Development of m-Sahayak- the Innovative Android based Application for Real-time Assistance in Indian Agriculture and Health Sectors

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***Abstract*—Mobile or Smart phones (Android based) is becoming an essential device for all types of people irrespective of the age group and literacy (literate or illiterate). In India, mobile technology has unleashed a paradigm shift in the communication medium to reach out to the masses. Crops/plants need regular physical and scientific handling for proper growth. Extension of mobile-phone based any-time, any-where scientific expert advices to the farmers is a possibility in India, i.e., information was available earlier for electronic processing, and now, communication is merged with Information Technology to create ICT impacts as a whole. ICT enabled environment is becoming a day-to-day reality everywhere in India. Tele-health allows health care professionals to diagnose and treat patients in remote locations using ICT. In this paper, the development of a special Android-based application is reported. The application takes care of certain problems in agriculture and health care by concurrently capturing images, audio and video and sending them to a specified server. Agricultural Scientists or doctors can view or listen to this images/video/audio information and provide proper solutions, accordingly. The development was tested satisfactorily. The paper will report on system concepts, design details and results.**

Keywords-Android; Mobile Application; Remote area; Real-time Assistance; Telehealth

I. INTRODUCTION

The agriculture sector is changing the socio-economic environments of the population due to liberalization and globalization. About 75% people are living in rural India and still depend on agriculture. About 43% of India's geographical area is used for agricultural activity. The agriculture continues to play a major role in Indian economy, by contributing 1/6th of the export earnings. Agriculture is crucial to India's economy, as it provides 20% of GDP and employs 60% of the workforce. However, most of India's poorest people are subsistence farmers who have little or no access to technology for their proper solution of the damaged crops. Farmers lack knowledge on medicine or procedure to control the plant damages [1]. Every year, significant amounts of agricultural products are lost in India due to some critical diseases and improper maintenance. In remote areas, very often, the farmers do not get any suggestion regarding the correct scientific procedure to be followed for a particular cultivation. For this reason, they produce lesser amounts of crops by incurring more expenditure.

Sahayak, in some Indian languages, means 'Assistant'. Therefore, the application we present has been given a local name, Mobile Sahayak or m-Sahayak. In India, problems are faced by common people in rural areas in the health sector, too. In urban areas, people get better facility in health care. However, the qualified doctors are not always willing to go to serve in remote rural areas. Many patients in remote villages die without proper treatment [11]. The population is increasing day by day, but the number of physicians, doctors, nurses or government hospitals serving rural population is not increasing proportionately. Therefore, the health care needs of rural population are not being addressed properly [12]. In remote areas, there is a dearth of modern healthcare facilities. This situation demands introduction of tele-medicine support in order to provide fast and high quality medical consultancy covering broad areas. The significant increase of capabilities in modern telecommunication and data processing enables advanced tele-service solutions to assist medical treatment at remote locations [9]. As an affordable and accessible means of communication, rural communities are realizing the potential of mobile telephony to create economic opportunities and strengthen social networks. Mobile telephony effectively reduces the "distance" between individuals and expert scientist/doctors, making the sharing of information and knowledge easier and more effective. It is hoped that the development of this Android-based application can be widely implemented in the near future. This will benefit people in rural areas. Even rehabilitation centres, village schools, mobile health care units and industrial units like mines [5] of developing countries may use the application.

II. RELATED WORKS

In recent days, there has been an attempt to assist the farmer by telephony service but, this service is not 24X7 hours service. Sometimes, the farmers are not able to connect with experts due to communication failures [6]. Another important problem is that in a critical situation, if the farmers are not able to explain or if the disease is a new one, then farmers would not be able to identify the diseases of the crops [1][2][4][9]. Captured images from crop surfaces can provide a better solution where the remote agri-scientist can see instantly the image for disease diagnosis. Similarly,

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captured skin, face, or other images through the developed application may be sent to expert doctors to extend tele-health advice to remote areas.

III. SYSTEM ARCHITECTURE

The overall architecture of the developed system includes Google Application Engine(GAE) and Google Web Toolkit(GWT) functioning as server .

The real-time assistance ensures information flow to remote areas using internet (GPRS) or via SMS. Mobile application can go beyond restricted information flow adding real values to the information transferred.

Figure 1 shows overall flow chart of the system.

