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Agricultural Field Monitoring System using ATMEGA16 and GSM

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Abstract- The advancement of technology has provided a better platform in various aspects where monitoring of the agricultural field has also been considered. Agriculture being considered as the backbone of Indian economy, the advanced technologies has contributed a lot in controlling the field where various sensors has been introduced in order to get the information regarding the field and thus monitoring it accordingly which helps in reducing wastage of water, proper yield of crops and less manual work. The system proposed uses an ATMEGA16 which is the heart of the system, LM35, Soil Moisture Sensor and Raindrop Sensor for monitoring the field. Based on the condition of the soil moisture sensor it allows the motor to pump water and is further connected to GSM for allowing the user to communicate to the field by getting the condition of the field in terms of SMS.
Index Terms- *ATMEGA1; LCD; LM35; YL-69 Soil Moisture Sensor; Raindrop Sensor; GSM;*

1. INTRODUCTION

Use of water is considered as one of the most important factor when it comes to farming. Excessive use of water not only leads to wastage but also affects the plants and thus reducing its growth and loss in income to the farmers. Most of the livelihood in rural areas depends on farming as their prime source of occupation. The advancement in technologies helps them to reduce the manual labor by replacing the conventional methods and thus allowing them to have proper yield of crops. LM35 temperature sensor senses the temperature depending on the condition of the field. Soil moisture sensor measures the water content of the soil and depending on the weather where a raindrop sensor is established it allows the water to flow through the pump to the field. This helps is supplying water to the field only when required depending on the condition of the field and thus reducing wastage of water and manual labor to control the pump. All these three sensors are programmed in the controller which then displays the result in LCD. The GSM connected to the system also allows the user to get the necessary information regarding the condition of the field in SMS form through the use of AT commands programmed in the controller and need not go to the field regularly for checking on it. In [1], the system is designed to provide medium and long-term credit to farmers for the purchase of farm machinery and for the development of small irrigation system. Automatic monitoring and control of the field are implemented with the use of different sensors like temperature, humidity, moisture sensors and nitrogen content of the soil and ARM LPC2148 processor to provide data to the user, GSM is used where the user can obtain the real data monitoring of the field through SMS. This system also reduces the loss of water level which goes into waste due to improper planning of water usage. Valves are used to turn ON/OFF automatically such that water is supplied on when needed. It consumes less time, human labor and error is reduced and also maximizes net profits. The system further suggested the use of MMS facility for capturing the video of the field and sending it to the farmer. In [2, 3] it both deals with the real-time atomization of Indian agricultural system which concentrates on the water availability to the field. It used an ARM7TDMI which is a 32-bit core chip and GSM that allows the user to know about the condition of the field. The sensors used are temperature, humidity, soil moisture and water level sensors. The irrigation control system continuously monitors the field and gives the output to the client through SMS. The system offers a less expensive, faster communication and less power consumption which offers a conventional system for the efficient usage of the agricultural and for the emergency conditions. In addition to this, works on solar power supply that reduces the cost of electricity. In [4], agricultural system using ARM7 was developed for controlling the water use and prediction of weather using weather monitoring mechanism. In addition to temperature, humidity and soil moisture sensor, C02 sensor was used for monitoring the presence of CO2 in air. The problems faced with the existing systems such as weather monitoring, remote operation, remote monitoring etc. were discussed providing a solution to all these problems in the proposed system. In [5], it basically deals with drip irrigation system where water is given to the roots in drop wise which not only saves

