IOT Based Energy Efficient Wireless Monitoring System for Agarian Areas in Indian Agricultural System using GPRS module

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Abstract: India being an agricultural country needs some innovation in the field of agriculture. Traditional methods of irrigation not only require water in quantity but percentage of water wastage is also high. Globally water is becoming a scarce resource that instigating the need of controlled crop irrigation. Recent advances Engineering & Technology, such as the convergence of internet of things (IoT), communication, wireless sensor networks and information technologies have paved the way for new era of monitoring and controlling the agricultural parameters from the remote places. To enhance the resource utilization in a constrained manner an autonomous energy efficient sensing platform is developed and is installed in an agriculture land to monitor the soil moisture, ambient temperature & humidity. Based on the soil conditions, motor pump can be Turned ON/OFF, the measured data from cultivation field is processed and sending the same information from to Amazon web servers through GPRS gateway. The measured data is accessed from server through the websites.

The whole irrigation system is powered by solar energy with battery power management system. The automated irrigation system is tested in turmeric and onion plantation simultaneously for 50 days. Water savings is up to 90% when compared with the present trickle irrigation channel is achieved. By incorporating the automated irrigation scheme, consumption of water and electricity is reduced, further it increases the quality of food grains and the yield of crops.

Keywords: IoT, AWS, Renesas Controller, Soil Condition Monitoring, GPRS Gateway, Wireless monitoring.

I. INTRODUCTION

Main reasons for the global water crisis besides population growth, urbanization, and climate change are excessive water use, poor management, and inadequate irrigation. According to the United Nations World Water Development Report, 70% of freshwater worldwide is used for irrigation. The amount of applied water does usually not match the requirements of the irrigated crop, and either too much or too little water is used for irrigation. By 2025, as the United Nations Global Environment Outlook predicts, the water withdrawals in developing countries will increase by 50% and, if the trend continues, 1.8 billion people will be living in regions with absolute water scarcity [2]. However, not only developing countries, which are facing severe health problems due to limited access to freshwater, but also the world's wealthiest industrial nations are increasingly suffering from water shortages. In 60% of the European cities with more than 100,000 people, for example, groundwater is being used at faster rates than it is replenished. The water scarcity severely affects the nations' socio- economic development, because industrial and manufacturing activities require adequate water supplies. As a direct consequence, increasing water, food and energy prices as well as hampered agricultural productivity has major implications on the nations' economies[1] [2].

There is no ideal irrigation method available which may be suitable for all weather conditions, soil structure and variety of crops cultures. It is observed that farmers have to bear huge financial loss because of wrong prediction of weather and incorrect irrigation method to crops. Several different methods are now being used like drip irrigation, sprinkler irrigation etc. that provide controlled water supply but some software support is also needed for decision making like where and how much watering is desired. Such intelligent irrigation is an essential part of smart agriculture [3] [4]. Different framework to develop intelligent and autonomous systems been offered specifically for agriculture domain. There are various sensors which sense different physical phenomena around them such as temperature, humidity, Rainfall, moisture level and water level of the field[5]. Thereafter, the sensed data are transmitted to the farmer through wireless networks. After collecting the data, different decisions are taken by the farmer.

This system proposed for automatic irrigation as well as environment parameters monitoring like temperature, humidity though wireless techniques i.e. through IOT and The microcontroller to have regular monitoring on the environmental conditions of farm and also provides the necessary precautions to be taken for yield to increase for modern agriculture. Those recorded parameters are accesses anywhere from server [6].

II. SYSTEM OVERVIEW

This chapter deals with the Hardware components and software used in this project. The hardware components are as listed below. The block diagram that is being implemented in this project is as shown in figure 2.1;

This IOT based Energy Efficient Wireless Monitoring System for Agrarian areas in Indian Agricultural system using GPRS Module has been developed, by incorporating Soil Moisture Sensor, Temperature sensor and Humidity Sensor.

