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Sensor Based Smart Farming and Plant Diseases Monitoring

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ABSTRACT--- In India, farming is the primary source of income in almost all villages. Depending upon the weather conditions and availability of power supply, farming systems in India are strategically utilized .With the acute water crisis being faced by our country and the depleting water level, farmers now face optimum water management issues. Power supply to farmers is untimely and not reliable, nearly one-fifth of India's rural households still remain in acute darkness. The proposed system mitigates and provides a cost effective solution to address these issues. The system detects the water requirement of the soil based on soil moisture, temperature and humidity sensors. A threshold water level is set based on the plant type to automate the motor on/off operations. This is a convenient and affordable system which detects the supply voltage to automatically control motor operations. This system detects the phase voltage by using a phase detection circuit and sends a message to the farmer regarding availability of power supply. By using above sensors this system can also be tuned for disease monitoring. It also consists of a look up table which provides early stage plant disease prediction based on disease monitoring. ARM-7 LPC2148 is used which works on 3.3V power supply. The proposed model provides optimum use of resources for irrigation, reduces water requirement and helps to increase the crop yield.

Keywords: ARM 7, Automated Irrigation, Disease Monitoring, GSMSIM 800, Optimum Irrigation

I. INTRODUCTION

Indian Economy mostly depends on agricultural sector as about 70% of the population depends on it either directly or indirectly and about 58% of the employment is through agriculture. Also, Indian farmers' livelihood depends largely on agriculture [1, 2]. Crop failure is one of the major reason for mass farmer suicides in vidarbha and across the country. Some common reasons of crop failure include lack of proper monitoring of soil moisture, humidity and temperature. The diurnal temperature and humidity variations is observed in the real field conditions [3]. Due to high level of humidity loss of yields, root diseases and foliar problems may occur. While low humidity leads to hard growth, crops may take longer time to gain a salable size and the overall growth would not be good [4]. Thus, loss of quality varies according to the level of humidity/moisture levels, which in turn decreases the selling price and increases the cost price thereby reducing the profit of farmers.

To improve the crop production with better quality of crops, optimal irrigation is required with regular monitoring. Apart from the optimum irrigation, proper monitoring of crop health and plant diseases will further help to increase the crop yield and avoid crop wastage. Hence, in this paper we propose a system which can provide the optimal irrigation to crops by controlling the water pump. Further, this system can also be used for the plant disease monitoring.

II. LITERATURE SURVEY

Researchers in [5, 6] presented a new wireless multi-sensor based technology for the automatic measurement of soil moisture consisting of three different sensors with different sensing techniques. The proposed system takes advantage of resistive, capacitive and Dual Probe Heat Pulse (DPHP) [7] based soil moisture sensors. Here, each sensor node was equipped with a controller, a wireless data communication module, a solar powered battery module and instrumentation. Each sensor measured the moisture content of soil once per hour.The results of these sensors were then compared on the basis of power, accuracy and cost.

Researchers in [8] have proposed a scheme to make agriculture smart using IoT and automation. Following were the highlights of the proposed scheme.

A robot controlled by GPS was used to perform tasks like spraying, weeding, keeping vigilance, bird and animal scaring, moisture sensing, etc.

Accurate real time field data was collected using an intelligent and smart control decision making system.

Theft detection, Temperature maintenance and Humidity maintenance using Smart warehouse management.

All the devices used in this scheme were controlled through either computer or any smart remote device. The hardware devices used in this scheme includes micro-controller, actuators, Wi-Fi or ZigBee, sensors and camera.

Researchers in [9] have presented a smart irrigation system in which sensors were used to sense where and when irrigation was required based on the environmental parameters and a Truth table. The proposed system comprises of a decision making system which includes a micro-controller and its interfacing circuitry, sensors and a water pump. In the proposed system, the locations that require irrigation were narrowed down using sensors and only that particular part was sprinkled using the sprinklers. In this way, the water was not sprinkled over already damped locations. Sensing parameters that were taken into consideration include moisture, humidity and temperature. In order to determine the orchard soil condition remote transmission and automatic precise irrigation was used. System was equipped with a low power MSP430F149

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micro-controller, an automatic solar power supply module, water content reflect meters, flow sensor module, Solenoid valves, GSM wireless asynchronous module, etc.

[10] had proposed a system cored with a low power consumption mode of the MSP430F149 and was equipped with a water content reflectometer, an automatic solar power supply module, GSM wireless asynchronous module, flow sensor module, Solenoid valves etc. to realize the functions of the orchard soil data's remote transmission and automatic precise irrigation. When the lower limit of soil moisture was reached , the collection terminal uses the long-range wireless communication technology to warn the user by sending the humidity data, collected by SMS through the GSM module.

