Arduino Based Agriculture Weather Monitoring and Security System Using GPRSL

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ABSTRACT

Smart farming is a way to do agriculture by precisely managing the inputs based on variation of field parameters in order to achieve optimized outputs at minimum disturbances to the environment. It is well known that climate is one of the most imperative field parameters that determine plant growth and its output. This is because each plant is susceptible to certain growing conditions such as air temperature, relative humidity, soil temperature, wind and light, etc. Therefore, it is vital for farmers to understand these climatic conditions of their farms. Many of the problems in managing farms to maximize productions while achieving environmental goals can be solved with appropriate information collected from the weather stations. Weather stations help to understand the interactive influence of climate and management factors on crop yield. The use of real-time weather monitoring system is one of the most effective ways to equip farmers with timely climatic information and knowledge for better crop management.

1.0 Introduction

Climate is the primary determinant of agricultural productivity. Concern over the potential effects of long-term climatic change on agriculture has motivated a substantial body of research over the past decade. This body of research addresses possible physical effects of climatic change on agriculture, such as changes in crop and livestock yields, as well as the economic consequences of these potential yield changes.

This paper reviews the extant literature on these physical and economic effects and interprets this research in terms of common themes or findings. Of particular interest are findings concerning the role of human adaptations in responding to climate change, possible regional impacts to agricultural systems and potential changes in patterns of food production and prices.

Limitations and sensitivities of these findings are discussed and key areas of uncertainty are highlighted. Finally, some speculations regarding issues of potential importance in interpreting and using information on climate change and agriculture are presented.

2.0 Literature Review

Monitoring microenvironment at the farm level has recently become one of the hottest topics in precision agriculture. Zigbee technology is then the most prospective candidate for wirelessly networking those field sensors due to its low cost and power consumption and flexible architecture.

The microclimate monitoring system in this research is a suit of equipments based on Zigbee networking to measure the air temperature and humidity in a vast area. Every sensor node works on a cluster tree topology which extends the point-to-point distance up to 1 mile (line of sight), allowing this system to cover large farm using less sensor nodes. A sensor node consists of a micro-controller unit connected with air temperature and humidity sensor chips which are packed in a cylindrical louvered housing to prevent fault air temperature and humidity data from solar radiation. Every sensor node uses energy from a solar cell charged by a charger circuit to a battery package that stores power for use during night time. An energy management scheme was implemented to optimize power use for sending and receiving data. The data from every node were sent to

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the receiver every 8-30 minutes, depending on backup energy status at each node. The humidity and temperature data are stored on a data-logging PC and only current data are displayed on website Weather forecasting stations are systems that allow forecasting of daily, weekly or monthly weather conditions. These systems, which are used by meteorology in our country, can be both difficult and costly for individual use. Smart weather stations are being developed that can be used individually in order to get rid of such problems. In this study, a smart weather station has realized for the monitoring of weather conditions when changing during the day.

The data that received from the temperature, humidity, pressure and rain sensors in the air station, are processed by an Arduino-based processor and then estimated weather information has been given to users. The study results have been compared with results obtained from meteorology and the results have been seen to be close to each other.

3.0 Existing System

A power efficient and highly scalable IoT agricultural system. This system is based on LoRaWAN network for long range and low power consumption data transmission from the sensor nodes to the cloud services.

Our system of cloud services is highly scalable and utilizes data stream for analytics purposes. Data from the sensor nodes is transmitted to the LoRaWAN base stations and from there to The Things Network (TTN) platform .

The TTN is an open platform for registration of LoRaWAN devices (sensor nodes) and base stations (gateways).

It has an implementation of all needed backend services for LoRaWAN base station operation i.e. all functions needed for the data and the transport layer, along with all required security layers.

The TTN platform is responsible for collection, formatting and rerouting the data from the sensor nodes to our cloud services, while maintaining data integrity and security.

