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A Wi-Fi Based Smart Wireless Sensor Network for Monitoring Agricultural Environment

R.Ramya[1], M.Vijayan.ME[2],

PG Scholar, Department of ECE, Velalar College of Engineering & Technology, Erode, India [1]

Associate professor, Department of ECE, Velalar College of Engineering & Technology, Erode, India [2]

***Abstract*— Environmental monitoring systems and sensors systems have increased in importance over the years. However, increases in measurement points mean increases in installation and maintenance cost. The measurement points once they have been built and installed, can be tedious to relocate in the future. To overcome these drawbacks, several sensors nodes were installed in existing method in which data's were manually collected as well as using wireless technology. Shorter range of data collection is the tedious process which increases complexity. Therefore, the purpose of this project is to monitoring the agricultural environment using Wi-Fi based Smart Wireless Sensor Network which is capable of intelligently monitoring agricultural conditions in a pre-programmed manner. The proposed system consists of three stations; they are Sensor Node, controller and receiver. To allow for better monitoring of the climate condition in an agricultural environment such as field or greenhouse, the sensor station is equipped with several sensor elements such as temperature, humidity, soil moisture and water level. The overall system architecture shows advantages in cost, size, flexibility and power.**

***Index Terms*—Monitoring Systems, Wi-Fi, Wireless Sensor Network, Sensor Nodes.**

I. INTRODUCTION

Agricultural environments such as fields and greenhouses allow growers to produce plants with an emphasis on agricultural yield and productivity. In particular, the use of greenhouses provides plants with protection from harsh weather conditions, diseases and a controlled environment.

An emphasis on agricultural yields however should be balanced with use fresh resources and sustainability. This can only be done based on a deeper understanding and monitoring the environmental systems. In particular the ongoing discussion will likely continue to surrounding the potential for sustainable agriculture. Agricultural environments are complex systems where significant changes in one environmental factor could have an adverse effect on another. Environmental factors can affect survival and growth, in particular with regards to germination, sprouting, flowering and fruit development. They can also indicate increased risk of disease and be used for prediction of upcoming changes in the environment. It is therefore of particular interest to monitor these environmental factors in particular for any control and management systems that might be implemented. Temperature, humidity, soil moisture, water level are variables that are of interest to growers. Manual collection of data for desired factors can be sporadic, not continuous, and produce variations from incorrect measurement taking. This can cause difficulty in controlling these important factors. Sensor Networks have been deployed for a wide variety of applications and awareness has increased with regards to implementing technology into an agricultural environment. Sensor Networks are becoming the solution to many existing problems in industries with their ability to operate in a wide range of environments.

Sensor nodes can reduce the time and effort required to monitor an environment. This method reduces the risk of information being lost or misplaced. It would also allow placement in critical locations without the need to place personnel at risk. Monitoring systems can permit quicker response times to adverse factors and conditions, better quality control of the produce and lower labour cost. The utilization of technology would allow for remote measurement of factors such as temperature, humidity, soil moisture. Development is increasingly aimed towards wireless solutions as compared to wired-based systems. One particular reason is that an agricultural monitoring system might require a large amount of wires and cables to distribute sensors. Sensor location can often require repositioning. Wireless nodes provide for flexibility of placement and additional sensors. A traditional wire layout would not provide this flexibility and could cost a substantial deal of time and energy in order to address such wiring problems. The system aims to reduce the cost and effort of incorporating wiring and to enhance the flexibility and mobility of the selected sensing points while the wireless sensor network (WSN) looks at being a comparatively self-organizing system. It allows sensor nodes to connect to the network and

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have their data logged to the allocated sensor server selected. The present work describes the development of a wireless system to monitor agricultural environments measure temperature, humidity, atmospheric pressure, soil moisture, water level and light. The wireless connection is implemented to acquire data from the various sensors, and to allow set up difficulty to be reduced. It is important to see under what conditions agricultural products grow as compared to their optimum conditions, in order to try and put in place methods to maximize the growth potential of the product. The quality and productivity of crop plants is highly dependent on the management of resources and management of factors, which is dependent on the quality of the information gathered from the agricultural environment. There has been rapid growth within the wireless communication industry. There are now many wireless technologies available on the market for both personal and industrial uses. Among these wireless technologies WI-FI is reported as one of the most exploited wireless technologies in use. WI-FI technology is a widely used and often built in technology capable of using pre-existing hardware already available and serving other applications and hardware.

