Smart Farming using Arduino and Data Mining

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Abstract – **The current scenario in India depicts a steady decrease of agriculture contribution to the Indian GDP. The reasons for this condition are mainly - the current erratic weather condition and crop loss. New technologies and advanced fertilizers have not penetrated through the corners of India where majority of the farmers reside.**
Through this paper, we introduce a concept for smart farming which utilizes wireless sensor web technology for moisture detection in the soil in conjunction with a smart phone application which plays a vital role in helping farmers. We introduce Arduino based automatic plant watering system and android application which will help to control Arduino via internet. Also, this android application provides farmers with agricultural related information such as costs of seeds, moisture level required, type of soil needed, weather forecast, fertilizers and pesticides to be used.

Keywords–Agriculture; Arduino; Hygrometer; Automatic Watering System; Smartphone-application

NOMENCLATURE

Apps – Application, GDP – Gross Domestic Product

I. INTRODUCTION

Agriculture and its allied sectors are the pillars of Indian economy as they are the principal means of livelihood in rural areas of India. GDP is defined as the monetary value of all the finished goods and services produced in the country in a specific time period [3]. Agriculture is been contributing largely to Indian GDP over the years. In 2012-13 agriculture contributed to 13.9% of the total GDP[4], and employed 47% of the total workforce population [5]. The combined efforts of Central Government, State Governments and the community have succeeded in achieving a record production of 264 MT of food grains during 2013-14[6],[7].

It is been observed that contribution of agriculture to GDP is non-linear from 1951 to 2014. There are various reasons that are associated for this steady decline such as diversification and growth of Indian economy, environmental factors such as erratic weather conditions leading to crop loss, farmer's ignorance in embracing newer technologies that can be used for enhancement of gross profit from agriculture and its allied sectors. In spite of all such problems, agriculture is a cardinal source of employment and plays a key role in socio-economic development of India.

In order to improve the above condition, we can make use of technology in a smarter way. In recent years, mobile telephony has been penetrated through various parts of India and it is been used almost by everybody irrespective of the age group. Android phones which use android as an operating system are becoming popular because of ease of use and features such as internet browsing through handset and 3G, Wireless LAN connectivity, hardware like GPS, accelerometers.

The Ministry of Agriculture, Government of India, has started various schemes in the interests of the farmers. The mKisan Portal inaugurated in July'13 by Honorable President of India has received as of 1,85,40,07,285 messages, 5,74,40,63,746 and 237,777 advises as of 8th April 2015 [8]. The weekly/daily stock availability with dealers of seeds and fertilizers was made available at Rs. 5/month/dealer [8]. Applications like Krishi Ville [9], Kissan Kerala [10] are an attempt to provide such information to farmers over internet.

The current condition of farmers in India is not so good. Various socio-economic aspects such as high cost of life (education, health), poor management can be associated to their dismaying condition. It is estimated that more than a quarter of a million Indian farmers have committed suicide in the

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last 16 years. Thus it is necessary to improve the lifestyle of farmers with the help of technological advancements.

The proposed mobile application acts as farmer's assistant in the field. It provides essential agriculture related information like weather forecasts, news, market prices of crops and other detailed information about crops such as cost of seed, fertilizers and pesticides to be used, respective soil type required, moisture level required to the farmer. Therefore, this mobile application will serve to be handy as farmers will be able to seek information with just few clicks. Additionally, application will reduce the amount of field work by providing the control to water the plants. Additionally, application will lessen the amount of field work by providing the control to water the plants. We shall now present the proposed SMART FARMING system using Arduino and data mining, which will play an indispensible role in effective faming in India.

II. OBJECTIVE

Two major problems faced by Indian farmers are:

1) Farmers are unaware about various technologies that will be beneficial for effective farming

2) As monsoon is intermittent in India and water resources are limited, there is a critical need of using water efficiently.

To address above problems, we are proposing a system, Smart Farming using Arduino and Data Mining. In this system, we are introducing information hub on which farmers will get information about new technology in agriculture terrain and farmers will be updated with new innovations in agricultural field. Along with this the automated watering system will lessen the burden of farmers and it will stem excessive water supply.