3.1 Drawbacks
- Less number of caches (text) can be send.
- No security
- Not able to get live status of the environment
- Time delay while transferring the information

Fig 1: Block Diagram Using Ardiuno Controller
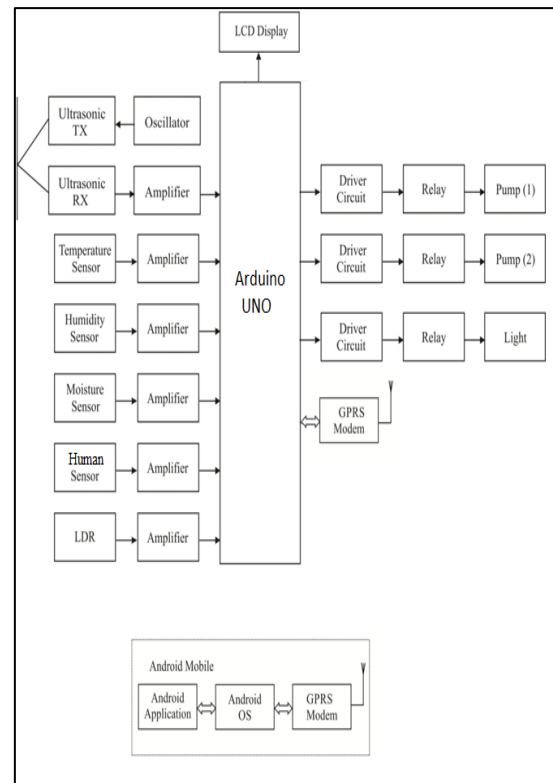

4.0 Proposed System

It is well known that climate is one of the most imperative field parameters that determine plant growth and its output. This is because each plant is susceptible to certain growing conditions such as air temperature, relative humidity, soil temperature, wind and light, etc. Therefore, it is vital for farmers to understand these climatic conditions of their farms. Many of the problems in managing farms to maximize productions while achieving environmental goals can be solved with appropriate information collected from the weather stations. Weather stations help to understand the interactive influence of climate and management factors on crop yield. The use of real-time weather monitoring system is one of the most effective ways to equip farmers with timely climatic information and knowledge for better crop management.

4.1 Arduino uno
Arduino/Genuino Uno is a microcontroller board based on the AT mega328P. It has 14 digital input/output pins (of which 6 can be used as PWM

outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.. You can tinker with your UNO without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again. Nodes store the character and the corresponding character frequency observed in the document.

Fig 2: Arduino Uno
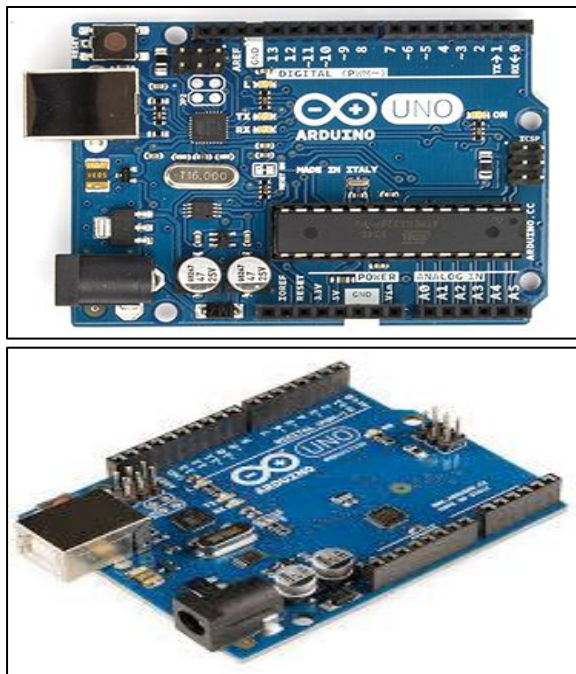
4.2 Ultrasonic transmitter and receiver

Fig 3: Ultrasonic Transmitter and Receiver
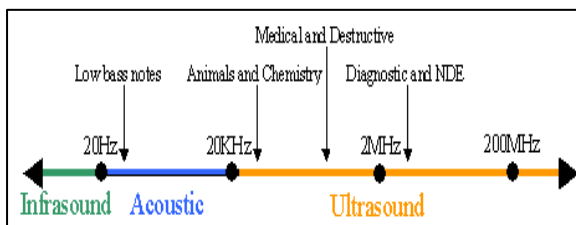
Ultrasonic refers to any study or application of sound waves that are higher frequency than the human audible range. Music and common sounds that we consider pleasant are typically 12 kHz or less,

while some humans can hear frequencies up to 20 kHz. Ultrasonic waves consist of frequencies greater than 20 kHz and exist in excess of 25 MHz. Ultrasonic waves are used in many applications including plastic welding, medicine, jewelry cleaning, and nondestructive test. Within nondestructive test, ultrasonic waves give us the ability to "see through" solid/opaque material and detect surface or internal flaws without affecting the material in an adverse manner.

