Field Monitoring Using IoT in Agriculture

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Abstract- For a good yield a farmer needs to monitor the filed from time to time. This paper focuses filed monitoring using IoT devices which would provide live soil moisture, humidity and temperature of the field to the farmers. An individual would be able to take a prompt action to manage the filed based on the data received from field. An Arduino Microcontroller board with soil, temperature and humidity sensors is used to collect the data from the filed on the fly from a remote field. The data once received are analysed and discussed.This work invoked to take a preventive measure for loss of crop and also increase the productivity of crop.

Keywords- Arduino Microcontroller, Soil Moisture, Temperature, Humidity

I. INTRODUCTION

India is a land of famers with one third of its population depending on farming for sustenance. Growing population brings challenges to produce more and with large number of fields being compromised to industries and housing needs it is more challenging for the produce more from the shrinking sources. Research has been going on to produce new varieties to increase the yield but if the fields and crops are not monitored properly the results may not be as per expectation. Use of modern techniques can help the farmers to not only remotely monitor their crop but also take timely action. To make irrigation system more proficient technical data plays an important role[1]. A timely action can be taken only if the data is available on time and also that it gives an idea to the farmer what action needs to be take. Monitoring the environmental component is not sufficient, a complete solution is required as there are many components like pests, and animal attack, bird attack and unknown attacks need to be considered. Punjab recently witnessed an attack on cotton crop by unknown insects. Had the field been monitored a timely action could have been take to protect the crop but unfortunately nothing could be done and the crop was compromised. This paper introduces and IoT based field monitoring system which would help the farmers to monitor their fields remotely. The important part of this paper is smart GPS based remote monitoring system to perform task in the field like wedding, spraying, moisture sensing. Secondly it has smart irrigation to control the real time field data. Thirdly it can monitor the temperature and humidity of the field. All the things can be controlled by the remote device or PC connected to the internet and the operations will be performed by interfacing sensors (temperature, humidity and moisture). A Radio module with Arduino microcontroller has been designed for the purpose.

II. SYSTEM ARCHITECTURE

For the proposed model Temperature, Humidity and Soil moisture sensors were deployed on Arduino microcontroller board. The board through a radio model was then connected to the system where a code was written to store and monitor the data. Since the board and sensors are not very costly the overall cost of the proposed model is very low, within the purchasing power of the farmers. The architecture is such that the with a click of a button a farmer should be able to not only monitor the data but also take timely action. A farmer would himself be able to check diverse parameters of the soil like salinity, acidity, and moisture from time to time. The system can be set-up at the pump house, which is normally located at a remote location and difficult to regulate it during the night or uneven power supply. The set-up would be interfaced with the pump starter and sensors are to be connected at various point on the field to acquire data. Utilizing this system they can not only switch on their pump manually [2] sitting cozily in their homes but also the system would be able to automatically turn on the pump if put on auto mode.