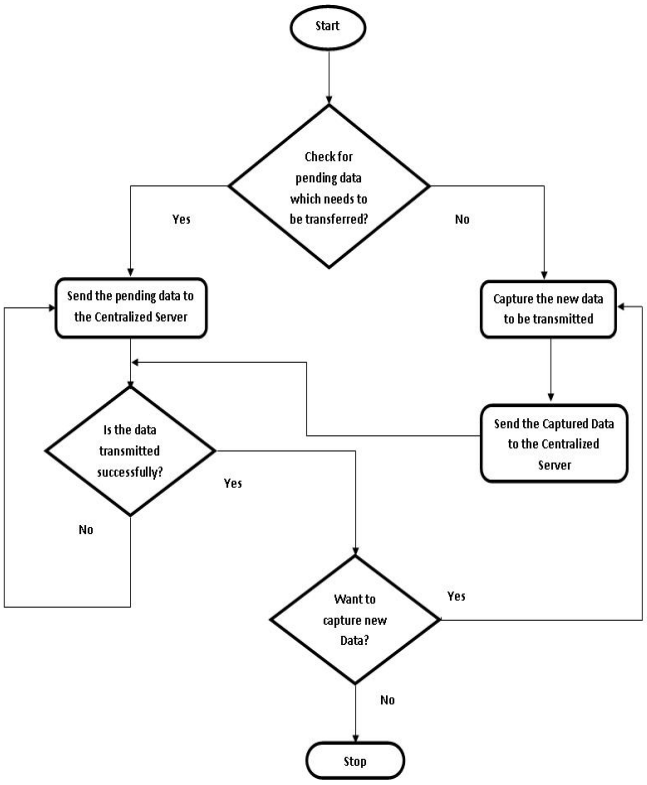

Figure 1. Overall Flow Chart for Real-time Assistance in Remote

Figure 1 shows the overall flow of the process. Depending on the user's selection, the process will execute.

This flow chart clearly shows the whole system flow of our developed application. As soon as the application starts, it will check for the images, which are needed to be transmitted to the centralized Server. Depending on the user action, the application will capture new data or will transfer the captured data on the centralized Server. It allows the user to capture data repeatedly and stores the data locally even after transmitting the data to the centralized server. After the particular file has been transmitted, the details of the file will be deleted from the spinner so that the user can have the actual list of images, which needs to be transmitted to the centralized server.

A. *m-Sahayak System overview for Farmers*

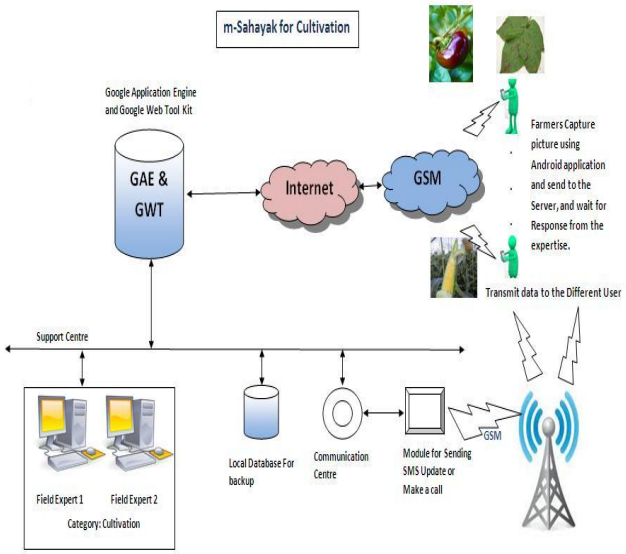

Figure 2. m-Sahayak System Architecture for Farmers

Figure 2 shows the architecture of m-Sahayak for Indian Farmers. The farmers can capture the picture with Android-based mobile handset with the developed Android application. Within the application, there is a provision to customize the camera settings like pixel resolution, flash, etc. When the application executes, it shows all the supported properties and the user can set them as required [7]. If the GPRS connection is slow, low resolution should be used. All the data (video, audio, image) are sent to the specified Server via HTTP connection using GPRS. On the server side the agricultural scientist is able to see all incoming data and images and provides proper solutions accordingly by call or sms.

