Portable e-Learning Box for Agriculture to Support Farmer in Rural Areas

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***Abstract*— This paper presents an economic e-Learning prototype for boosting up agricultural knowledge in rural regions of India. The proposed prototype is designed on low-resource and mobility concepts. An e-Learning service is utilized for local self-learning and local staff to instruct contents. Due to the limitations and problems of ICT infrastructure, we design our system to function in two modes which are an offline e-Learning server and a gateway hotspot. Low power consumption and alternative energy sources such as solar cell system, automotive battery, and mobile power bank are utilized concerning the electrical power issue. Ease of use and user-friendly interface are considered in order to suit the characteristic of Indian farmers and non-IT skill users. The system was evaluated by the practical performing. The testing results prove that the system can operate a local e-Learning service to participants up to 15 concurrent connections. Moreover, a local wireless hotspot is automatically activated when LAN cable is connecting to the Internet. Finally, the user satisfaction was evaluated to confirm the proposed solution performance and usability as well.**

Keywords—e-Learning System, e-Learning Box, Agriculture, Famer, Rural area

I. INTRODUCTION

e-learning focuses on usage of technology in the field of education and learning. e-learning refers to the use of advanced technology of information communication in the learning process where the advanced technology comprises of electronic media. In the current scenario, the rapid growth of information and communication technology has led to the alphabet " e" becoming the symbol of this latest age of information technology. The alphabet " e" is used as abbreviation for electronics. Thus, words prefixed with e" are currently emerging in every second field, like e- learning, e-health, e-business, e-government and many more. In the current scenario, where the world is being dominated by globalization, networking and information technology has reached its peak, e-learning plays a vital role in the field of education.

In the field of agriculture, according to Nelson, " Today, farmers feed 6 billion people. However, some 800 million people go to bed hungry every night and 166 million children are malnourished. At the same time, current agricultural practices are responsible for dead zones at the mouths of the world' s rivers and rapid species extinctions. By 2050, the human population will grow by two to three billion. The challenge for agriculture is not only producing more food but producing it in a sustainable manner while raising living standards for the poor, many of whom live and work in rural areas. All this must be done while dealing with the uncertain consequences of global warming and geopolitics. The solutions will include new policies, new technologies, and new production practices" (Nelson 2006)

II.POLICY AND STRATEGY ACHIEVEMENTS

Owing to problems and limitations in most of agricultural areas, the main goal of the research is to develop an ecosystem and an infrastructure for boosting up agricultural knowledge of farmer in rural locations. The research policy declares that any participants – including the farmer, local philosopher, smart officer, and agricultural organization staff can reach the proposed system for free to learn, proper content, and easy to use.

Several supported strategies are defined to achieve the objective and the policy of the research as following:

- Develop an appropriable system to collect knowledge and information for agriculturists which is used to help them for planning agricultural activities.
- Integrate Information Technology (IT) and knowledge of the farm for conveniently supporting the agriculturist.
- Increase the farming skill by using low-cost equipment that easy to access and usable to the agriculturist.
- Share contents, knowledge and information – including local and wide areas–among agriculturist, philosopher, organization staff, and etc.

Fig.1. shows method of proposed system, content authoring procedure and learning procedure. The staff can create a new

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content via Content Management System (CMS) and to synchronize contents from the main e-learning for agricultural respiratory.

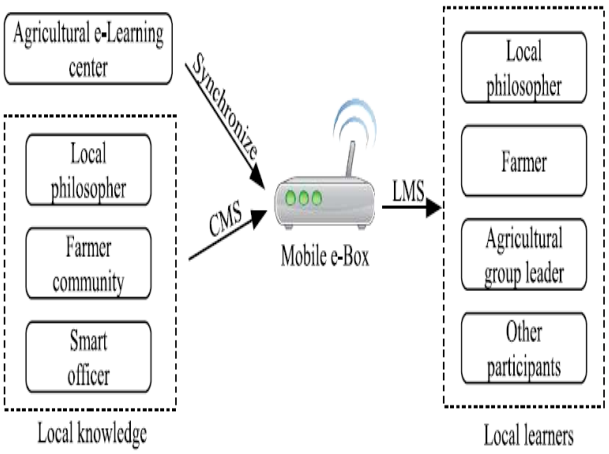

Fig. 1: Overall procedures to manage contents of the *system*

III. Proposed System

In this section, we discuss the system implementation with the purpose of an economy e-Learning equipment in order to disseminate agricultural knowledge to farmers in rural areas. The discussion includes the system architecture, proposed functionalities, and practical deployment. The details are explained in the following sub-sections.

A.Infrastructure design

Many functionalities are requested to solve limitations regarding rural regions. An important issue is a lack of electric system or uses unstable electric power, thus the proposed box is expected to work without the main electrical source. Alternative energy sources which are a solar cell system, an automotive battery, and a mobile power bank should be applied for power source instead of the electric in case of no electrical power grid in a working area. Additionally, low resource consumption is also required to run the box with system stability usage to support an unstable power situation. An idea to use a proposed box in rural areas is listed in Fig.2. Besides, a cheap price of the system topic is also strongly discussed to support an economic optimum of farmers in rural land.

