and liver fluke. Some other challenges include a lack of institutional stability and policies for an increase in production. [8]

Change in the climatic condition is a constant problem for most of the countries as most of the developing countries are dependent on rain-fed agriculture. Due to unpredictable climatic conditions there is a loss in crop production, degraded soils, extreme poverty, lack of infrastructure and many more challenges.

E-Learning has brought significant changes in the teaching-learning process. The objective of E-learning can be achieved only when resources and suitable infrastructure available. It is a major challenge for the farmers is to learn farming from advanced and modern tools and technologies. It had also been commented that the Ethiopian higher education system is following traditional teaching-learning methodology [9].

Therefore, this research focuses on educating and training the farmers and enabling them to use modern agricultural technology for improving agricultural productivity and economy.

III. TECHNOLOGICAL ADVANCEMENTS- SMART FARMING WITH PRECISION AGRICULTURE

Smart farming is one of the global initiatives by the researchers and technologists for maintaining sustainable agriculture and preserve resources. Sensors, Drones, GPS, Wireless Communication and some real-time applications and monitoring software in agriculture are being used for sustainable agriculture. Social media and market news will help in forecasting and predicting market behavior which leads to economic benefits. [10]

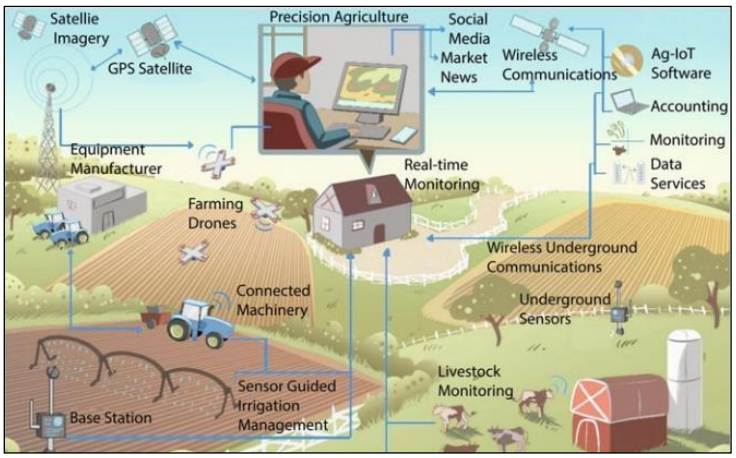

Figure1. Smart farming using precision agriculture [10]

Renowned IT firm Accenture has created two advance solutions using IoT in combination with big data analytics, visualization capabilities and Industry knowledge. These two advancements are Accenture Digital Agriculture Service (for large scale farms) and Accenture Connected Crop Solution (for

developing countries and smallholder farmers). The first one is for meaningful and timely decision making to improve yield and profitability. The second one can enable agro-input providers to boost field agent productivity and help farmers improve yields by providing fertilizer, pesticide, and seed recommendations personalized for each farmer's land and needs. [11]

IV. M-LEARNING USING TECHNOLOGY

The solution can be cost-effective and efficient by using open source tools and technologies. Marion (2016) suggested an Android App OppiaMobile integrated with Moodle LMS which allows different types of users to be benefitted. The course instructor can build the course and upload the course contents (text files, PowerPoint slides, videos) on the Moodle. Learners can access educational contents, activities, videos, quiz and other features while on network or offline. The very important functionality in this integrated technology is Text-to-speech which allows contents or activities to be read for the learners. Updated course contents automatically downloaded on mobile whenever the learner comes under network area (or turn-on internet connectivity). Other important features on the instructor side include course completion report, SMS and email notifications, grading system and user management. [12]

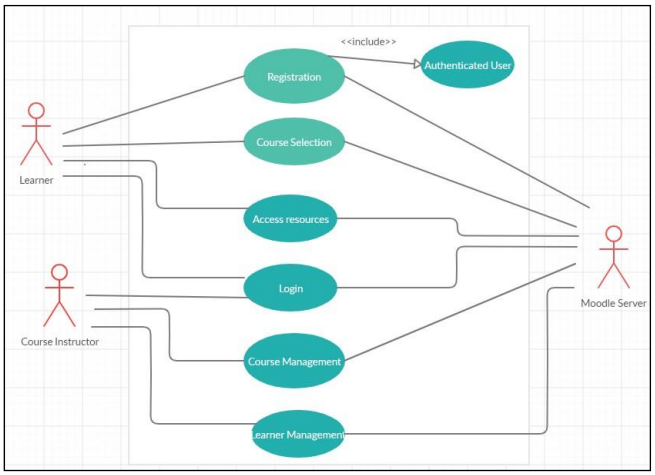

Figure 2. E-Learning through Moodle

V. SIGNIFICANCE OF KNOWLEDGEBASE AND CLOUD COMPUTING

A knowledgebase simply means a collection of knowledge using knowledge representation language. Knowledge representation is the part of Artificial Intelligence for solving complex problems, data processing and analysis, modeling and making predictions. [13] The knowledge-based system is the formal database of information and queries from the users analyzed by the complex system for the results. The results could be retrieved in the form of images, text, charts, videos or simulations. Knowledge-based systems recently accelerated due to the introduction of classification and analysis techniques for data extraction and decision making techniques. [14]

It is expected to have a significant increase in the knowledge base for agriculture in the current or latest trends of agriculture. Also, they require a structured agricultural knowledge-based system so that users will be able to perform a search on the available database and extract the required information. The standard vocabularies and important variables related to crop data needed to be included in the database.