B. *m-Sahayak System overview for Tele-Health Care*

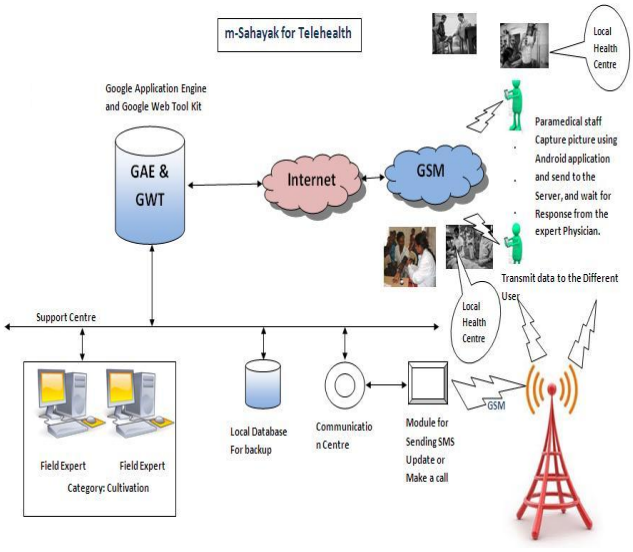

Figure 3. m-Sahayak System Architecture for Telehealth Care

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Figure 3 shows the system architecture of m-Sahayak for tele-health service. Even today, in many places in India, there is a local health center but not any physician on 24x7 basis. The paramedical personnel who are normally available in the local health centers can use the developed android-based application [3]. The paramedical staff may capture the picture (photo) and send to the server. On the server side, the corresponding expert doctor could then view the patient's specific zone of the body and give expert guidance to those patients in the remote area.

IV. DESIGN CONCEPT AND SOFTWARE DEVELOPMENT

m-Sahayak is based on client-server architecture. At the server side related doctors or scientists can retrieve all the incoming problem data from server. The application has the following technologies and user features [5].

- The application has easy to use Graphical User Interface (GUI) with the capability of providing the information about the image when it will be captured and stored in the mobile device.
- It's Graphical User Interface (GUI) is very simple to use, even the illiterate person can use it very easily. The picture can be captured by pressing a single button and then can be sent by pressing another .
- The data (video, audio and image) are transmitted through GPRS. The connection cost in this case is reduced to a minimum since only those few bytes requested by the user will be downloaded to the mobile phone.
- The data response comes through call or sms. All the information or advices are provided to the user by Call/SMS at 24X7 hours from the experts.
- Security: A secured connection using HTTP protocol would be there to prevent information fraud.
- Durability: In this application, the image will be saved in a directory after it is captured. Till the image is completely sent, the application will not begin to send any other image from any other directory. So there would be no ambiguity so as to which image has been sent and which one has not been sent.

