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An Efficient Method of Irrigation Using Sensors

R.Aarthi[1], Dr. A. Shaik Abdul Khadir[2]

Research Scholar, P.G. and Research Department of Computer Science, Khadir Mohideen College, Adirampattinam, Thanjavur (Dist), Tamil Nadu, India[1]

Associate Professor, P.G. and Research Department of Computer Science, Khadir Mohideen College, Adirampattinam, Thanjavur (Dist), Tamil Nadu, India[2]

Abstract: The current agricultural practices need to intensify the rate of food crop production for the rate of population growth with available resources. This paper focuses on measuring the water content in soil and crop growth monitoring using Raspberry Pi. The water level required for agriculture purpose is analyzed using soil moisture sensor. Optical devices like camera capture the field and automatic edge detection will be performed and viewed on the remote server. Moisture level and crop growth level can be viewed on the web browser. The water level will be measured and if it is found less than the actual requirement, it will be corrected manually. In edge detection process, if any disturbance is found, the manual inspection will be carried out to remove the disturbance.

Keywords: Infra Red Sensor, Peripheral Interface Controller, Pest, Raspberry Pi, Soil Moisture Sensor, Webcam, Wireless router.

I. INTRODUCTION

Agriculture uses nearly 85% of water resources worldwide and this percentage will continue to be dominant in water consumption because of population growth and increased food demand. There is an urgent need to create strategies based on recent science and technology, for the sustainable use of water. There are many systems to achieve water savings in various crops which include monitoring the status of water and irrigation is scheduled based on that [3]. Irrigation based on scheduling results in water savings up to 42%. Every single drop of water is important and should be used effectively.

Water shortage is a rising hazard affecting 2.8 billion people around the world. 70% of the world's freshwater reserves are being used for irrigation purposes, according to the UN World Water Development Report. There is an urgent need to develop improved and economically feasible irrigation strategies for sustainable use of water resources. The farm irrigation systems in the past used simple timers and switches to control the irrigation mechanism for a predetermined time period irrespective of the weather conditions or soil moisture content. Incorporation of advanced sensing, monitoring and control technologies has increased the efficiency and has radically reduced the labor requirement in the irrigation sector[2]. However, the major drawback of these systems is that they are complex and expensive, making them ineffectual for small scale and marginal farmers. Thus, the challenge is to develop an affordable and simplified irrigation automation system. A wireless sensor based irrigation control system is a potential solution to optimize yields and maximize the use of water effectively for fields with requirement and variation in water availability [5]. Along with water regulation, controlling of pest is important to maximize the yield [6].

This project presents the automated system to make effective utilization of water resources for agriculture and crop growth monitoring. Water is effectively utilized using sensor networks. Soil moisture sensor is used to detect the moisture content of the soil [1].

Along with that, IR transceiver is used to monitor growth level of crop. Camera interfaced with raspberry is used to capture the crop. This image is processed for the detection of pest. If the presence of pest is found, then pesticide is sprayed manually to control the pest.

II. PROPOSED SYSTEM

The Fig.1 this system deals with controlling and continuous monitoring of crop field by the use of sensors. Humidity value is measured by the analog soil moisture sensor. The sensed humidity value can be monitored by remote server. If the amount of moisture content in the soil is reduced or insufficient, it will hinder the crop growth. On an account of this, a human from local station is being employed to irrigate the crop field. IR transceivers are also used for effective monitoring of crop growth. IR transceivers are meant for both transmission and reception of data. If an obstacle is detected, it will show the length of the obstacle in both the LCD display and also in the remote server.

The crop field is continuously monitored using a webcam, which is interfaced with pi. The camera has high resolution than normal cameras. Focusing range of it is from 4cm to infinity, so there will be a larger coverage area. The crop field is continuously captured and edge detected for any pest attacks on leaf or plant. Pest affected crop can be identified by their veins. If the veins of the leaves are straight or normal in edge detection, then it is pest free. In case the veins are not narrow or abnormal, presence of pest is identified. To avoid the proliferation of pest, pesticides are sprayed immediately. Even a slight disturbance in the field can be find out immediately by the remote server access.