In a practical situation, the user can reply by phone, controller detects user's command, finally fuzzy control technology is used for precise irrigation. Through the practical operation, it shows that the system is reliable and stable and remote Human-Computer Interaction helps precise irrigation. Also it meets the actual needs of a wide range of the orchard area's cabling inconvenience. Compared to manual irrigation methods, it saves 20% to 30% of the water and tests results significantly. [10].

Researcher in [11] discussed an ARM based interfacing with temperature sensor, MEMS, GPS and GSM which gives real-time location and alert messages. In the proposed system, temperature sensor and GSM is used which is interfaced by ADC and UART, respectively, which is to be considered. Researcher in [12] IOT based smart home monitoring system with a priority Scheme. The paper gives brief idea of soil moisture and temperature sensor regarding interfacing and conversion process which is very useful in our design concept.

III. THEORY OF TECHNIQUES

LM 35 Temperature sensor:LM35 is a type of analog sensor whose analog output voltage is directly proportional to the temperature in °C. This eliminates the need to calibrate the sensor externally. Due to its linear output very low self-heating and low-output impedance, interfacing with the device becomes easy. This device can also be used with single power supply [13].

Soil Moisture Sensor:The Soil Moisture Sensor uses resistance to measure electrical conductivity of the surrounding medium. In soil, electrical conductivity is a function of the water content. The sensor creates a voltage proportional to the conductivity, and therefore the water content of the soil [5].

Fig 3: Soil Moisture Sensor

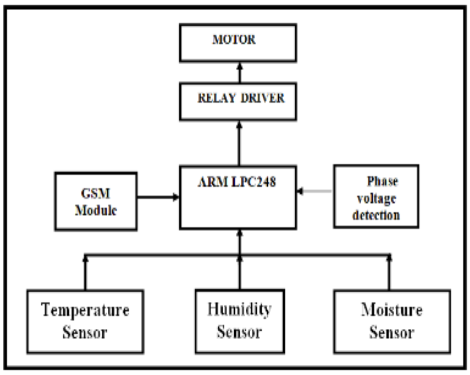

Fig 4: Block diagram of Proposed System

Figure 4. shows the Proposed block diagram of Sensor based Farming and plant disease monitoring. The system consists of ARM -7 microcontroller, wireless GSM module, Phase voltage detection, relay module, temperature sensor, humidity sensor and soil moisture sensor. The system consists of temperature, humidity, soil moisture sensor and phase detection circuit which act as an input to the proposed system. GSM module, Relay and motor work as an output to the proposed system.

The proposed system works in two modes. automatic mode and manual mode. As per the name in automatic mode the motor is turned on/off depending upon the data available in its program [15]. While in the manual mode user needs to control the motor. The phase voltage detection circuit shows the alert to the user regarding restoration of supply. Also, based on the input sensor, if the value of sensor goes beyond the expected value the SMS is sent which shows the status of soil accordingly the motor works.

Sensor	Interface and Conversion method
Temperature (LM35)	Analog Interface [((ADC value) *3300 / 1024) - 500] / 10 Temperature in Celsius
Humidity DHT11	Sensor sends actual values through 1-wire protocol Relative humidity in percentage, Temperature in Celsius
Soil Moisture	ADC value < 200 => Dry soil ADC value ∈[200,500) => Limited water ADC value ∈[500,800] => Sufficient water ADC value > 800 => Excess water soil

Table I. Sensor and Interfacing Table

Disease	Temp.	RH(%)	LW(hours)
Bacterial leaf Spot	25-30	80-90	-
Powdery Mildew	21-27	More than 48	-
Downy Mildew	17-32.5	More than 48	2-3
Anthracnose	24-26	-	12

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acterial cancer	25-30	More than 80	-
Rust	24	75	-

Table II. Favourable conditions for growth of Diseases[16]

Further, the developed system can be used for the plant disease monitoring, which will result in increase in the crop productivity Table 1.depicts the temperature and humidity range and their disease. These are the ranges over which the chances of diseases are most likely to occur.

The proposed system monitors the data via a sensor and alerts the user by sending an SMS. The figure 5 shows the basic flow chart which represents working of the system.