III. COMPONENTS

A. Soil Hygrometer Sensor

It is a type of sensor which is used to detect moisture content in the soil. When the moisture content in the soil falls below a threshold level, then the soil hygrometer detection module outputs a high level and vice versa outputs a low level. Integrating this senor with the proposed Arduino based module forms automatic plant watering system, so that the crops can be watered without human supervision.

B. Arduino UNO

Arduino is an open-source prototyping platform based on user friendly hardware and software which can be customized as per the needs of the user [4]. Arduino Uno board consisting of microcontroller ATmega328P is used to control motors. The Arduino board is programmed in such a way that it senses the moisture level in the soil and notifies the farmer [2].

C. Ethernet Shield

The Arduino Ethernet Shield allows you to easily connect your Arduino to the internet. This shield enables your Arduino to send and receive data from anywhere in the world with an internet connection which can be used for real time application.

D. Motor Shield v2

The Arduino Motor Shield allows you to control motor direction and speed using an Arduino and also allows an additional motor with an external power supply up to 12V.

E. Servo Motor

It is a motor which is when integrated with a sensor allows for precise control of angular position. The mechanism involved in servo motor rectifies the error in the system using negative feedback and hence enhances the performance of the system.

F. An application running on android phone

Android is an open source mobile operating system which is widely used in smart-phones now-a-days. In India, almost 60% of mobile phone users are using android. Android apps are designed and developed using tools like Android studio, Eclipse, Visual Studio etc. These applications are easy to download and user friendly. Developers can easily use internet connectivity of mobile phones and enhance usability of their apps.

IV. LITERATURE SURVEY

In "AN ANDROID-ARDUINO SYSTEM TO ASSIST FARMER IN AGRICULTURAL OPERATIONS" (as cited by Arpit Narechania) author has mentioned working of the system in two essential parts, software and hardware. On software side, the system makes use of PHP and HTTP client server APIs. These APIs are used into a MySQL database at a remote central server. Every time user attempts to login, the database table is queried for the username-password pair and accordingly grants further access or do not. A HTTP connection is made over GPRS or WIFI to the open source weather service which is returned from servers is in XML format. User is provided with weather forecast up to 16 days. This forecast includes type of weather, temperature, humidity etc. Application provides data about crops, prices and availability of resources. This application also updates user with news feeds. Users are also provided with the Help lines and Services. Along with this, farmers are given information about how to manage inventories, assets and also cropping cycles. On hardware side, robot is made which is doing the work of ploughing on field. Depth and angle of servo motor is controlled by an android app. Seed sowing mechanism is also present in this system which is also automated by the robot. Robot includes Bluetooth and GSM shield which help robot to communicate with an android app. By sending character messages motors can be turned on or off. On the other hand if farmers in near to his field, by connecting to Bluetooth component he can operate the robot.

In "Automatic Plant Watering System" (as cited by S.V. Devika, Sk. Khamuruddeen, Sk. Khamurunnisa, Jayant Thota,

Khalesha Shaik), Arduino based automatic plant watering system, the main focus is on addressing the two important problems of watering the plants i.e. the number of times to water the plants and quantity of water to be supplied . This project uses Arduino Uno, moisture detector, motor/pump and water sprinkler. Motor is controlled by programmed Arduino Uno driven by a 9 volt battery.

In our proposed system, farmers will be notified about watering though an android app which makes the system user- friendly. We are using servo motor which has operating voltage 4.8V which improves the performance of the system using negative feedback and the motors/water pump used for watering the plants are pre-installed. Thus, the use of external battery for servo motor is avoided.

V. WORKING

Two major functional units are soil hygrometer sensor and the servo motor (motor/water pump). The function of the soil hygrometer sensor is to sense the level of moisture in the soil and to send a signal to the Arduino UNO if watering is required. The hardware representation of the system is shown in the Figure No. 1. This project uses Arduino Uno to control the motor. Arduino and android application will communicate with each other via internet.