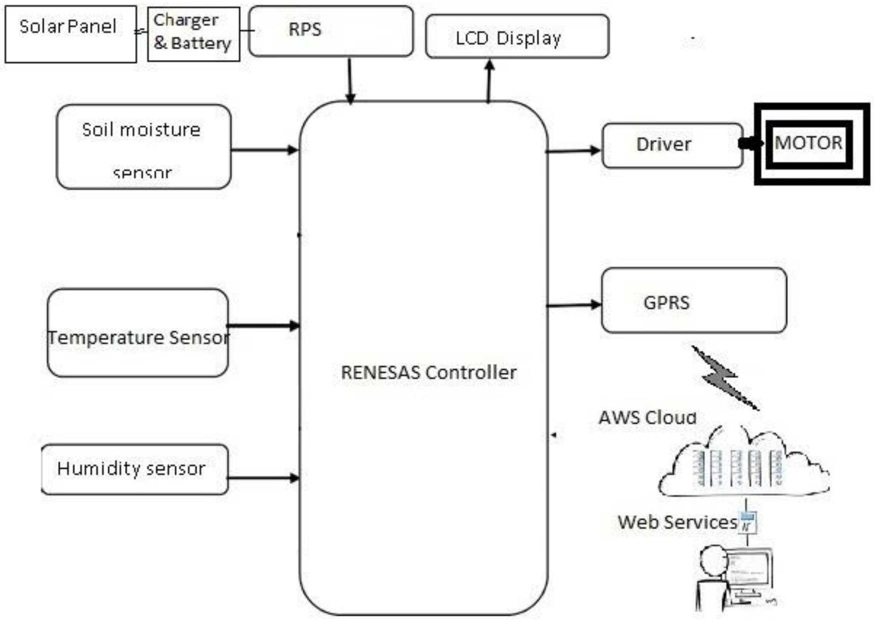


Figure 2.1: Proposed system block diagram

When power supply is turned on, the controller starts to initialize the serial ports, GPRS, I/O ports and LCD module. After initialization, the controller starts reading Temperature, Humidity, soil moisture of the land, if any of the parameters exceeds the threshold level, immediately it alerts the farmers and displays the alert information along with the parameter values on the LCD. Here if the Soil moisture exceeds the threshold of 295 digital values, then it indicates the wet land demanding to turn of the Motor pump. Suppose if the soil moisture is below threshold then it indicates dry land and alerting farmer to take action to Put-ON the motor pump. Humidity and temperature sensor measures the current temperature and humidity around the land, higher temperature and humidity is also alerted with soil condition to operate the motor. Also the system will also update the whole data onto the Amazon Cloud, hence allows the farmers to monitor the land and then operate the motor accordingly.

2.1 Renesas microcontroller:

These increasingly popular MCUs make possible ultralow-power applications by giving system designers advanced power-saving features and high-performance operation. Because the devices offer important capabilities such as an innovative Snooze mode that allows serial communication and ADC operation while the CPU is inactive, RL78 MCUs are demonstrably superior solutions for a vast span of battery-powered applications. Best-in-class performance for superior designs and low power, Wide voltage and temperature operation and On-chip safety features.

The Renesas controller group is ideal for applications that require high-performance timer and analog functions in small packages, such as motor control and sensor systems, as well as various consumer and industrial applications.

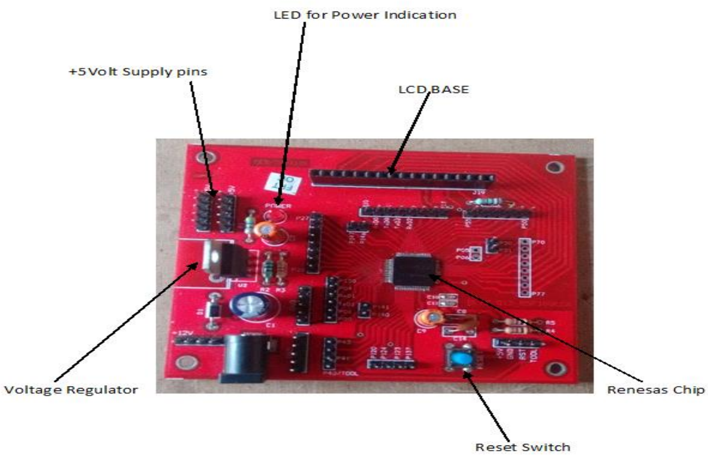


Figure of 64 pin Renesas Microcontroller Board

2.2 soil moisture sensor:

Soil dampness assumes an essential part in the advancement of climate designs and horticultural applications. In this proposed look into soil dampness sensor is utilized to know the correct soil dampness conditions on their fields. This encourages agriculturists to for the most part utilize less water to grow a harvest; they can build yields and the nature of the product by enhanced administration of soil dampness amid basic plant development stages.