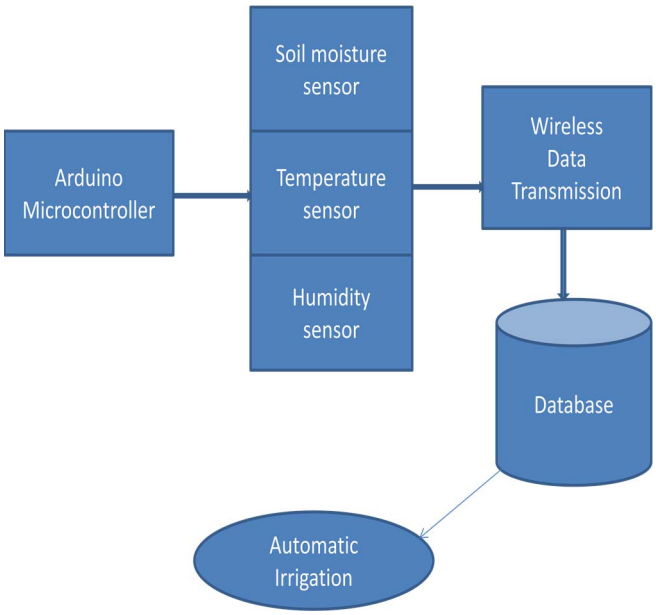


Fig. 1. Block Diagram of Proposed system

Fig 1 shows the proposed system model. This system model has a microcontroller which acts as a heart of the device. Its role is to control, detect and establish communication for fetching data from soil as a temperature, moisture and humidity. This unit is also useful to send data fetched by sensors to a mobile device through Bluetooth technology or ZigBee . The system can be directly hooked with a laptop or a computer through a USB cable. It can also be connected with a mobile phone which is readily available with farmers these days.

The Microcontroller has an additional feature of energy conservation. Therefore, it is used in the present work. It is used through control saving modes as a standby mode and sleep mode in this work.

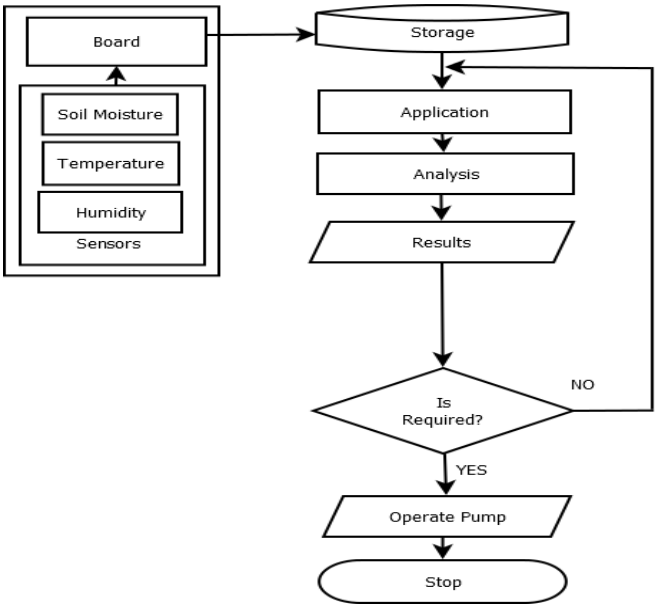
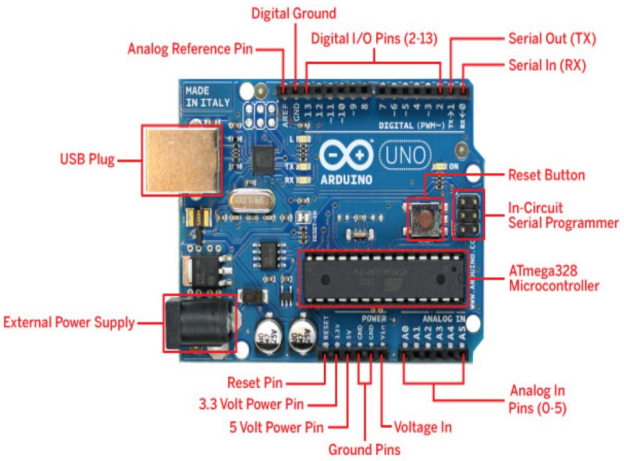


Fig.2 Flowchart of the IoT Firmware

The proposed system works as follow, when powered on, Microcontroller unit activates the peripherals for controlling detecting and establishing communication from the various connected devices. Microcontroller unit initiates tests from sensors one by one and also do verification of device to ensure their connectivity [3]. If connection is established, it started to exchange the information to mobile devices. Flowchart in Fig 2 shows the IoT firmware of proposed system. The data from the field is captured by the sensors on the board and transmitted to a computer. The data is then processed and an analysis is carried out with the already stored data of the area monitored in ideal condition. If a deviation is found more than the acceptable threshold value, required action is carried out by the system that includes warning to the farmer and switching on the water pump if required.