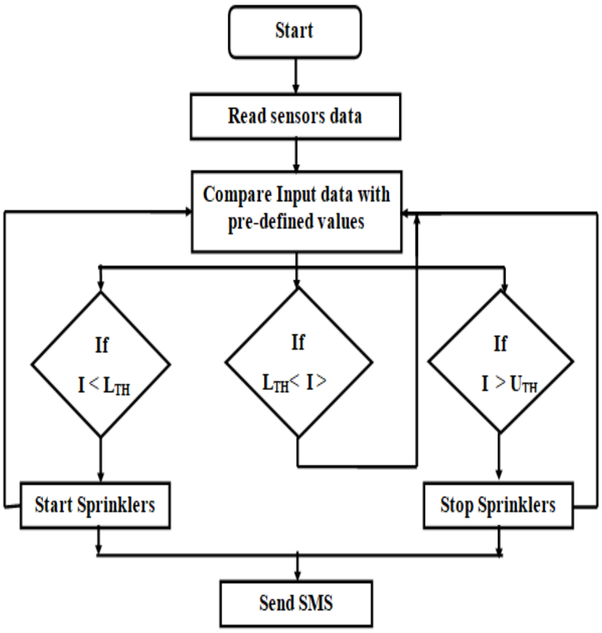

Fig 5: Flow-chart of Proposed system

The flow chat of proposed Sensor based farming and plant disease monitoring is shown in fig.5. The various data of humidity, temperature and soil moisture value is compared with the database stored in the lookup table in flash memory. If the input value (I) is less than the lower threshold value (LTH) then microcontroller gives command to relay to activate motor and start sprinklers. If the input value given by sensor (I) is greater than upper threshold (UTH), the controller allow relay to deactivate motor to stop sprinkler. The SMS is send to the user to know the status of a system.

	8051	PIC	AVR	ARM
Bus width	8-bit for standard core	8/16/32-bit	8/32-bit	32-bit mostly also available in 64-bit
Communication Protocols	UART, USART, SPI, I2C	PIC, UART, USART, LIN, CAN, Ethernet, SPI, I2S	UART, USART, SPI, I2C, (special purpose AVR support CAN, USB, Ethernet)	UART, USART, LIN, I2C, SPI, CAN, USB, Ethernet, I2S, DSP, SAI (serial audio interface), IrDA
Speed	12 Clock/instr-uction cycle	04 Clock/instr-uction cycle	01 Clock/instr-uction cycle	01 Clock/in-struction cycle
Memory	ROM, SRAM, FLASH	SRAM, FLASH	Flash, SRAM, EEPROM	Flash, SDRAM, EEPROM
ISA	CLSC	Some feature of RISC	RISC	RISC
Memoy Architecture	Von Neumann architecture	Harvard architecture	Modified	Modified Harvard architecture
Manufacturer	NXP, Atmel, Silicon Labs, Dallas, Cyprus, Infineon, etc.	Microchip Average	Atmel	Apple, Nvidia, Qualcomm, Samsung Electronics, and TI etc.
Cost (as compare-d to features provided)	Very Low	Average	Average	Low

Table III. Difference between various microcontrollers and their comparative analysis [17]

IV. RESULTS

The Proposed system is shown in Fig.6(a). The system works in 3 different modes. (i) Automatic or manual mode (ii) It detects Phase Supply to know the alert regarding supply voltage restoration (iii) It provides disease monitoring and based on that it predicts the disease. SMS is send to the user's mobile which helps him in taking necessary action. The system is effective and cost efficient as it works for single phase as well as three phase motors. The system increases the yield and hence increases productivity.

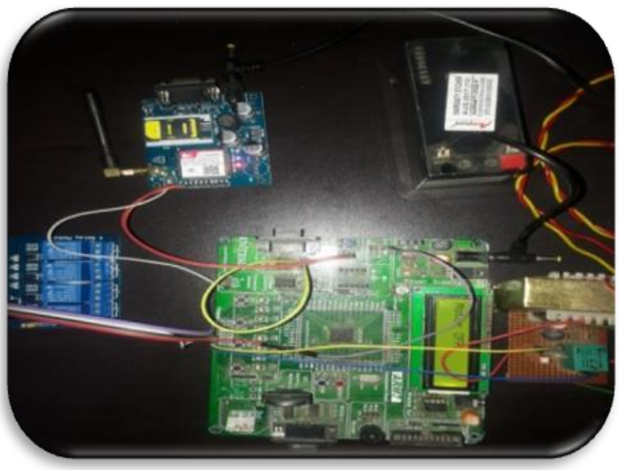

Fig 6:(a) Proposed System

The experimental setup is shown in fig 6.(a) ,the entire system is shown. 16X2LCD is used, which displays the status shown in fig 6(b). If the motor is on by sending an SMS to the controller the status is shown on Screen.