The objective of suggesting cloud service is to avoid the communication delay and enhancing scalability. As cloud computing comprises of various servers, virtual machines and storage devices interconnected with each other, performance would be the major issue. As far as application and software is concern,

virtualization support in cloud allows better flexibility and customization.[15] Therefore, Moodle on cloud would be the better option for model.

VI. PROPOSED MODEL

The proposed model comprises of Moodle integrated with knowledgebase hosted on cloud. The complete computing storage will be on the cloud side and users can access applications with very less memory space on the mobile. The knowledge base will be the structured agriculture knowledge-based system for extracting information queried by the user. It needs to be updated by the registered course instructors. The course instructors can create the courses and upload the contents based on their expertise area in the agriculture domain or technology. After course creations, publish the course on OppiaMobile Server which will transfer the course contents with all activities/resources created for the users. At the user end, farmers can access the information in local language for easy understanding, livestock market information to manage their debts, taxes and other living expenses. Weather forecasting details help the farmers for proper crop management. Social media help the farmers for sharing their success stories with other farmers or group of people. Awareness and other programs related to farming can be shared with the help of social media. This will motivate the peer to peer interaction. All these are possible by using agriculture APIs integrated with the mobile application. Implementation of this proposed model is possible only if there is smooth internet connectivity.

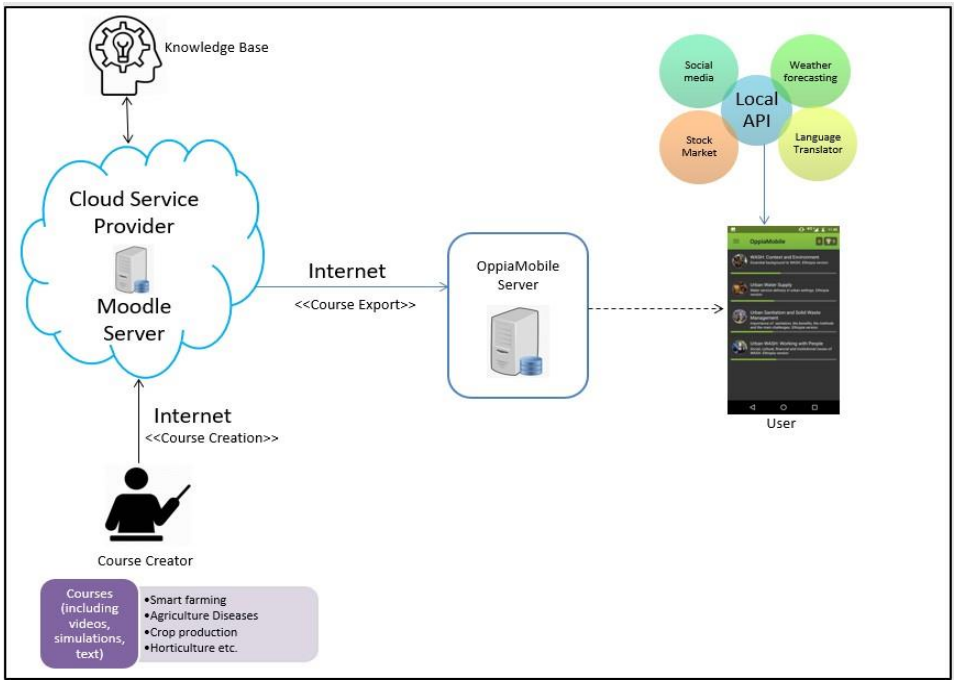

Figure3. Proposed M-Learning Model

VII. CONCLUSIONS

The major outcome expected from this research is successful and productive E-Learning by introducing latest tools and technologies. It is expected from the course instructor to design the course in such a way that farmers can easily understand the concepts and practical implementation of the course. The contents and course materials must be easily accessible from the mobile phones (preferably smart phones). This will help the farmers to understand latest agriculture technologies for farming and enforce the same in real life situations. Automatic reminder or notifications, SMS, videos, simulations, social media, Language translation and other features will be add-on facilities provided for the farmers. M-learning enable farmers

to learn advanced agriculture technologies at anytime and anywhere. It's an effective solution for the organization/institutes as cloud computing is integrated with M-Learning so as to overcome the problems of high network cost, low transmission rate and storage.

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