III. HARDWARE DESCRIPTION

Development of the wireless mobile system for measuring and checking of the fundamental quality soil parameters depends on Arduino modules. There are utilized modules with wireless communication, for measuring temperature, humidity, conductivity and acidity of the soil and module-a base station connected with a portable laptop for accepting, receiving, processing and storing data from wireless sensor modules.[4,6] Arduino platform depends on the input-output board and a development environment that utilize language processing. Arduino board is outfitted with powerful ATmega microcontrollers and normally, fills in as the "mind" of the robot and interactive projects. Arduino can "feel" his world surroundings different sensors and react to changes in the environment.



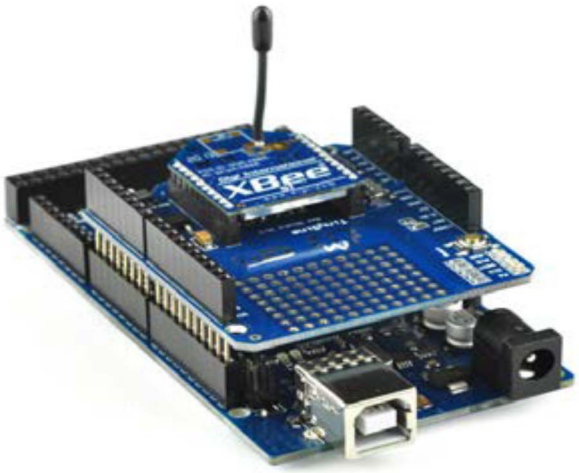


Fig. 3 The Base Station

A. Sensors Data acquisition

To attach sensors with the board a shield board is used. The shield board extends the capabilities of Aurdino. Aurdino board sits over a shield board and according to the pins connected the pins of the sensors are plugged into the shield board. Once a proper connection of the sensors with the pins of Aurdino is establishes the data acquisition becomes just a piece of cake. To capture soil moisture data a soil moisture sensor as shown in fig 4 was plugged into the soil. In a moist soil resistance is less therefore it has good conductivity of current as compared with dry soil [4,5]. Therefore, it helps to detect the moisture contained in the soil.

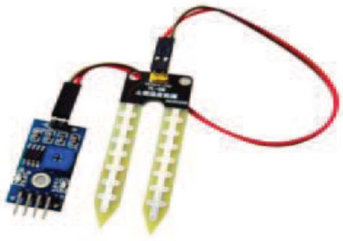


Fig. 4 Soil Moisture Sensor

To capture humidity and temperature of the soil DHT11 temperature and Humidity sensors are used in the present work. The aggregate sum of water vapor in air is characterized as a measure of humidity. Humidity of the soil varies relatively as the temperature varies in our observation. The measure of water droplets in air increases after irrigation and has effects in drop in temperature drop resulting in more humidity in the environment [5]. So, an appropriate action could be initiated by the farmer after receiving regular interval of temperature and humidity reading from the crop field to increase the productivity of the crop.

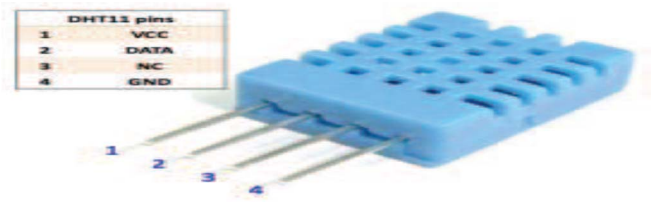


Fig. 5 DHT11 Temperature and humidity Sensor

IV. RESULT ANALYSIS

The sensors are deployed in the wheat crop for data capturing and shown in fig. 6. The results are carried out and analyzed in the form of temperature, moisture and humidity from the wheat crop field for invocating alarm to the farmer when required and shown in fig 7, fig 8 and fig 9.

These monitored real time data are calculated or recorded on the server. The monitoring of temperature, moisture humidity are plotted for the month of 10 January to 13 May.