water but also prevents the plants from flooding and decaying. An ATmega32 microcontroller is used which forms the heart of the system along with moisture and temperature sensors that collects the real time data from the field. GSM technology is used which allows the farmers to keep a track on the field through. It controls, monitors and automatically ON/OFF the water pump as per the requirements. This system has some advantages like it reduces the growth of weed which led to less use of weedicides and also the growth of fungi has lessened. It uses less amount of water, improves quality, productivity of crops thus making the irrigation practice automatic and accurate. In [6], real-time monitoring is considered which can prevent from unnecessary wastage of water. Distributed in-field sensor based irrigation gives a solution to support site specific irrigation management. Temperature, pH and level sensors are used to monitor the field and the water level in the tank where data is send to the AVR microcontroller. GSM technology is used for the end user. Two motors are used: one for low rpm for sprinkling motor and the other high rpm for shunt motor. In [7, 8], mobile phone acts as a remote control application for controlling the motor-pump induction. Here the motor will automatically work depending on the commands either by a missed call or an SMS through the help of GSM technology. The processor used is a PIC16F877 microcontroller. Sensors used are temperature, humidity, and soil moisture, water level of tank and pH of soil. It further suggested the implementation of spoken command for illiterate people that can be converted to SMS and the use of solar energy to reduce the cost as well as abnormal voltage conditions. In [9], an in-situ distributed wireless sensor network of soil moisture and temperature sensors are placed in the root zone of the plants. Ultrasonic and pH sensors are used in addition for automation. ATMEGA16 controller is used with Zigbee technology. LABVIEW software is also used for collecting the data and displaying using the framed software protocol. In [10], real time monitoring of agricultural environment based on Zigbee technology is used. System is mainly designed for use of wide range of technologies and to replace the non-technological methods. PIC microcontroller is used along with temperature, soil moisture and water level sensors. Zigbee technology is used which is applicable for long distance communication. The system has been proposed to provide with a proper crop yield. In [11, 12, and 13] propose the design of a WSN based automated agriculture monitoring system. It proposes the design innovativeness of GSM and Zigbee based for irrigation. The sensor nodes can acquire the different real-time data from the sensors which are transferred to the remote monitoring center by the gateway via the transmission network. The information are processed by the controller and transmitted over the Zigbee module. The data can be sent to the computer via RS232 interface or it can be sent to the user directly in the form of SMS by using GSM. This system can further be used by installing cameras with the help of Zigbee device in the field to take snapshots. In [14], the main objective was to develop a smart Wireless Sensor Network for agricultural field monitoring. It uses a Zigbee technology, 8-bit AVR and temperature, humidity and soil moisture sensor and LCD for display. This system proposed in such a way that even illiterate people can operate it that they can switch on the pump from their home whenever required. The system is installed at the pump house located remotely to the village and interfaced with the pump starter and sensors plugged at different location in the field. In [15, 16], are both designed on ARM processor with GSM technology. It aims to find the exact field condition and to control the wastage of water in the field by providing the exact field controlling method through drip irrigation. The sensors used are temperature, humidity, soil moisture, humidity, leaf sensor, pH, and level and phase sensor. In [17, 18], 8051 microcontroller AT89C51 is used along with temperature and moisture sensor for monitoring the field outside by using WSN (Wireless Sensor Network). GSM is used for allowing the farmers to receive the condition of the field. Soil is monitored continuously with the help of soil moisture sensor and also the level of water content using sensors, temperature and humidity with the help of temperature sensor. By this if any level of water or temperature changes takes place then immediately the message is passed to the farmer with the help of GSM. Future scope can be enhanced to detect the soil parameter and suggesting proper fertilizer and its feed time, detecting particular disease on plants and its proper measures and MMS facility for capturing the video of the field. In [2], a simple and cost effective system is being developed that focuses on predicting the start of germination of the disease. Wireless network is used that transmits different environment conditions to the field where data is stored and analyzed and has been tested under various obstacles and a delay has been observed. Here, Graphical User Interface is developed that allows the farmers to access to the system. It further suggested the use both in open field as well as in greenhouse based system. Water is provided directly to the roots with the help of drip irrigation. In [19], a wireless sensor network that allows an improved water management and controlling various parameters required to the field which helps to store and utilize the rain water, increase in crop productivity and to reduce the cost for cultivation. It mainly focuses on to the poor farmers in the semi-arid areas. ATmega16 is used along with temperature, humidity and soil moisture sensor. In addition to the previous work, carbon dioxide gas sensor has been added. In [20], a farming environment