The vital part of the application is the data transfer part. In this mechanism at first, it will connect to the central server through HTTP call and connect to [13]. Some source codes for transferring image data to the server are exemplified as below.

```
@Override
protected Void doInBackground(String... arg0)
{
    String rcvFileName,ext;
    rcvFileName=arg0[0];
    int dotPosition=rcvFileName.indexOf(".");
    ext=rcvFileName.substring(dotPosition+1, rcvFileName.length());
    String response;
    Date date=new Date();
    if(ext.equals("jpg"))
    {
        try
        {
            File filToSend=new File("/sdcard/SaveImages/"+rcvFileName);
            long flength=filToSend.length();
```

```
//Sending Image Data.............................
URL url = new URL("http://msahayak.appspot.com/upload");
HttpURLConnection conn =(HttpURLConnection)url.openConnection();
conn.setDoOutput(true);
conn.setDoInput(true);
conn.setRequestMethod("POST");
conn.setRequestProperty("Content-type", "image/jpeg");
//this for sending Mobile IMEI no to destination server
conn.setRequestProperty("MobileIMEI",rcvFileName);//IMEI no is as File Name
conn.setRequestProperty("NAME",name);
conn.setRequestProperty("PLACE",place);
conn.setRequestProperty("REMARKS",remark);
conn.setRequestProperty("SenderTime",date.toString());
//conn.setRequestProperty("PhoneInfo",phoneInfo());
conn.setRequestProperty("FileLength", Integer.toString((int)flength));
DataOutputStream dos = null;
// open the file for reading
try
{
    File fileOut=new File("/sdcard/SendImages/"+rcvFileName);//for device back-up
    if(filToSend.exists())
    {
        FileOutputStream fos=new FileOutputStream(fileOut);
FileInputStream instream=new FileInputStream("/sdcard/SaveImages/"+rcvFileName);
OutputStream out = conn.getOutputStream();
dos=new DataOutputStream(out);
System.out.println("File Data Lenght=="+flength);
byte [] shortBuff = new byte[1000];
int n=0,percent=0;
double increamentPercent =((double)100*1000)/flength;
double tempPercent=0;
int offset=0;
int readCount=0;
if(flength>1000)
    readCount=1000;
else
    readCount= (int)flength;
while (offset < flength && (n = instream.read(shortBuff, 0, readCount)) >= 0)
{
    if(isCancelled())
        break;
    dos.write(shortBuff, 0, n);
    fos.write(shortBuff); //for device
    out.flush();
    offset+=n;
    if(flength-offset>1000)
        readCount=1000;
    else  //
    {
        readCount= (int)(flength-offset); // for remaining size less than <1000
    }
            tempPercent+=increamentPercent;
            percent=(int) Math.ceil(tempPercent);
            publishProgress(percent); //for call UpdateProgress
            System.out.println("Send data="+offset+" Percentage="+percent);
        }
        instream.close();
        out.close();
        if(flength==offset)
        {
            filToSend.delete(); //delete local image already sent to server
        }
    } // end of if (file exists ?)
    else
    {
        System.out.println("Image not found in sdcard.............");
    }
}  //End of Inner try block
    catch(Exception e)
    {
        e.printStackTrace();
    }
    BufferedReader in =new BufferedReader(new InputStreamReader(conn.getInputStream()));
    text=new StringBuffer(" ");
    conn.disconnect();
} //End of outer try block
catch( Exception e)
{
    e.getStackTrace();
}
}// end if for Image data
```

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V. TESTING , RESULTS AND DEPLOYMENT

The application is tested on HTC Wild Fire Handset and the application is developed for Android 1.5 to 2.2 Version. Some of the screen shots of the application are given in Figure 4, Figure 5 and Figure 6.

Figure 4. Screen Shot for Application start

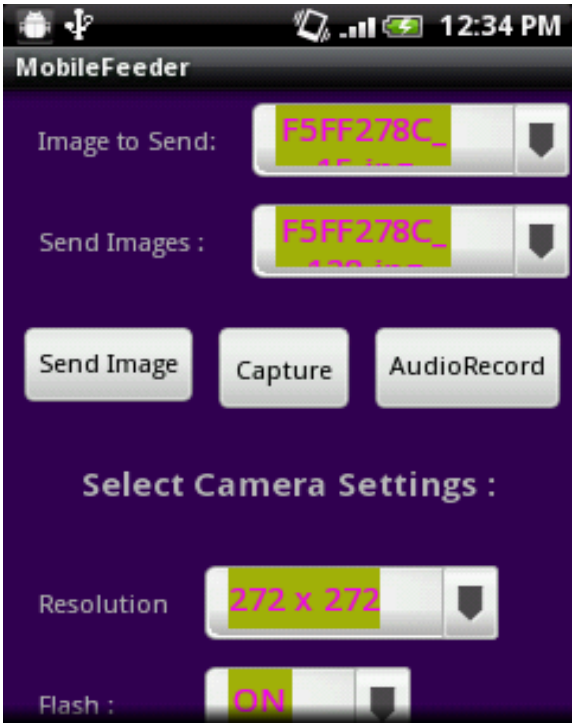

Figure 5. Screen shot of main Application layout

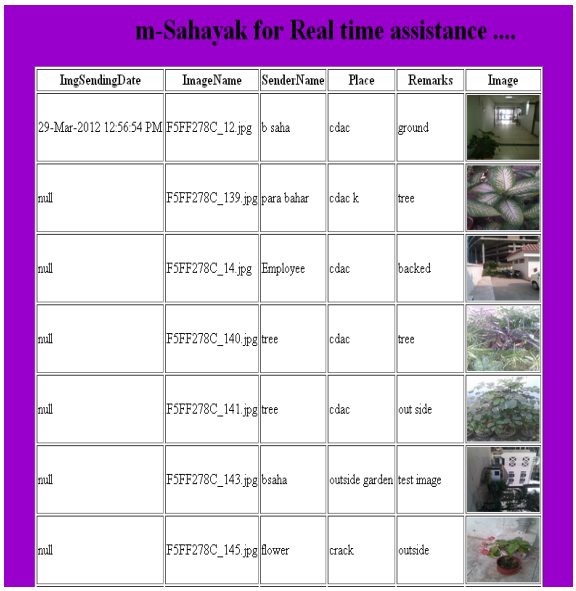

Figure 6. Demo application Web Screen using google application engine (GAE) at [13]