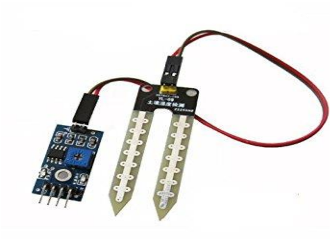


Figure. 2.2: soil moisture sensor module

2.4 DHT-11 (Temperature and Humidity Sensor)

Fig 2.4.1 Humidity Sensor

DHT-11 measure both temperature and humidity of the soil. It provides for **temperature** measurement through an electrical signal. A thermocouple (T/C) is made from two dissimilar metals that generate electrical voltage in direct proportion to changes in temperature. If the voltage increases, then the temperature rises and there is a voltage drop between the transistor terminals of base & emitter, they are recorded by the sensors. If the difference in voltage is amplified, the analogue signal is generated by the device and it is directly proportional to the temperature. It also senses **humidity**, measures and reports the relative humidity in the air. It therefore measures both moisture and air temperature. Relative humidity is the ratio of actual moisture in the air to the highest amount of moisture that can be held at that air temperature. The ratio of moisture in the air to the highest amount of moisture at a particular air temperature is called relative humidity. Humidity sensors work by detecting changes that alter electrical currents or temperature in the air. There are three basic types of humidity sensors: capacitive, resistive and thermal.

2.5 LCD Display:

Fig.2.5.1 lcd display

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.

2.6 Solar panel:

Solar cell is the basic unit of solar energy generation system where electrical energy is extracted directly from light energy without any intermediate process. The working of a solar cell solely depends upon its photovoltaic effect hence a solar cell also known as photovoltaic cell. A solar cell is basically a semiconductor device. The solar cell produce electricity while light strikes on it and the voltage or potential difference established across the terminals of the cell is fixed to 0.5 volt and it is nearly independent of intensity of incident light whereas the current capacity of cell is nearly proportional to the intensity of incident light as well as the area that exposed to the light.

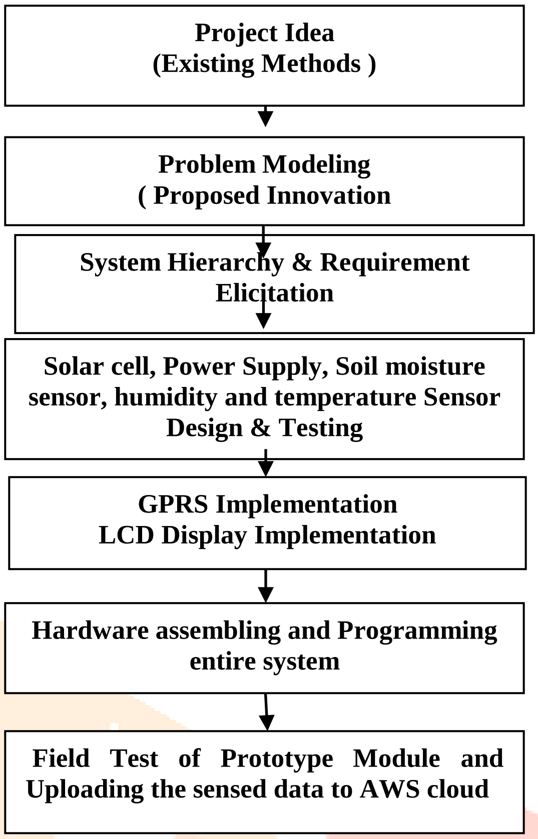
Fig.2.6.1 solar cell

2.7 GPRS Module:

Fig2.7.1 GPRS modem

General Packet Radio Service (GPRS) is a packet oriented mobile data service on the 2G and 3G cellular communication system's global system for mobile communications (GSM). GPRS was originally standardized by European Telecommunications Standards Institute (ETSI) in response to the earlier CDPD and i-mode packet-switched cellular technologies. It is now maintained by the 3rd Generation Partnership Project (3GPP).

III. METHODOLOGY:



IV. RESULTS & DISCUSSION

The Complete working prototype module of IOT based Energy Efficient Wireless Monitoring System for Agrarian areas in Indian Agricultural system using GPRS Module has been developed and tested for its functionality and performance, by incorporating Soil Moisture Sensor, Temperature sensor and Humidity Sensor. Here all the individual modules are studied, analyzed and tested before assembling the entire system. The working module is as shown in figure 4.1.