framework for observing the data concerning an outside by using wireless sensor network innovation has been proposed. It gathers the soil data on the outside through WSN based ecological and soil sensors. Main aim is to atomize the irrigation system for social welfare of agriculture system. It monitors the field continuously with the help of soil moisture sensor and water level sensor and if any change is observed, it immediately sends message to the user with the help of GSM. In [21], an automated wireless watering system has been designed to overcome the difficulties encountered by the traditional wired system. The system provides two modes of operation: manual and automatic. Manual mode that works just as the traditional methods where the watering of the field has to be decided by the user whereas in automatic mode, the user need not pay attention to this as it will function on its own depending on the commands implemented and the condition of the field sensed by the sensors. GSM modem is also used that allows the user to receive message. In [22], a single-board microcontroller-based system has been designed and implemented to monitor and control several variables and maintain desired condition in each greenhouse. A rule-based fuzzy controller has been designed to control the microclimate of each greenhouse. The main objective of the proposed project is to monitor and control the climatic condition inside each greenhouse according to the desired values of crop. The farmer can remotely select a greenhouse to monitor the measured variables. Live video is available through adjustable web camera to monitor crop growth and health. The farmer can send commands to turn ON or OFF certain devices in a selected greenhouse through wireless communications. In [23], an emphasis on WSN approach has been considered for monitoring and controlling the field in greenhouse based system that results in an optimum crop production and maximum profit. A control system is developed using Atmega microcontroller which are preferred over other microcontrollers due to some important features including 10- bit ADC, sleep mode , wide input voltage range and higher memory capacity. In [24], a low cost system is developed to monitor and control the greenhouse environment using Arduino Uno which is a low cost, simple and effective as the commercially available greenhouse monitoring systems are quite expensive and most of the Indian farmers are unable to afford it. Various sensors are integrated to this board which monitor and control various parameters. Condensation occurs if temperature and humidity is not maintained properly. This affects the overall growth of plant. The experimental results demonstrate that the growth of plant is increased by 20% in the control environment. A low cost embedded system is developed to measure and monitor poly-house environment. The wireless model needs as DC supply can be given in the form of a battery bank easy to charge with solar system. There are limitation in terms of seasonal measurements and crop needs. In [25], a low power, low cost, robust data collection system to generate and gather data autonomously in isolated or remote areas has been proposed. The sensor module collects soil moisture and temperature data and air temperature and humidity data that are then gathered periodically by a line following robot that uploads the stored data from the sensor module via Bluetooth communication for further analysis. The proposed system combines a sensor module to gather real-time data regarding soil temperature and moisture, and air temperature and humidity with a robot that will autonomously pass by the sensor module and upload the data via Bluetooth communication. The implementation of a custom RTOS adds to the low cost and high efficiency of the proposed system.

2. BLOCK DIAGRAM

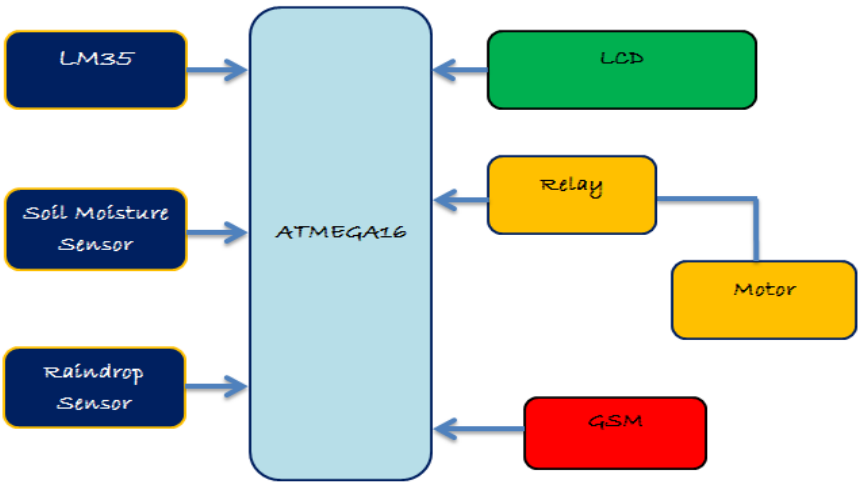

Figure 1. Block diagram of the designed system

3. SYSTEM OVERVIEW

The block diagram above shows the design for the embedded system based agricultural field monitoring system. The software tool used here is AVR Studio 4 for writing the codes and interfacing it to the system to carry out the readings. The system consists of three sensors which are placed in the field for monitoring the condition of the field. The input provided by the sensor is fed to the controller which is then programmed using codes. The results are displayed in LCD and is further received by the user in SMS form with the help of the GSM modem connected to it programmed using certain AT commands. The pump works automatically depending on the condition of the field i.e. the information provided by the sensor to the controller for water requirements.

4. HARDWARE IMPLEMENTATION

4.1 Reading of sensor values

Since the controller can read only in digital form, the Atmega16 which has an inbuilt ADC converts the input given by the sensor from analog to digital form. ADC has an inbuilt of 10-bit resolution (i.e. 1024 steps) and depending on the reference voltage selected, the readings are observed.