Figure 4 shows the initial screen of the Application when it is initiated by the user in the Android mobile set. When the "Start" button (as shown in Figure 4) is pressed the next screen which is provided to the users is about the parameters which needed to be configured (as shown in Figure 5). These parameters are for basic camera settings like resolution, Flash etc. The spinner titled "Image to Send"(as shown in Figure 5) shows the file name which will be transferred when the "Send Image" button (as shown in Figure 5) is pressed by the user. On successful transmission of all the images to the Central Server this spinner list will be empty. This helps the user to keep a track of pending data which needs to be transferred to the Central Server. This happens when no GRPS/Wifi/3G i.e., internet service is not available on the mobile handset and the transmission of data fails. The mobile handset stores the data in its internal memory and transmits it when the service is available. In this way it helps the user from repeatedly capturing the data. The spinner titled "Send Images" (as shown in Figure 5) holds the list of filenames which have been successfully sent to the central server. A button titled "Capture" (as shown in Figure 5) is provided to capture the real time scenario by the user. Another button titled "AudioRecord" (as shown in Figure 5) is provided to record the voice or query of the user along with the captured image. This button causes to open a new screen along with user setting to record the voice and also having a button to send it to the central server. A copy of the data which has been sent is available on the mobile handset also . Figure 6 shows the administrative screen of the m-Sahayak application available on the field experts terminal. On the basis of the available data, a solution is provided to the corresponding users. The service is available to registered users only. The current centralized server is based on google application engine (GAE) and the data which needs to be viewed by the field experts is available over HTTP [13].

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Testing of the developed application is done on Android 2.2 Emulator. The test result on the emulator comes out with satisfactory outputs. The whole application is broken into 3 main units i.e., the capturing of the image, recording of the voice and sending of the data. When tested individually these units show satisfactory results on an emulator. After the successful testing on an emulator, we have installed the application on the HTC Wildfire handset having Android 2.2. The behavior of the application is satisfactory in the initial stage that has been mentioned. This application is also compatible with higher versions of Android (2.2 and above).

The m-Sahayak prototype has been deployed in the experimental site i.e., a garden near the design lab. Field conditions in this garden were similar to the real farming site. The natural capturing of images from at least 5 types of plants were examined from a distance by agricultural experts. Final deployment in a district of the state of West Bengal, India is under consideration through m-Governance scheme initiated by the Government of West Bengal, India.

VI. FUTURE WORKS

The proposed architecture is at the initial stage of development whose results have been mentioned. The deployment of the application in the experimental site is successful. Using the current version of the application, the architecture of the systems stands firm.

VII. CONCLUSION AND REMARKS

The application m-Sahayak would be a boon to Indian farmers as well as common people in the remote areas. Those who are already using an Android phone, can register with their phone number and get an account. The data sent by them will be stored in the corresponding account. The experts may provide their advice to that particular phone number. By this application, the health care units, may be able to provide better treatment using limited resources to the Indian common people. Using this application, farmers nay control the crop damage and prevent the food problem.

Special features which would popularize the application are

- Simple Graphical User Interface (GUI) that can be used by everybody.
- “One Stop Solution” to all kinds of disease problem in crops and tele health care for people.
- User cost (GPRS) is minimal.

The most common benefit of mobile devices, as found by the survey is its penetration in rural India as the largest basic medium of basic communication. The mobile phone is the only convenient mode of communication to which farmers have access. So it would help the farmers and the rural people if used properly and would be beneficial to most of them.

As far as infrastructure is concerned in India, the Mobile communications services reach to each and every remote place. We have surveyed the current market which shows the basic requirement for running the application is available easily which Indian rural people can afford.

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