Due to the characteristic of Indian agriculture, an ease of use of the portable e-Learning box is focused. A user-friendly system with simple hardware interface and user interface are determined to keep a benefit of easy to use. The portable device requirement is asked for gaining an opportunity to move and share contents among participants.

According to the above discussion, we decide to use a

tiny and affordable computer from the Raspberry Pi project

to develop a proposed solution [1]. Raspberry Pi board provides low-cost, high-performance computer, and less-energy consumption that people can access computing, digital making, and Internet exploring. Handling light internal or web traffic server is possible. In addition, Raspberry Pi is as small as the size of a credit card. Then it conveniently a mobility action to keep a moveable concept.

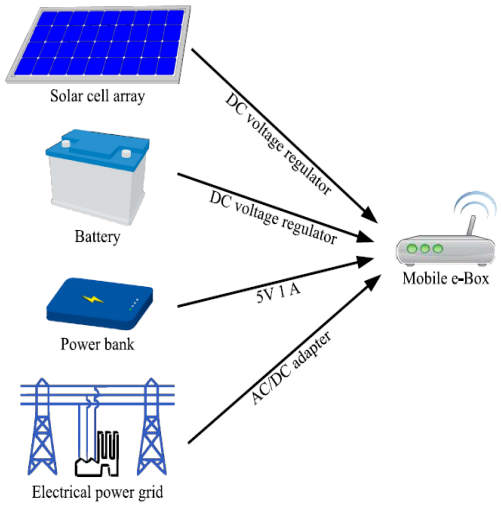

Fig. 2: Energy sources solutions for portable e-Learning box

B. System Architecture

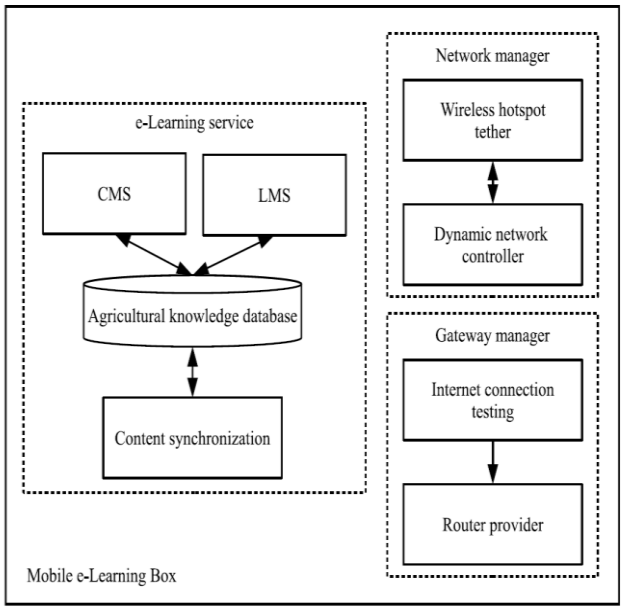

Fig. 3: A Systematic Architecture

To achieve the goal and the policy of the proposed system, we mainly implement the box as a lightweight server to perform an e-Learning task for local learning. However, the Internet sharing function is also added to give usefulness for users. The system architecture of the box is presented in Fig. 3.

The system consists of three parts that are e-Learning service part, Network manager part, and Gateway manager part.

1)e-Learning service part: It contains CMS and LMS modules of the e-Learning system. CMS module is utilized for users who are author such as philosopher, smart officer,

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and staff to manage contents, while LMS module is used for any participant who needs to take materials by self-learning. The part also includes a content synchronization module that using for the first time to initial prepared contents from the central agricultural repository.

2) Network manager part: This part is applied to automate network configuration of mobile devices of connected users. There are two modules work collaboratively; Tethering function serves a local wireless hotspot, and Dynamic network function provides Internet Protocol (IP) address and other related configuration information.

3) Gateway manager part: When using a LAN cable connects to the box and it can access the Internet, the box automatically starts an Internet sharing function. This function

(a) A typical model for offline e-Learning service.
(b) A typical model with Internet gateway servicing.