4.1.1 LM35 Temperature Sensor

- Reference voltage/ 10-bit resolution (1024 steps)
- Reference voltage/ 10-bit resolution (1024 steps) * adc value
- (Reference voltage/ 10-bit resolution (1024 steps) * adc value)/10. In order to get the temperature in °C, the reading observed is divided by 10

4.1.2 Soil Moisture Sensor

- Reference voltage/ 10-bit resolution (1024 steps)
- Reference voltage/ 10-bit resolution (1024 steps) * adc value
- Depending on the graph and the equation obtained from calibration, the adc value is fitted to the equation for setting up the threshold value

4.1.3 Raindrop sensor

- Raindrop sensor acts as a switch such that it indicates whether it is raining or not. Depending on it, the motor works for pumping the water.

4.2 Software used

- AVR Studio
  AVR Studio for writing the program. Prior to installation of AVR Studio, the compiler WinAVR needs to be installed. The environment is very user-friendly.
- Proteus
  Before burning the codes to the hardware, one way to check the code is by using Proteus software. Here, the hex files generated from the AVR studio software is used. This is the perfect tool for testing the microcontroller designs before constructing a physical prototype in real time.
- AVRUBD
  A serial port connector connects to a computer's USB port and performs in-system programming. . It supports most types of AVR microcontrollers (Mega series), which have self-programmable capability, boot section and UART.

5. RESULTS AND CONCLUSION

Table 1. Various conditions generated by the sensors depending on the condition of the field

Temperature sensor	Raindrop sensor	Soil moisture sensor	Pump condition
40°C	NO RAIN	>50%	OFF
40°C	RAINING	>50%	OFF
40°C	RAINING	<50%	OFF
40°C	NO RAIN	<50%	ON

Table 2. Results displayed on LCD and messages send to the user

LCD DISPLAY	MESSAGE GENERATED
Temperature 40°C, Moisture is 60%, Moisture is HIGH, No Rain, Pump is OFF	Temperature 40°C, Moisture is 60%, Moisture is HIGH, No Rain, Pump is OFF
Temperature 40°C, Moisture is 60%, Moisture is HIGH, Raining, Pump is OFF	Temperature 40°C, Moisture is 60%, Moisture is HIGH, Raining, Pump is OFF
Temperature 40°C, Moisture is 30%, Moisture is LOW, Raining, Pump is OFF	Temperature 40°C, Moisture is 30%, Moisture is LOW, Raining, Pump is OFF
Temperature 40°C, Moisture is 30%, Moisture is LOW, No Rain, Pump is ON	Temperature 40°C, Moisture is 30%, Moisture is LOW, No Rain, Pump is ON

From Table 1, we can observe the output generated by various sensors depending on the condition of the field. Temperature is varied depending on the condition of the field, raindrop sensor depending on

the condition of the weather if there is rainfall or not and soil moisture sensor by monitoring the moisture content in the soil. Table 2 displays the results in LCD generated by various sensors in the field and the same message that is displayed on the LCD if further send to the user is SMS form by using GSM module. This allows the user to get the information regarding the condition of the field which reduces manual labor and also allows proper maintenance to the field. The use of raindrop sensor can further be used for rainwater harvesting by setting up a tank for storing water which is also considered as one of the important factor in farming industry. Further implementations can be done by setting up more complex sensors and also for video monitoring of the field.

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REFERENCES

[1] N. Sureah, M. l; G. Yaswanth, G. S.: Real-time Automatization of Agricultural Environment for social modernisation of Indian Agricultural System, IJSEAT March 2015, pp.90-92

[2] B. N. Sree; B.N Kumar: Design and Development of Precision Agriculture Embedded Systems, International journal & magazine of Engineering, technology, management and research, vol-2 (2015), issue no: 11(November)

[3] C. V. Swamy; B. S. Kumar: Wireless Monitoring and Automated Irrigation Control System, International journal of advance research in science and engineering, vol-4, issue no.7, July 2015, pp.206-210

[4] Bhanuchandar N.; M. S Ali: Real-time atomization of agricultural environment for Indian Agricultural system using ARM7, International Journal of Industrial Electronics and Electrical Engineering, ISSN: 2347-6982 Vol-3, Issue-6, June-2015, pp.22-25

[5] S. Punia: Drip irrigation system using embedded systems: an initiative of saving water, IJRET: International Journal of Research in Engineering and Technology eissn: 2319-1163 | pissn: 2321-7308, pp.157-159

[6] A. M. George; M. Sindhubala; J. E. Thilakavathi :Monitoring and Management of Agricultural Environment Using Sensors and GSM, International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181 Vol-2 Issue 6, June – 2013

