An Astute Irrigation System With Crop Management And Marketing

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Abstract: Food crisis in India due to rapidly growing population is pressurizing the farmers to increase productivity with the help of irrigation means. These means require physical presence of the farmer to check the water level in the soil and regulate the water pump accordingly. The warming climate and pollution are making the water supply even scarcer. But this can be taken care of by efficient usage and proper water management. In this context we want to propose a solution in the form of a sensor kit along with a mobile application which monitors the soil water level and automatically operates the pump. It also provides features for marketing of crops by availing to the user information about markets and price rate of crop. The application will also provide information on the latest schemes introduced by the government.

1. Introduction

The major concern that out country is struggling with is to meet the food requirements of the ever increasing population. Our Indian system of farming is based on conventional methods. Rapid urbanization and increasing demand are putting enormous pressure on the quantity and quality of crop production. Primitive methods make it difficult for farmers to meet needs and earn profits.

The conventional methods primarily use irrigation for the farming activities. Irrigation is controlled application of water to crops at needed intervals. It is mainly used to satisfy water supply requirements against erratic rainfalls. Many different traditional irrigation methods are still used such as surface water bodies, sprinkler, and drip irrigation.

India has diverse topographies causing variation in temperature, elevation, and rainfall in regions. Hence, the methods water procurement has evolved very differently over the years in different places.

Along with irrigation, crop management is also very important in agriculture. Crop management refers to the monitoring of agricultural parameters to improve the growth of crop and yield of agricultural produce. Growing right crops at the right time and in the right place plays a very important role in agriculture. In the current scenario, farmers have limited knowledge about crop and soil conditions necessary for each crop type. When these conditions are not met according to the crop type, it affects both the crop quality and the yield.

The next important part is crop marketing. This involves selling of the agricultural produce, which undergoes a sequence of transfers i.e. from farmers to brokers and then finally to the customers. In such a scenario it is highly unlikely that the farmer gets a good return for his efforts.

Nomenclature

AISCMM An Astute Irrigation System With Crop Management ANd Marketing

2. Literature Survey

For the development of the proposed system existing research papers on automation of irrigation system and monitoring of soil parameters were reviewed. The following provides a short summary on research papers studied.

In irrigation system main aim is to water plants as per their need. This need is dependent of different parameters such as soil temperature, moisture, pH level of soil etc. These values play a major role for deciding when to supply water to crop. The basic system uses soil temperature sensor and moisture sensor to collect all required data. This data is collected by microcontroller and depending on data received it will make a decision. This system uses relay which will switch on the water pump. It uses LCD display to show current status. The major disadvantage of this system is it is not suitable for farms spread over large geographical area. When the area to be operated on is large, need for wireless sensor network arises. The system divides the large geographical area into multiple zones. Each zone consists of a wireless sensor unit comprising of different sensors like temperature, soil moisture, humidity and water level. Each of these zones report to a gateway unit, which handles all sensor information, takes appropriate action and transmits data to a web application. The sensor values can be monitored on the web page. In order to check this data user must have access to web application which is not feasible all the time. To overcome this issue, GSM system is used. The system will use GSM messages to control the system. This replaces the need for internet connection. The users of this system will be able to monitor the system using GSM messages and a simple android application. It is designed to allow users to access system at any time thus, eliminating need of web application. These messages are used to control system and to monitor information using android application. Android application will read data contained in message and display it to users. The disadvantage of this system is, it covers a small chunk of agricultural land and is not economically affordable for all.

3. Proposed System

The objective of this project is to automate the work of irrigation to some extent and help the farmer to take appropriate decisions such as crops selection and crop marketing.

3.1. Modules

An Astute Irrigation System with Crop Management and Marketing is available to the users in the form of a mobile application that can be installed on mobile phones along with some on-field hardware.

Modules involved in the system are as follows:

Automatic Irrigation Module

This module automates the irrigation system by automatically turning on and off the water pump as per the requirement of the soil. Soil temperature and soil humidity are considered for determining the threshold.

Crop Management Module

Crop Management module will enhance decision making of farmer to select the suitable crop to be grown in farm for the greater yield and returns. This module will check various aspects of soil and suggest the farmer the best suitable crop to be grown.