Figure 4.1: Prototype module of proposed system

Here we designed a prototype module, which demonstrates the real-time working of the entire system in the agricultural land. After switch on the module, the controller starts to initialize the serial ports, GPRS, I/O ports and LCD module. After the initialization the controller starts reading Temperature, Humidity, soil moisture of the land, if any of the parameters exceeds the threshold level, immediately it alerts the farmers and displays the alert information along with the parameter values on the LCD.

Figure 4.2 shows the different cases of demonstration based on parameters measurement readings. Here if the Soil moisture exceeds the threshold of 295 digital values, then it indicates the wet land demanding to turn of the Motor pump. Suppose if the soil moisture is below threshold then it indicates dry land and alerting farmer to take action to Put-ON the motor pump. Humidity and temperature sensor measures the current temperature and humidity around the land, higher temperature and humidity is also alerted with soil condition to operate the motor.

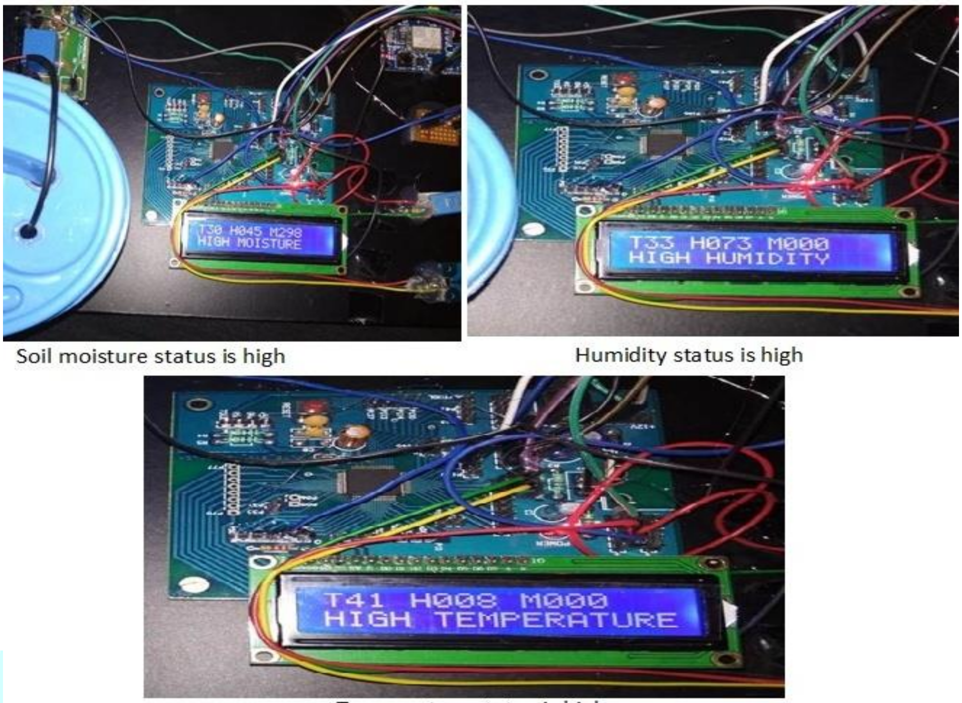


Figure 4.2: Soil condition, Humidity and Temperature status of the land

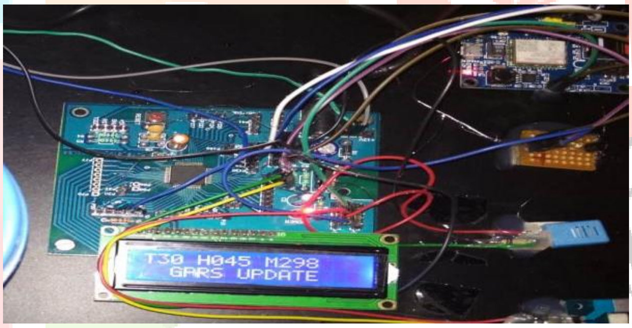


Figure 4.3: GPRS Updates data onto Amazon Cloud

Time	Date	Temp	Humidity	Moisture	Water Pump
13.02.43	2018-07-01	28	009	217	1
13.02.18	2018-07-01	28	010	218	1
13.01.53	2018-07-01	28	013	217	1
13.01.28	2018-07-01	29	017	217	1
13.01.03	2018-07-01	29	024	217	1
13.00.38	2018-07-01	30	039	217	1
13.00.13	2018-07-01	33	052	218	1
12.59.48	2018-07-01	37	005	217	1
12.59.14	2018-07-01	74	004	217	1
12.58.20	2018-07-01	28	004	218	0
12.57.55	2018-07-01	00	000	000	0
12.55.13	2018-07-01	43	005	217	1
12.54.06	2018-07-01	27	005	218	0
12.53.16	2018-07-01	27	005	217	0
12.52.27	2018-07-01	00	000	000	0