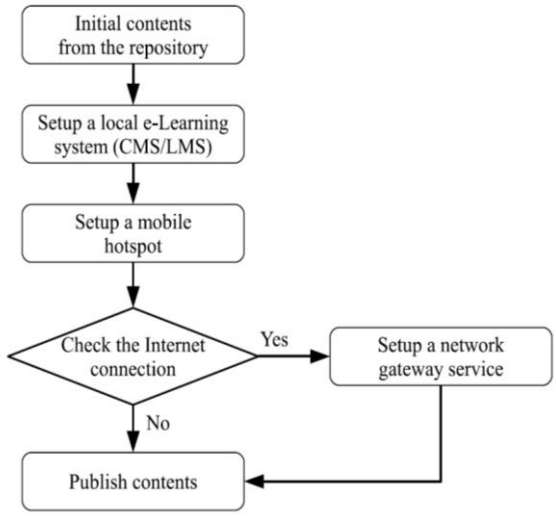
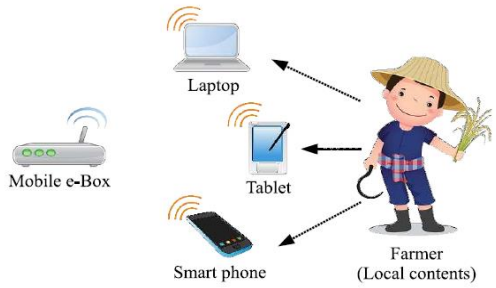
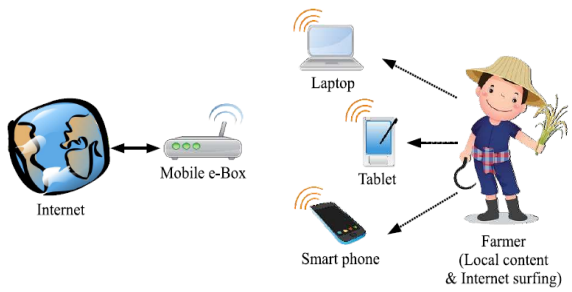


Fig. 4: A system workflow



(a)A typical model for offline e-Learning service



(b) A typical model with Internet gateway servicing

Fig. 5: Approach models for the local e-Learning system

Fig.5. approach models for the local e-Learning system is done by router provider module for forwarding data packets along local area network and wide area network.

Fig.4. describes a workflow of the system that defines a sequence of tasks. The flow shows an infrastructure for the contents preparation, services initialization, and services performing. A task starts with a content synchronization from the central agricultural repository in the first time that apply to initially prepare contents to the database for offline learning.

Then, the e-Learning service is started for serving e-Learning activity. A mobile hotspot is activated subsequently for local devices connection. Next, a process to test an Internet accession is triggered. If an Internet connection is detected, the network gateway service is automatically granted. Finally, all contents and knowledge are published to users who are connecting to the network. Since the system is projected on limitations of target area and user, then a deployment method in practical environment is designed. The system can be used on two types of the practical usage to reduce a defect of an infrastructure lacking. The first method is to use the e-Learning box as an offline e-Learning server for local learning, discussion or seminar as displayed in Fig. 5(a) The box is automatically running an e-Learning system for sharing contents to users. Users who have mobile

devices such as smartphone, tablet or laptop computer can join to a local wireless network, Intranet, provided by e-Learning box. Then, they can access to LMS via web browser application for gathering knowledge. In this method, it is suitable for a location where there is no Internet connection. Knowledge or content is limited to the prepared contents built in the box. Another method is developed to support Internet functionality as a gateway mode. This means that when a portable e-Learning box connecting to the Internet via a network cable, it automatically switches to a router mode for sharing Internet accession. In the same time, the function of an offline e-Learning server for local learning is also running as same as the first method. Users can access to local contents and explore more information from the Internet immediately. Fig.5(b) explains a utilization diagram of a gateway mode.

IV. Estimated Results

A major objective of the research is to build a low-cost infrastructure while keeping an enough system performance for using in rural areas. Not only the proposed solution but ease of use from the user point of view is also estimated to verify our scheme. Since the main target of the research is farmers in the rural locations of India, then we evaluate the prototype system by using in the practical workshop in the target area.

A. Performance Evaluation

In this paper, the second generation of Raspberry Pi board – Raspberry Pi 2 Model B – is used to produce the proposed

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system. It includes enhanced technical specifications such as quad-core processor at 900 MHz, 1 GB memory capacity, four ports of USB 2, full-size HDMI port, and more powerful features. An external USB Wi-Fi adapter is plugged into the board. The wireless adapter supports protocol IEEE 802.11b/g/n and speeds up to 150

(a) A prototype is running via energy source from a power bank

(b) A prototype is powering by solar cell energy

Fig. 6: The prototype of e-Learning box.

Mbps over 11n. We install a Raspbian operating system without a graphic interface for reducing resources consumption. We apply a Word Press platform to use as flexible CMS and a lightweight LMS for the e-Learning system [2]. Word Press is an online, free, open source website creation tool that enables users to build and manage a full-featured website. Contents including video, image, document, clipart, e-Book, and more are added to the system. Fig. 6 shows actual prototype that serving the e-Learning service.

V. CONCLUSIONS

The present century is the century if digitalization and informationization. E-learning supports the widespread use of educational training. E-learning has various advantages over the traditional techniques of learning and is superior. E-learning helps in the development of agriculture education. By the help of e-learning many farmers learn the new techniques of increasing crop yields and methods of agriculture productivity in a very short time by internet.

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