Fig.6(b) System shows Status of Motor ON

Fig.6.(c) System shows Status of Motor in OFF position.

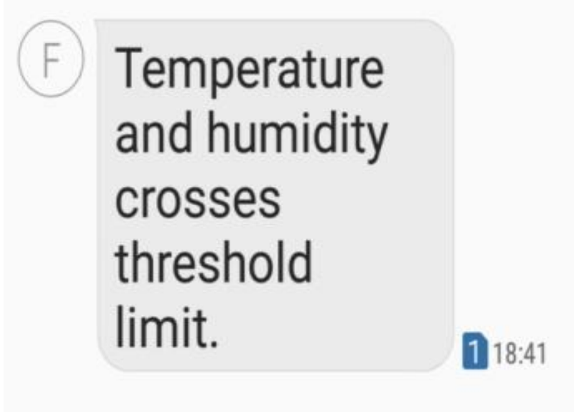

Fig 7: Supply Restoration and Soil moisture status SMS and temperature and humidity alert Message

V. CONCLUSION

The Proposed system comprises of the phase detection, disease monitoring and prediction which can be studied and upgraded with automatic and manual modes of motor controlling. Temperature, humidity and moisture sensors work together in a robust manner so as to increase the accuracy of the measurements. This makes the system more cost effective, faster and reliable.

REFERENCES

1 Vadivelu and B.R. Kiran, Problems and prospects of agricultural marketing in india: an overview, International Journal of Agricultural and Food Science, 3(3), pp. 108-118, 2013.

2 Nidhi Dwivedy, Challenges faced by the Agriculture Sector in Developing Countries with special reference to India, International Journal of Rural Studies, 18 (2), pp. 1-6, 2011

3 S. PALAPARTHY, M. SHOJAEIBAGHINI, D. N. SINGH"COMPENSATION OF TEMPERATURE EFFECTS FOR IN-SITU SOIL MOISTURE MEASUREMENT BY DPHP SENSORS", ELSEVIER COMPUTERS AND ELECTRONICS IN AGRICULTURE, 141, 2017, PP 73-80.

4 V. S. Palaparthy, M. ShojaeiBaghini, D. N. Singh, "Review of Polymer-Based Sensors for Agriculture-Related Applications", ICE Emerging Materials Research, 2(4), pp.166-180, 2013

5 P. Aravind, et. al, "A Wireless Multi-Sensor System for Soil Moisture Measurement", Proc. of IEEE Sensors Conference, 2015, South Korea.

6 J. John, et. al, "Design and Implementation of a Soil Moisture Wireless Sensor Network", Proc. of IEEE NCC, 2015, India.

7 N. Jorapur, et. al, "A Low-power, Low-cost Soil-Moisture Sensor using Dual-probe Heat-pulse Technique", Elsevier Sensors And Actuators A: Physical, 233, 2015, pp. 108-11

8 N.Gondchawar,R. S. Kawitkar, "IoT based Smart Agriculture", Department of Computer and Information Science, National Taichung University, Taichung, Taiwan.

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9 K.Masaba, A. Ntakirutimana and T.SelimUstun, “Desing and Implementation of a Smart Irrigation System for Improved Water-Energy Efficiency”, School of Electrical and Computer Engineering, Carnegie Mellon University. PA, USA.

10 Y. Na, L.Junfeng, “Smart Orchard Soil Moisture Monitoring System.Based on Wireless Communication Technology”, 978-1-4244-6055-7/10/2010 IEEE.

11 S.Chakole,V. R. Kapur “ARM Hardware Platform for Vehicular Monitoring and Tracking”2013 IEEE DOI 10.1109/CSNT.2013.16

12 Varun Tiwari, AvinashKeskar, “Design of IoT Enabled Local Network Based Home Engineering, Technology & Applied Science Research 2017.

13 Datasheet of LM35: http://www.ti.com/lit/ds/symlink/lm35.pdf

14 Datasheet of DHT-11: https://www.mouser.com/ds/2/758/DHT11-Technical-Data-Sheet-Translated-Version-1143054.pdf

15 V. S. Palaparthy, et. al, “An Automated, Self-sustained Soil Moisture Measurement System using Low Power Dual Probe Heat Pulse (DPHP) Sensor”, Proc. of IEEE Sensors Conference, 2015, South Korea.

16 https://www.elprocus.com/difference-between-avr-arm-8051-and-pic-microcontroller

17 P.G. Adasule, Director National Research Centre for Grapes, Pune, “Good Agricultural Practises for Production of Quality Table Grapes”.