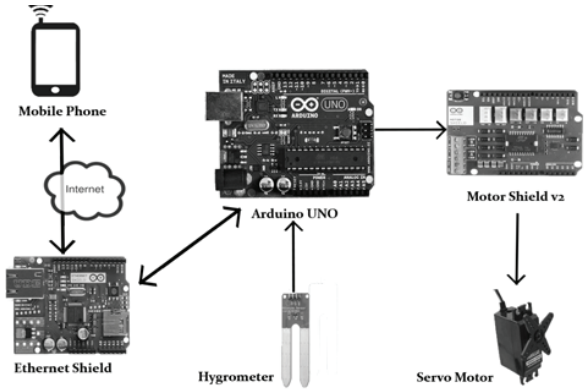

Fig.1: Hardware Representation

The work flow of plant watering system is shown in the Figure No. 2. The detailed steps are as follows:

1. Soil hygrometer sensor will be employed in the soil. It will detect the moisture level of the soil and send to the Arduino UNO. Arduino will compare the moisture level with database value for a particular plant.

2. If this notified moisture level is below the threshold value for respective plant, a notification for watering a plant will be sent to farmer through Arduino ethernet shield by arguing UNO.

3. Farmer will be provided with 2 options. - Automatic watering of a plant or watering plants manually.

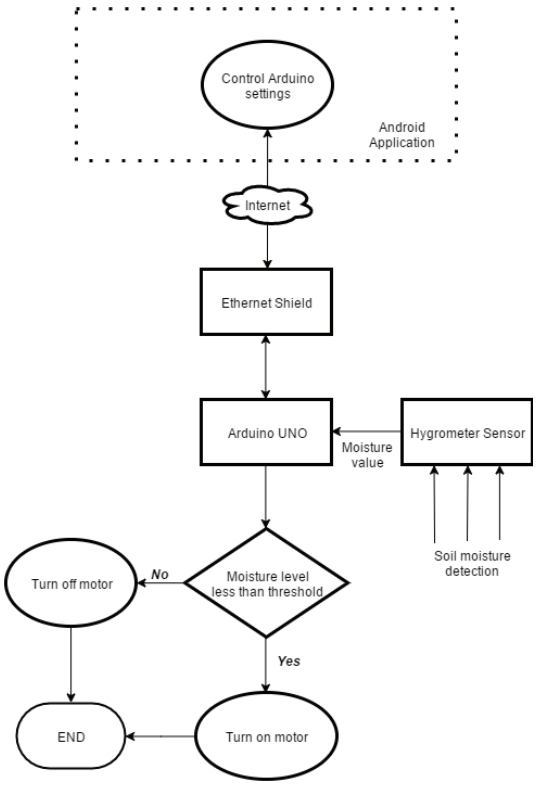

Fig..2 Flowchart for Plant watering sy**stem**

4. Based on the option selected by farmer, appropriate actions will be carried out by the Arduino UNO. If farmer selects automatic mode, Arduino UNO will trigger the servo motor via motor shield v2 to turn ON and supply the water to respective plant. When the desired moisture level is reached, the system halts on its own and the servo motor is turned OFF. If farmer selects manual mode, Arduino UNO will trigger the servo motor to turn ON and the time for which water to be supplied would be decided by farmer.

The overall mechanism of an android application which will serve to control watering of plants and assist farmers to obtain intended information is explained with Figure No. 3 and 4.

Farmer has to sign up on an android app following some set of steps which are explained in Figure No. 3. After farmer has successfully signed up, his profile will be created and he will be able to see and navigate through news feed page. News feed page will have weather prediction and many other useful and important data. The working of the system after successful login is shown in the Figure No. 4.

There will be a database which will contain detailed information about crops such as cost of the seeds, soil moisture level required, fertilizers and pesticides to be used. An android application will be connected to the database which can be used to mine the data using regression mining algorithm along with key attributes like crop, soil type, area, weather condition.