[7] V. S. Saptasagare; B. B. Kodada: Real-Time Implementation and Analysis of Crop-Field for Agriculture Management System based on Microcontroller with GPRS (M- GPRS) and SMS, International Journal of Computer Applications (0975 – 8887) Vol-5, July 2014

[8] S. Sumeetha; D. Sharmila: Embedded based Remote Control Application using Mobile Phone in Irrigation, International Journal of Power Control Signal and Computation (IJPCSC) Vol-3. No1. Jan-Mar 2012 ISSN: 0976-268X

[9] K. Karthickpriya; Dr. S. Vijayarajan; Mr. K. Kannan: Real Time Atomization of Indian Agricultural System, IJREAT International Journal of Research in Engineering & Advanced Technology, Vol-3, Issue 1, Feb-Mar, 2015

[10] S. P. Goyal; Dr. A. Bhise; Zigbee Based Real - Time Monitoring System of Agricultural Environment, International Journal of Engineering Research and Applications ISSN : 2248-9622, Vol-4, Issue 2(Version 6), February 2014.

[11] G. V. Satyanarayana; SD.Mazaruddin: Wireless Sensor Based Remote Monitoring System for Agriculture Using ZigBee and GPS, Conference on Advances in Communication and Control Systems 2013, pp.110-113

[12] S. S. Patil1; A. V. Malviya: Agricultural Field Monitoring System Using ARM, International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering Vol. 3, Issue 4, April 2014, pp.8781-8787

[13] D. Bansal; S. R. N Reddy: WSN Based Closed Loop Automatic Irrigation System, International Journal of Engineering Science and Innovative Technology (IJESIT) Vol-2, Issue 3, May 2013

[14] Prof C. H. Chavan; Mr. P. V. Karande: Wireless Monitoring of Soil Moisture, Temperature & Humidity Using Zigbee in Agriculture, International Journal of Engineering Trends and Technology (IJETT) – Vol-11 Number 10 - May 2014

[15] N. Priyanka; Aravind: Modern Indian Agricultural System Using GSM, International Journal Of Engineering Science & Advanced Technology Vol-2, Issue- 5

[16] K. Prathyusha; G. S. Bala; Dr. K. S. Ravi: A real-time irrigation control System for precision agriculture using WSN in Indian agricultural sectors, International Journal of Computer Science, Engineering and Applications (IJCSEA) Vol-3, No.4, August 2013

[17] S. L. Pandian; Y. Charishma; V. Parameswary: Monitoring of Indian Agriculture using LPC2148,

International Journal of Computer Applications (0975 – 8887) Vol-116, No. 16, April 2015

[18] M. Ramu; CH. R. Prasad: Cost effective atomization of Indian agricultural system using 8051 microcontroller, International Journal of Advanced Research in Computer and Communication Engineering Vol-2, Issue 7, July 2013

[19] N. R Patel; S. S. Mathurkar et.al: Microcontroller Based drip Irrigation System Using Smart Sensor, IEEE India Conference 2013

[20] M. Giri; A. Doshi, P. Kulkarni; K. Yendhe; S. Raskar: Wireless Sensor Network Application for Agricultural Environmental Sensing, International Journal of Advanced Research in Computer Engineering & Technology (IJARCET) Vol-3, Issue 5, May 2014, pp.1946-1949

[21] Dr. R B. Babu; CH Jonathan Soumith; T Cherishma Sri Lakshmi; R Keshav Rao: GSM based Agriculture Monitoring and Controlling System, Global Journal of Computer Science and Technology: A Hardware and Computation Vol-15 Issue 2 Version 1.0 Year 2015

[22] Prof. Mrs. S. S. Patil; Prof. V. M. Davande; Prof. J. J. Mulani: Smart Wireless Sensor Network for Monitoring an Agricultural Environment, International Journal of Computer Science and Information Technologies, Vol-5 (3), 2014

[23] K. M al-Aubidy; M. M Ali et.al: Real-Time Monitoring and Intelligent Control for Greenhouse Based on Wireless Sensor Network, IEEE 2014

[24] Miss. V. R. Deore; Prof V. M. Umale: Wireless Monitoring of the Greenhouse System using Embedded Controllers, International Journal of Scientific and Engineering Research, Vol-3, Issue 2, February 2012, pp.1-8

[25] A. Shaouti, K. Juzswik; K. Guyen, H. Peurasaari ; S. Awad: An Embedded System For Agricultural Monitoring Of Remote Areas, IEEE 2015, pp.58-67