The use of Internet Protocol (IP) is quite mature with readily available network management services making it a good choice for many environment monitoring systems. Therefore, the objective of this project is to design and develop a WI-FI based Wireless Sensor Network for an agricultural environment capable of intelligently monitoring agricultural conditions in a pre-programmed manner that can be updated as required. The main advantages of the proposed design in comparison with previous works are:

- It has the ability to monitor agricultural climate parameters (temperature, relative humidity, light intensity, air pressure, soil moisture, water level).
- The system does not require cables to operate and has low power consumption.
- It comprises of wireless sensor nodes that can be used to collect environmental data.
- It allows communication between the server and sensor nodes that are located in different parts of an agricultural environment.
- Investigation into integrating Novel Planar Electromagnetic Sensor to sensor system for use in environment monitoring to detect nitrates and contamination in water sources.
- The system allows for battery operation, easy relocation once installed and maintenance that is relatively cheap and easy.

II. LITERATURE REVIEW

During an agricultural product's development, it goes through various changes - these can include germination, sprouting, flowering and fruit development. As with many organisms it is affected by its environment in particular the availability of nutrients in the surroundings and the suitability of conditions. An agricultural environment can consist of a large number of factors. These factors can contribute or indicate how agricultural products develop either directly or indirectly, where poor environmental conditions can damage agricultural products, or increase the likelihood of diseases.

In the past there have been largely limited field tests with the deployment of a few relatively high cost sensors and sensing stations, thus limiting the coverage. The high cost of such systems usually made it difficult for interested parties to deploy a large number of sensing units. The hope was to have a sensor system able to measure a physical quantity and convert it into an electrical signal in order for it to be read and understood, be it by an observer or by an instrument.

Sensor technology has become commonplace in a wide variety of industry sectors, particularly where it is important to utilize information gained by monitoring and measuring the different sensors. Therefore there is some need to investigate the provision of reliable novel sensors that could be used in environmental monitoring systems and this should be carried out before interested parties such as environmental researchers contemplate taking on such systems.

A. Existing Agriculture Monitoring System

There are several methods and systems available for monitoring agricultural environment. This section reviews a few existing monitoring systems that can be used to monitor an agricultural environment.

1. Smart Farm System

The Smart Farm Field Monitor measures moisture level, temperature and data received from irrigation systems. All Smart Farm System components transfer data through wireless to the hub. The data is transmitted to a computer, enabling you to view data and monitor farm variables. All data is saved in CSV files. Additionally the system can control irrigation systems and pond levels. It also allows for future enhancements to be made.

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Fig.1: Smart farm system.

2. Soil Moisture Testing

Volumetric water content (VWC) is a numerical measure of soil moisture. It is the ratio of water to soil volume. To work out the volumetric water content, various tests were performed with soil to acquire the relationship between VWC and voltage output.

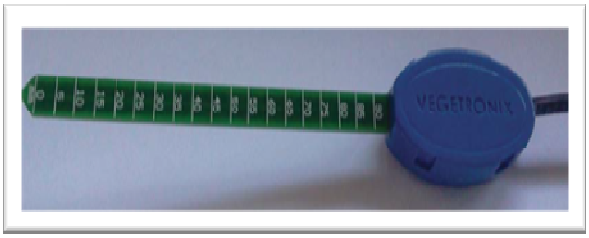

Fig.2: Soil moisture Sensor.

As iron nails were used as electrodes in the rest case, due to moisture content, iron nails started to corrode. It affected the voltage value obtained considerably. So, instead of iron nails, electrodes made of stainless steel were used. Making of the moisture sensor required several attempts.

3. Data Fusion Technology

Data fusion technology was introduced into wireless sensor networks to effectively improve data collection efficiency, communication bandwidth, save energy resources and extend the network life cycle. The design and application of wireless sensor networks have been greatly important to the development of modern computer networks. The ant colony algorithm was applied successfully applied to solve optimization problems in agriculture monitoring. Fusion centers in the ant colony optimization algorithm can reduce the search space size, thereby speeding up convergence.

4. Temperature and Controlling System

Temperature is an important parameter in irrigation system. Very high temperature can damage the crops, as it dehydrates the water content of the crop. Exhaust fan were enabled to prevent rise in temperature beyond the critical temperature. Noises were obtained during the verification of the output. Sensors got heated immediately at many instances. This sometimes even damaged the sensors. Due to overheating, sometimes the LCD display didn't show any output.