Figure 4.4: Amazon Cloud showing Real-Time data of the land parameters

Apart from alerting and displaying the land parameters, the system will also update the whole data onto the Amazon Cloud for remote operation and control by the farmers. Figure 4.3 shows the GPRS updating the data onto the Amazon Cloud. The Figure 4.4 shows the Real-Time data received from the agriculture land monitoring system. This facility allows the farmers to monitor the land and then operate the motor accordingly.

V. ACKNOWLEDGMENT

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VI. CONCLUSION AND FUTURE SCOPE

The proposed project is designed using structured modeling and is able to provide the desired results. It can be successfully implemented as a Real Time system with certain modifications. The method of monitoring and controlling the conditions of the agriculture land will prove to be most useful technology and eases the burden of farmers to spend their man hours to visit the land or stayed at the land for long in manual checking of land conditions and crop status. It is more beneficial to the farmers whose lands located far away, thus the proposed system measures all the land parameters efficiently and uploads to the highly secure Amazon Cloud for remote monitoring and operating the system accordingly, and the farmer will be encouraged to go for such more advanced technologies to improve the production in less land.

The future scope of the proposed system is to incorporate Three Phase power supply availability for operating the Motor Pump, Rain fall status, Soil acidity levels, and most importantly intrusion detection system to enable more security, so that it makes easier for a farmer to sit at home and monitor the stuffs remotely.

REFERENCES

[1]Automated Irrigation System Using a Wireless Sensor Network and GPRS Module Joaquín Gutiérrez, Juan Francisco Villa-Medina, Alejandra Nieto-Garibay, and Miguel Ángel Porta-Gándara IEEE transactions on instrumentation and measurement.

[2] Energy Efficient Wireless Monitoring System for Agarian Areas in Indian Agricultural System using GPRS module P.Revathi, Member IEEE, C.Rajasekaran, Member IEEE.

[3] S.V. Devika, Sk. Khamuruddeen, Sk. Khamurunnisa, JayanthThota, KhaleshaShaik "Arduino Based Automatic Plant Watering System.

[4] S. Harishankar, R. Sathish Kumar, Sudharsan K.P, U. Vignesh and T.Viveknath "Solar Powered Smart Irrigation System.

[5] J. Gutiérrez, J. F. Villa-Medina, A. Nieto-Garibay and M. Á. PortaGándara, "Automated Irrigation System Using a Wireless Sensor Network and GPRS Module," in IEEE Transactions on Instrumentation and Measurement, vol. 63, no. 1, pp. 166-176, Jan. 2014.

[6] J. John, V. S. Palaparthy, S. Sarik, M. S. Baghini and G. S. Kasbekar, "Design and implementation of a soil moisture wireless sensor network," 2015 Twenty First National Conference on Communications (NCC), Mumbai, 2015, pp. 1-6.

[7] Nakutis et al., "Remote Agriculture Automation Using Wireless Link and IoT Gateway Infrastructure," 2015 26th International Workshop on Database and Expert Systems Applications (DEXA), Valencia, 2015, pp. 99-103.

[8] P. Y. Dattatraya, J. Agarkhed and S. Patil, "Cloud assisted performance enhancement of smart applications in Wireless Sensor Networks," 2016 International Conference on Wireless Communications, Signal Processing and Networking (WiSPNET), Chennai, 2016, pp. 347-351.

[9] Deepak Sharma, Amol P Bondekar, Amritesh Oza, Awdhesh Kumar Shukla, C Ghanshyam, "A Technical Assessment of IOT for Indian Agriculture Sector", 47th Mid-Term Symposium on Modern Information and Communication Technologies for Digital India, Chandigarh; ResearchGate, April 2016.

[10] N. Sales, O. Remédios and A. Arsenio, "Wireless sensor and actuator system for smart irrigation on the cloud," 2015 IEEE 2nd World Forum on Internet of Things (WF-IoT), Milan, 2015, pp. 693-698.