Marketing module

After crop management it's time for some returns, this module will help farmers to find best profitable market for their crops so that they can be sold with reasonable price. This module will give total profit the farmer can earn by deducting all other expenses.

3.2. Working

The first step is to register with the system in order to use system functions. For registration the user will have to use Gmail account. Once user is registered successfully, user can access the system using the registered google account. After the successful registration user will be prompted to select region of farm, height of water storage tank. This will help system in implementing automated irrigation and crop prediction.

After successful registration the soil type will be used to suggest the best suitable crops to the user. While suggesting crops the system will consider previous year market need and current production of the crop.

The user will select one crop from the suggested list. Once crop is selected then the system will set threshold parameters of NodeMCU to the crops required values. Then system will keep on monitoring various readings and takes appropriate corrective measures.

Once the crop is harvested completely, the system will show the user's marketing strategies to sell the crops. This includes two strategies:

a) Sell crop in nearby market.
b) Sell crop to manufacturing unit.
Whichever is selected, the system will show the expenses for selling the crop and after selling how much profit farmer can earn.

4. System Design

An Astute Irrigation System with Crop Management and Marketing is a system with 3 modules:

(1) Astute Irrigation System

(2) Crop Management System

(3) Crop Marketing System

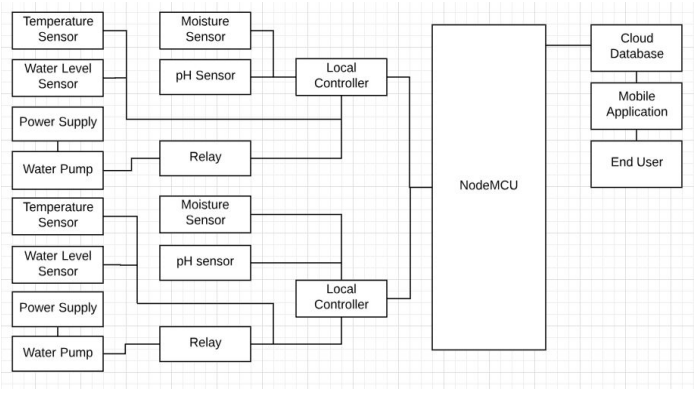

Fig. 1 -Block Diagram of Astute Irrigation System with Crop Management.

Fig 4.1 The above explains block level representation of proposed system. It shows how different modules will be interacting with each other and entire flow of the system.
Whichever is selected, the system will show the expenses for selling the crop and after selling how much profit farmer can earn.

5. Technologies

5.1. Hardware

a. *NodeMCU:*

NodeMCU is an open source Lua based firmware for the ESP8266 WiFi SOC and uses an on-module flash-based SPIFFS file system. NodeMCU is implemented in C and is layered on the Espressif NON-OS SDK. The NodeMCU is cheaper and better option over other microcontrollers and it provides wireless data transmission within 400m.

b. Soil Temperature:

The model of temperature sensor used is DS18b20. This temperature sensor works on one wire protocol. The 4.7Kohm resistor needs to be placed in between Vcc and data pin to complete the circuit. The sensor is waterproof and can measure temperature up to 125°C. The accuracy of ±0.5°C is provided by the sensor.

c. Moisture Sensor:

KG003 Soil Moisture Sensor Module is used to detect the moisture of soil or measure the water content in the soil. This sensor outputs the voltage

level depending on moisture present in soil which is given to NodeMCU for further processing.

d. Water level sensor:

To measure the remaining water level in the storage tank, HC-SR04 Ultrasonic distance sensor is used. This sensor uses ultrasonic frequency to measure the distance. The distance is calculated based on the difference between transmitting and receiving time of the signal. Then using this time difference, NodeMCU will calculate the distance using the time-speed-distance formula. Here the speed will be 171.50m/s (the speed of sound in water).

e. DC water pump:

To supply water to farm, a DC water pump will be used. The water pump will work on 3-6 V DC power supply. This water pump will be operated by using 5V single channel relay. This relay will be connected to one of the GPIO pins of NodeMCU. Whenever moisture level will fall below a threshold value, the NodeMCU will switch on the pump by sending a command to a relay connected to it. Once the moisture level is regained, the water pump will be switched off.