5. DIAS Field Server

The DIAS Field Server monitors agricultural fields such as rice and maize. The platform contains an all-in-one PC set up. The field server as a sensing network comprised of the devices, is designed and constructed in different shapes and functions based on the application purpose and deployed place. It contains a wireless transmitter distance that covers 100 m to 1000m around the field server. As a standard configuration it measures temperature, humidity, and light intensity and has a built-in web-camera.

DIAS Field Server Can Contain:

- Web Server
- Wi-Fi and/or Cellar-phone
- Cameras: 0.3-8M pixel
- Sensors: up to 24
- Ambient air temperature/humidity
- Solar radiation/UV
- CO2 ,SO2, NO2, H2S, CH4
- Leaf surface condensation
- Soil moisture/temperature
- Water/Air pressure
- Insect, Rainfall gauge

- DSSS - Direct sequence spread spectrum
- FHSS – Frequency hopping spread spectrum

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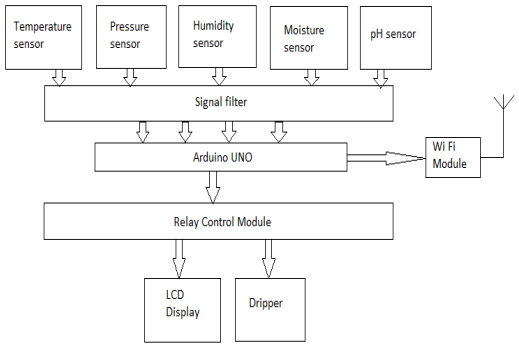
Table 1: Comparison of wireless technologies

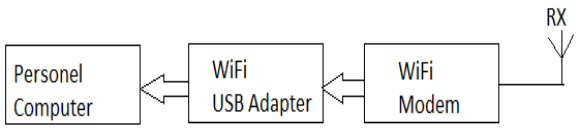
Feature	WI-FI	Bluetooth	ZigBee
Radio	DSSS*	FHSS*	DSSS
Data rate	11 Mbps	1 Mbps	250 Kbps
Nodes per master	32	7	64,000
Range(m)	100	10	70
Extendibility	Roaming possible	No	Yes
Battery life	Hours	1 weak	>1 year
Data type	Video, audio, graphics, pictures, files	audio, graphics, pictures, files	Small data packet

III. PROPOSED METHOD

In our proposed system, we use the Wi-Fi technology and arduino to interface the sensed analog signal. Block diagram for our proposed system is as shown below.In this system sensed analog values are sent to user via the Arduino controller. Arduino UNO itself contains ADC, so it automatically convert analog into digital values. User can access information through the wireless technology Wi-Fi.



(a)



(b)

Fig.3: Block diagram of proposed model (a) Transmitter (b) Receiver

A. *Tools Required*

Hardware: Sensor nodes, Wi-Fi module, Arduino UNO, Fans and relays, water pump, LCD display.

Language: Embedded C.

Software: Arduino IDE 1.0.1

B. *Hardware Description*

Arduino Uno

Arduino can be used to develop stand-alone interactive objects or can be connected to software on your computer (e.g. Flash, Processing). The open-source IDE can be downloaded for free (currently for Mac OS X, Windows, and Linux). The Uno now uses an ATmega8U2 instead of the FTDI chip. This allows for faster transfer rates, no drivers needed for Linux or Mac (information file for Windows is needed), and the ability to have the Uno show up as a keyboard, mouse, joystick, etc.

Wi-Fi Shield

The Arduino WiFi Shield connects your Arduino to the internet wirelessly. Connect it to your wireless network by following a few simple instructions to start controlling your world through the internet. As always with Arduino, every element of the platform – hardware, software and documentation – is freely available and open-source. This means you can learn exactly how it's made and use its design as the starting point for your own circuits.

- Requires an Arduino board
- Operating voltage 5V (supplied from the Arduino Board)
- Arduino Due compatible
- Connection via: 802.11b/g networks
- Encryption types: WEP and WPA2 Personal

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- Connection with Arduino on SPI port
- on-board micro SD slot
- ICSP headers
- FTDI connection for serial debugging of WiFi shield
- Mini-USB for updating WiFi shield firmware