4.3 Soil moisture sensors

Soil moisture sensors measure the water content in soil. A soil moisture probe is made up of multiple soil moisture sensors. One common type of soil moisture sensors in commercial use is a frequency domain sensor such as a capacitance sensor.

Another sensor, the neutron moisture gauge, utilize the moderator properties of water for neutrons. Cheaper sensors -often for home use- are based on two electrodes measuring the resistance of the soil. Sometimes this simply consists of two bare (galvanized) wires, but there are also probes with wires embedded in gypsum.

4.4 Agriculture

Measuring soil moisture is important in agriculture to help farmers manage their irrigation systems more efficiently. Not only are farmers able to generally use less water to grow a crop, they are able to increase yields and the quality of the crop by better management of soil moisture during critical plant growth stages.

Besides agriculture, there are many other disciplines using soil moisture sensors. Golf courses are now using sensors to increase the efficiencies of their irrigation systems to prevent over watering and leaching of fertilizers and other chemicals offsite.

4.5 Humidity sensor

A humidity sensor, also called a hygrometer, measures and regularly reports the relative humidity in the air. They may be used in homes for people with illnesses affected by humidity; as part of home heating, ventilating, and air conditioning (HVAC) systems; and in humidors or wine cellars. Humidity sensors can also be used in cars, office and industrial HVAC systems, and in meteorology stations to report and predict weather.

A humidity sensor senses relative humidity. This means that it measures both air temperature and moisture. Relative humidity, expressed as a percent, is the ratio of actual moisture in the air to the highest amount of moisture air at that temperature can hold. The warmer the air is, the more moisture it can hold, so relative humidity changes with fluctuations in temperature.

The most common type of humidity sensor uses what is called "capacitive measurement." This system relies on electrical capacitance, or the ability of two nearby electrical conductors to create an electrical field between them. The sensor itself is composed of two metal plates with a non-conductive polymer film between them. The film collects moisture from the air, and the moisture causes minute changes in the voltage between the two plates. The changes in voltage are converted into digital readings showing the amount of moisture in the air.

5.0 Simulation Result

Fig 4: Simulation Output from Proteus Software
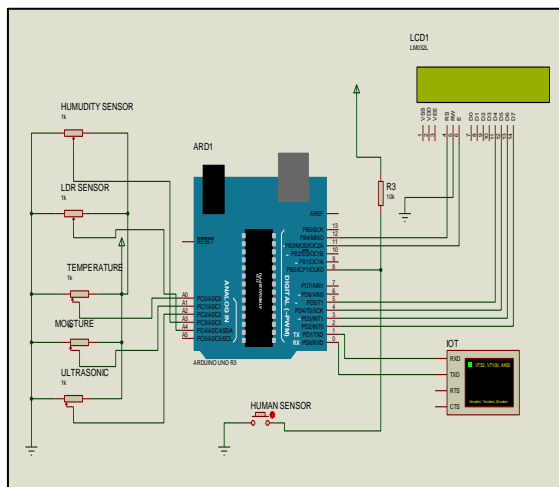
6.0 Conclusions

The low-cost reliable microclimate weather station called Cloud-based station was successfully designed, fabricated and installed in an Edamame farm. Upon comparing the data sets statistically, the results have shown that the Cloud-based station is equivalently efficient to measure air temperature, relative humidity and wind direction. Both commercial and lab-made stations yield similar characteristics of climatic conditions at the farm.

Therefore, the cloud-based station is more preferable to use in terms of cost affordable to farmers.

In the future, to compare other parameters like soil moisture and soil temperature to control amount and duration of watering crops in the farm. The use of soil sensor controlled by same microcontroller makes the cost of our weather monitoring system comparatively lower than Davis Vantage Pro2. Secondly, we hope to use this low cost weather station together with air quality monitoring system. After all, the Cloud-based stations can be used in remote farms of developing countries.

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