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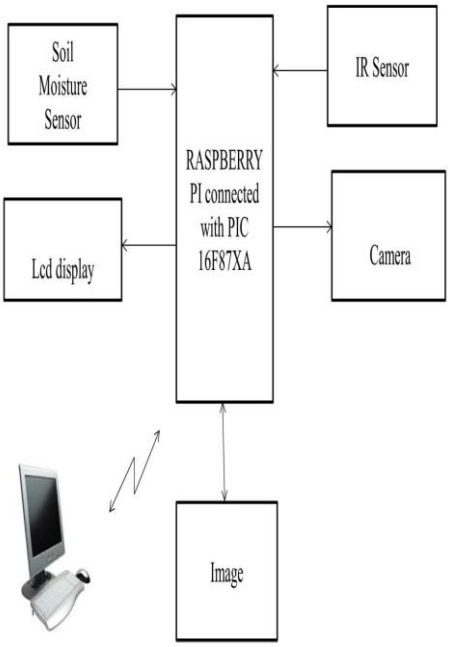

Fig.1 Block Diagram of Irrigation System.

A. Raspberry Pi

The Raspberry Pi is a series of credit card-sized single-board computers developed in the UK by the Raspberry Pi Foundation with the intention of promoting the teaching of basic computer science in schools. The original Raspberry Pi is based on the Broadcom BCM2835 system on a chip (SoC), which includes an ARM1176JZF S700 MHz processor, Video Core IV GPU, and was originally shipped with 256 megabytes of RAM, later upgraded (models B and B+) to 512 MB. The system has Secure Digital (SD) (models A and B) or MicroSD (models A+ and B+) sockets for boot media and persistent storage. Raspberry pi has interfaced with IR sensor, Soil moisture sensor, Camera, LCD display to get the data from these peripherals and store them in the memory. It takes the control over these peripherals and give the instructions to order the sequential work of the corresponding peripherals.

B. PIC Microcontroller

PIC is a family of modified Harvard architecture microcontrollers made by Microchip Technology. The name PIC initially referred to *Peripheral Interface Controller*. All current models use Flash memory for program storage. Program memory and data memory are separated. Data memory is 16-bit. Program instructions 24 bits long. The PIC 16F8774A has five serial ports namely A, B, C, D and E. PIC microcontroller is used to interface raspberry kit with LCD display. It is used to move the data content from the memory for the user's visualization.

C. Soil Moisture Sensor

Soil moisture sensor is used to monitor the moisture content of the soil consequently. The sensor keeps on recording the moisture content of the soil and tracks it to the Raspberry Pi memory and displays the soil temperature on the LCD display. When the soil temperature falls below the crops needed moisture level, then the cultivator need to manually set-out water to the crops.

D. IR Sensor

In addition to soil moisture sensor, IR sensor is equipped with our agriculture monitoring kit to notify the growth of the crops. It keeps on monitoring the length of the crops and if any obstacle presents, it immediately alerts the user to check for the affected crops.IR sensor has both transmitter and receiver that is it works as a transceiver. It sends IR signals from one sensor to another and it senses any obstacle like weeds and unwanted sprouting etc.

E. Wireless router

A wireless router is a device that performs the functions of a router but also includes the functions of a wireless access point. It is used to provide access to the Internet or a private computer network. It can function in a wired LAN (local area network), in a wireless-only LAN (WLAN), or in a mixed wired/wireless network, depending on the manufacturer and model.

F. Web camera

Camera is used to monitor the crops. We use 25 mega-pixel camera to capture the field even during night time. This camera detects the pest spread in the field, connects it with the web server and notifies the user about the affected area.