Fig. 6. Sensor deployed in the Wheat Crop for data capturing

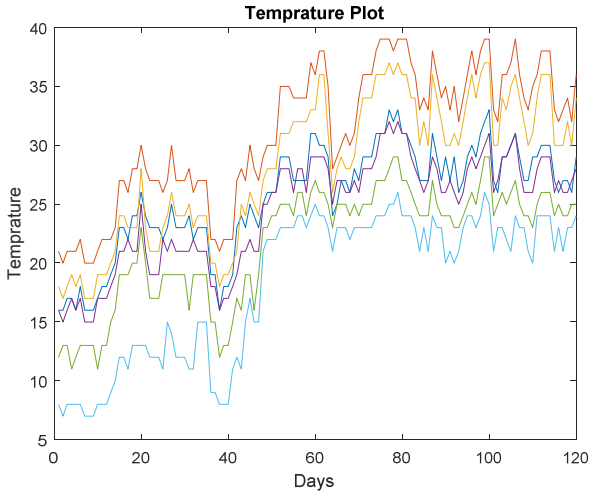


Fig. 7. Temperature monitoring of 120 days

Fig 7 shows a plot of temperature received over 120 days at 09:00 AM, 02:00PM, 06:00PM, 09:00 PM, 12:00 Midnight, and 05:00AM respectively on regular interval basis. It is clear from the plot how the temperature varies. The temperate rises but remains more or less constant between 40 and 120 days.

Fig 8 shows a plot of Soil Moisture data received over 120 days. The plot shows the variations in the moisture. Values falling below 10 can be considered as an alarm.

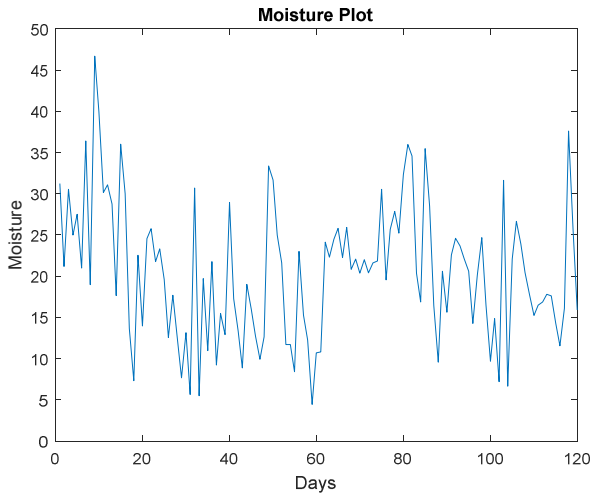


Fig. 8. Soil moisture monitoring for 120 days.

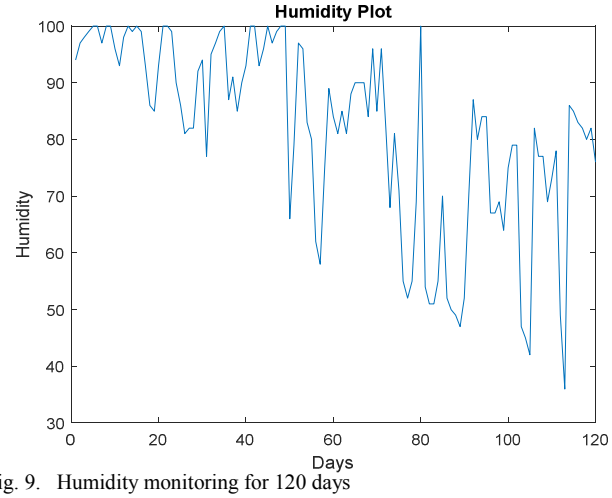


Fig. 9. Humidity monitoring for 120 days

Fig 9 shows a plot of Humidity of the site over 120 days. It is observed that as the temperature increases the Humidity decreases alarmingly. Near 110 days the Humidity falls down to around 35. This again can be a trigger an alarm to the farmer to water the fields. Since the system can be on Auto mode the pump could start on its own.

V. CONCLUSION

Filed monitoring based on IoT is a reliable and fast system which helps farmers in monitoring the fields effectively. This helps them to take corrective measure for the protection and better yield of the crop. Monitoring vegetation fields from distant locations not only helps in better utilization of the manpower but also quality of the crop. The collected data could be used for planning the strategies to get better output in the future.

VI. REFERENCES

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