Additionally farmers can share the farming methods and give their reviews about different methodologies which they have

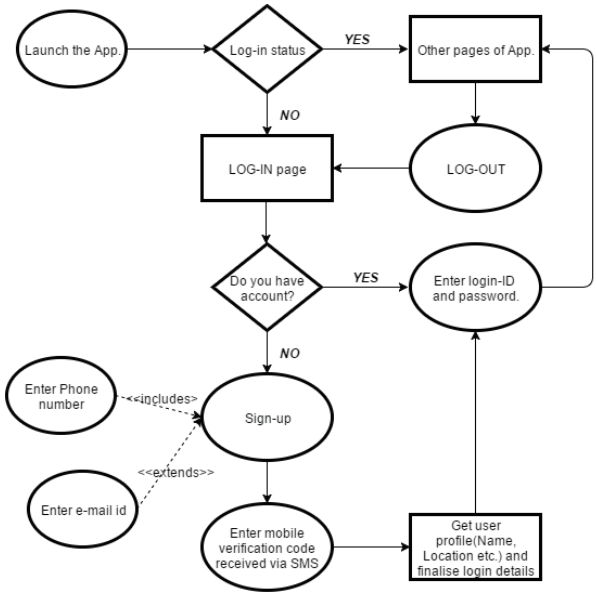

Fig.3. Flowchart for Android Application (Part A)

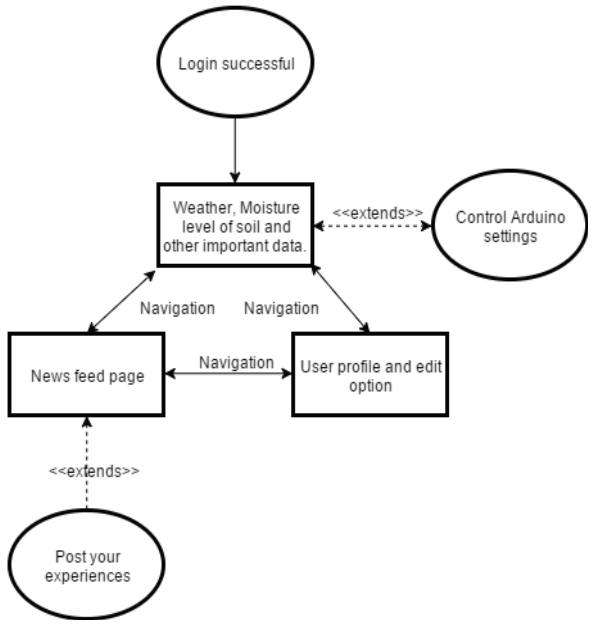

Fig. 4.Flowchart for Android Application (Part B)

employed using the android application. Therefore, this application will be helpful to farmers, as farmers will be able to seek intended information with just few clicks.

Along with this, the android application will predict the weather condition for the coming days using the empirical data. It will consider the following steps; first it will consider the last week's temperature along with the temperature value of the same dates of last four year and calculate the average value which will be the best predicted temperature value.

VI. CONCLUSION AND FUTURE SCOPE

As watering is an indispensable cultural practice and essential part of farming, automating it with the use of technology will lessen the burden of farmers. In addition to this point, automatic watering system will enhance the lifestyle of farmers. Water conservation is another important aspect, which is taken care by using automation of watering system. Also, the availability of agricultural information directly in a farmers hand without him being dependent on neighbors or landowner or even waiting for a SMS response from the mKisan portal like schemes, will enable the farmers to take better decisions in short span of time. This will not only foster greater productivity but will ameliorate a farmers life reducing stress and also instilling zeal to learn new technology which is essential in sthis era of Digital Revolution.

Some other improvements can be incorporated in these projects such as giving more accurate predictions about weather conditions. As we are using different sensors, all the information can be recorded on the servers. We are planning to do these changes in future versions of our project. Instead of using android platform, we are planning to design independent unit which will be easy to use for rural people. Future work will be to build a commercial sellable product with possible additional features like harvesting, or a video camera sending live video feed to the farmer's cell phone via an IP Camera. Use of Radio Frequency (RF) and Wi-Fi Network can increase the operational distance of the vehicle but involves high costs and less accuracy with high risks. Future work will be application of these communication networks.

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