G. LCD Display

The name LCD initially referred to Liquid Crystal Display. We use 16*2'' LCD display. A 16*2" LCD means it can display result in2 lines and16 characters per line. In this LCD each character is displayed in 5x7 pixel matrix. In this project we use LCD to display the soil moisture and the IR value to the user.

III. EXPERIMENTAL RESULT

The following are the results obtained using web camera and sensors. Fig.2 shows the status of the crop. It was monitored by IR (Infra Red) transceivers. Camera interfaced with Raspberry Pi is used to capture the crop field. The captured image is processed to detect an edges automatically. This processed image can be viewed using remote desktop connection. Even a slight disturbance in the field can be find out immediately by the remote server access. The processed image is analyzed for pest detection.

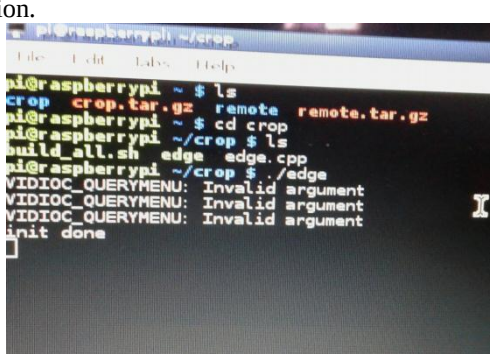

Fig.2 Edge Detection

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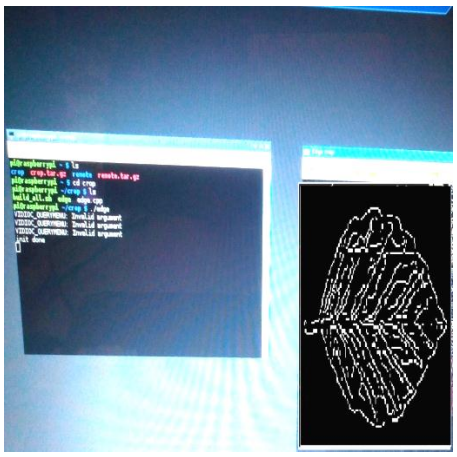

Fig.3 Leaf without pest

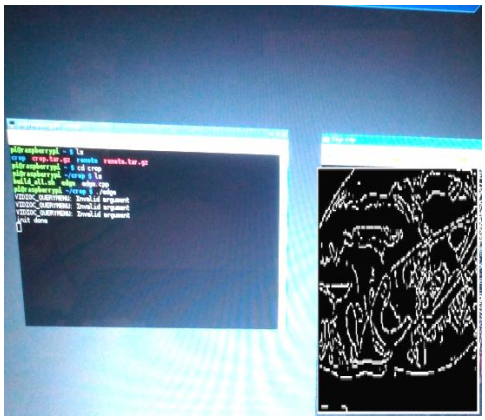

Fig. 4 Leaf with pest

The Fig.3 shows the leaf without pest. The pest affected crop can be identified by the veins. The veins of the leaves are straight or normal in edge detection, then it is pest free.

The Fig.4 shows the leaf with pest. The veins of the leaves are not narrow or abnormal, presence of pest is identified. To avoid the proliferation of pest, pesticides are sprayed immediately.

IV. CONCLUSION

The prototype of the proposed systems was implemented and it proved to be efficient to control the flow of water. It can thus be effectively used in places with water scarcity. Growth of the crop is monitored using IR sensor. Image is captured and processed for the pest. Thus using these sensors you can reduce the complication of agricultural labor. By using Raspberry Pi kit that is interfaced with PIC microcontroller, we can monitor the growth of crops in a healthy way. It could be enhanced in the future from manual work to automated work, thus reducing the man power.

The legacy behind this sensor is that, it has a positive sustainability over a period of time. It can sustain the market among all the competitors until other products gets over it. Nevertheless our product can be improvised by adding the new components, to the currently existing kit. Overall sensor is a boon to agricultural revolution.

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