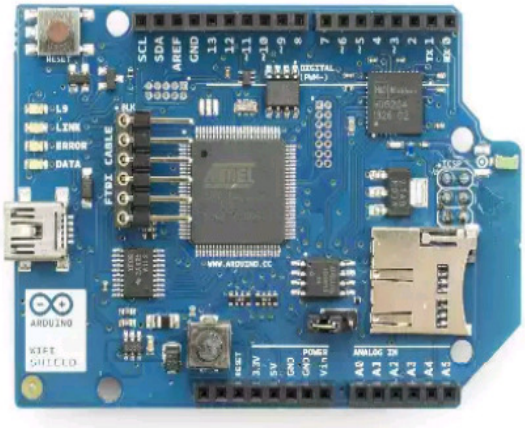

Fig.4: Arduino Wi-Fi shield

C. *Software and Language Description*

The Arduino integrated development environment (IDE) is a cross-platform application written in Java or C, and derives from the IDE for the Processing programming language and the Wiring projects. It is designed to introduce programming to artists and other newcomers unfamiliar with software development. It includes a code editor with features such as syntax highlighting, brace matching, and automatic indentation, and is also capable of compiling and uploading programs to the board with a single click.

IV. CONCLUSION

This project can be used as a solution to overcome the traditional method of manual collection of data and also use of technologies with short range. The system using Wireless Fidelity (Wi-Fi) as wireless technology to continuously transmit the data in wide range with low cost . It also addresses problems faced by the traditional use of wires and cables to distribute sensors. The sensor node can allow for battery operation, relocation, repositioning and addition of new sensors.

REFERENCES

[1] Akyildiz I.F., Sankarasubramaniam Y. and Cayirci E. (2010), 'A Survey on Sensor Networks', IEEE Communications Magazine, Vol. 40, No.9, pp.102-114

[2] Awati J.S., Patil V.S. (2013), 'Automatic Irrigation Control by using wireless sensor networks', Journal of Exclusive Management Science - June 2013-Vol 1 Issue 6 - ISSN 2277 – 568

[3] Bandyopadhyay S. and Siuli Roy D. A., (2008), 'Agro-sense: precision agriculture using sensor based wireless mesh networks', Proceedings of the First ITU-T Kaleidoscope Academic Conference, May 12-13, Kuala Lumpur, Malaysia, pp.383-388.

[4] Chi T., Chen M. and Gao Q. (2008), 'Implementation and study of a greenhouse environment surveillance system based on wireless sensor network', Proceedings of the International Conference on Embedded Software and Systems Symposia (ICESS2008), Chengdu, China, pp.287-291.

[5] Falsetto S., (2008), 'History of the Greenhouse: The Origins of Growing Plants in Indoor Structures in Europe', [Online]. Available:http://sharonfalsetto.suite101.com/history-of-the-greenhouse-a81808. [Accessed 10/11 2010].

[6] Haefke M., and Mukhopadhyay S.C. and Ewald H. (2011),'A Zigbee Based Smart Sensing Platform for Monitoring Environmental Parameters',Proceedings of IEEE International Conference on Instrumentation and Measurement Technology pp1-8.

[7] Irwin G. W., Colandairaj J. and Scanlon W. G.,(2006), 'An Overview of Wireless Networks in Control and Monitoring', Proceedings of the International Conference on Intelligent Computing, Kunming, CHINE, Vol. 4114, pp.1061-1072.

[8] Lin J.S. and Liu C.,(10-12, 2011), 'A Monitoring System Based on Wireless Sensor Network and an SoC Platform in Precision Agriculture', Proceedings of 11th IEEE International Conference on Communication Technology, Hangzhou, China, pp.101-104.

[9] Pawson, E., (2008), 'An Environmental History of New Zealand Agriculture', Proceedings of the EDS National Conference, Auckland, New Zealand, pp 1-7.

[10] Richard Hamilton, (2009), 'Agriculture's Sustainable Future: Breeding Better Crops', Scientific American Special Editions, [Online]. Available: http://www.scientificamerican.com. [Accessed 4 6 2010].

AUTHORS BIOGRAPHY

Miss R.Ramya had completed her BE Degree in Electronics and Communication Engineering from Velalar College of Engineering and Technology,Erode in the year 2014 and pursuing her post graduate degree in Applied Electronics in the Velalar College of Engineering and Technology,Erode. She had attended 3 national conference and 6 workshop in her carrier.

Mr.M.Vijayan was born on 05th january 1959. He had 24 years of industrial experience in cement, sugar and power generation plants and 8 years experience in teaching in various engineering college. Presently he is working in Velalar College of Engineering and Technology. He had attended 4 International Conference, 25 National Conferences and 10 workshop

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