5.2. Software

a. Software Development:
Xamarin, Visual Studio 2017

b. Database:
Azure SQL server database

6. Implementation Details

The NodeMCU microcontroller is connected to various sensor and is responsible for data collection from different locations of the farm. Then this data from various locations is assembled at a local server. Communication between NodeMCU and the local server is carried out with sockets in python. Data received on the local server is forwarded to cloud database through web services. This real-time data is fetched by the application to make decisions and predictions of crops that are to be recommended to the user.

A cross-platform mobile application is developed using Xamarin Software Development toot which uses C# codebase to create applications for Android, IOS, and Windows. It helps users to monitor status of the farm.

The application uses Google sign-in to authenticate the users. After successful google sign-in new users need to enter personal and farm specific details. Once the user is authenticated successfully, they will be redirect the user to the homepage.

After successful login the application suggests some crops that the user can select for farming based on the farm location and previous year yield. Then system records the soil parameters in real time. Whenever the user wants to check the temperature and moisture status of the soil user can use option of monitor farm status available on the homepage. On clicking the application will open a new window which will show the real-time data collected by sensors. This data will be displayed using a graph as shown in Fig. 2.

Using only one language to display application is not good because it may happen that the end user is not able to understand that language and in such case, the user will not be able to use application. Hence, the application is designed in such a way that it will check default language of the device and set that language to display all application data. For now, the application can work for English, Hindi and Marathi language.Example of this is homepage as shown in Fig.6.3.

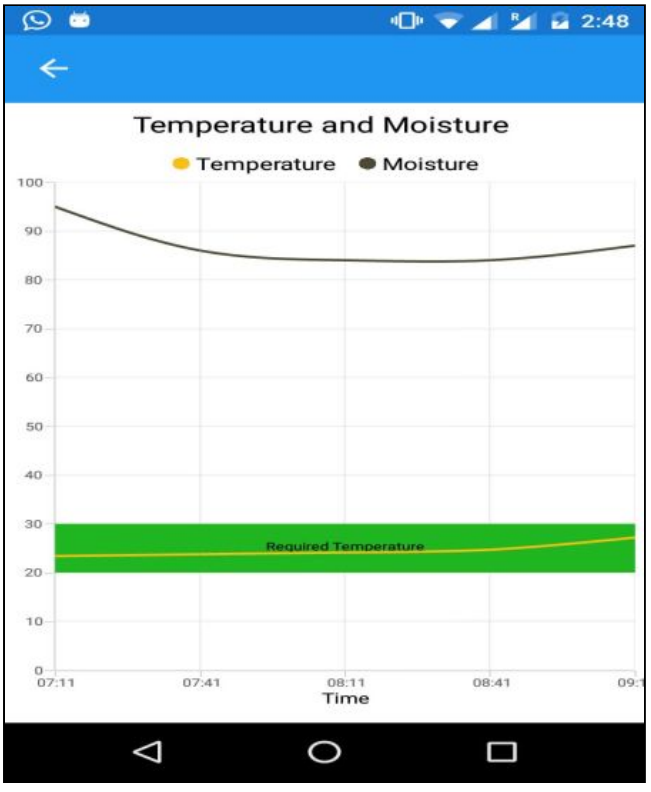

Fig. 2 - Temperature and Moisture graph

Fig. 2 represents reading versus time graph of present temperature and moisture content in the soil. The temperature readings are in Degree celsius. The green region shows the required temperature for the selected crop.

According to the these readings of the soil and the pre decided threshold for the crop the system takes decision whether to switch the water pump or not. If the moisture content in the soil are below the threshold or the temperature is too high for the crop then water pump is switched on and user gets the notification on the mobile application. After some time the system retakes the reading and switches off the water pump.

Once the crop is ready for marketing, the marketing module provides the options where the farmer can sell his product. The marketing module suggests two options:

- To sell in near by markets,
- To contact near by industries.

The total cost of the travelling is automatically computed and the user can select the best option with maximum profit

7. Conclusion

The Astute Irrigation System with Crop Management and Marketing is an application that makes use of the technological advantages provided by IoT to automate the irrigation system. The decision making provided by the system plays a vital role in suggesting crop to be grown. The main objective behind this system is to increase productivity and also to increase profitability by suggesting market for sale. The hardware used is durable and minimalistic in cost to make it affordable for the farmer. This project can be scaled to provide benefit for as many farmers as possible.

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