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RESEARCH ARTICLE

GSM Based Automation System for Agricultural Field

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Abstract— Embedded controlled sensor network is the technology used to implement environmental solutions effectively. Many researchers have been making attempts to develop the embedded controlled sensor network. The existing systems are bulky, very costly and difficult to maintain. The proposed system is cost effective and controlled by user friendly embedded systems. In the proposed system ARM based microcontroller and wireless sensors are used to control the various devices and to monitor the information regarding the environment using Zigbee and GSM technologies.

Key words— Embedded controlled sensor networks, Environment monitoring system

I. INTRODUCTION

In the twenty first century, there is revolution of the sensor networks which have also come up with various applications like surveillance, traffic control, environmental and wildlife monitoring, agricultural application, home automation and industrial process control[1]. Embedded controlled sensor networks (ECSN) are mainly designed to be application- specific so that the energy consumption is minimum as the battery-powered nodes demand life-time of several months or even a few years.

Agriculture is the backbone of Indian Economy. Because without agriculture living is impossible since agriculture produces the main source of food for us. The farmer has to toil himself day in and day out to produce the crop which brings him little revenue, so he has to try some other options for his sustenance, also today the availability of labor for carrying out agricultural activities is less, therefore the automation in agricultural process is needed

The available technologies are Bluetooth, WI-Fi, WI-Max, wireless mobile Ad hoc network (WMANET), UMB, wireless HART, Bluetooth and ZigBee. Embedded sensor networks are formed by communicating over wireless links without using a fixed networked infrastructure controlled by microcontroller. Precision agriculture demands intensive field data acquisition. Wireless sensor networks are a new technology that can provide processed real-time field data from sensors physically distributed in the field. This paper mainly deals with integrating the embedded technology in the Agriculture field. It is done using the Wireless Sensor Nodes (WSN) technology with the help of microcontroller. Wireless Sensor Nodes (WSN) has become very popular technology in the recent past years

These environments can be characterized using well understood parameters such as power controlling as per environmental condition. In this system all the devices work on their own with the help of inputs received from the sensors which are monitoring the agricultural land round the clock and farmer can monitor whether everything is going normal or some action is needed to be taken. The entire process is controlled and monitored by programmable controller.

Proposed System

In the proposed system we use GSM technology. Here we have five sensor sections. In the Sensor section it has LDR, humidity, temperature, PIR and water sensor to monitor and also control the agriculture parameters. When any of these sensors generates a low signal, the controller enables the GSM modem to send the message of the particular parameter and display the ON condition on LCD by 4 – bit initialization. For every parameter, a controlling part is designed. These controlling loads are interfaced with microcontroller through a relay. The relay switch gets ON/OFF the load as per the input data from sensor.

GSM is used to inform the user about the exact field condition. The information is given on user request in form of SMS. GSM modem can be controlled by standard set of AT (Attention) commands. These commands can be used to control majority of the functions of GSM modem and the sensing data will be displayed on the LCD.

Guangming Song (etc) [2] developed a wireless-controllable power outlet system. Researchers have worked on home automation and environmental monitoring system in the past but in the existing systems cost is high, size is an issue and they are difficult to maintain [3][4][5][6]. The proposed system is cost effective and controlled by user friendly embedded systems. The block diagram of the proposed system is as shown in figure2. In this proposed system, we have designed one master module which consists of microcontroller, GSM module and Zigbee module. Three slave modules are designed using Sbit microcontroller and Zigbee module. Remote control circuit is designed to control the various devices of home for short distance communication. GSM module is used for long distance control of devices and monitoring of environment of home.

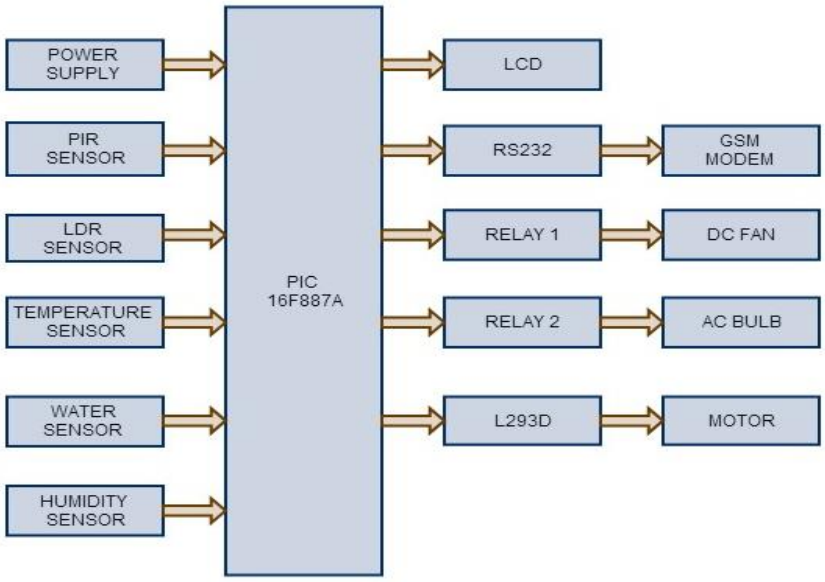

Fig.1.1 General Block Diagram

Block diagram of ECSN consists of a master circuit which is connected to number of sub networks consisting of the various slaves. Master circuit is connected by a personal computer which can be controlled by the internet. Wireless technologies for environmental monitoring and device control in homes offers many benefits to the users.

II. RELATED TECHNOLOGY

2.1 GSM Technology

Global System for Mobile Communications (GSM) is a standard developed by the European Telecommunications Standards Institute(ETSI) to describe protocols for second generation(2G) digital cellular networks use by mobile phones. It is the default global standard for mobile communication with over 90% global market and is available in over 219 countries and territories. This ubiquity means that subscribers can use their phones throughout the world, enabled by international roaming arrangements between mobile network operators. GSM differs from its predecessor technologies in that both signalling and speech channels are digital. This also facilitates the wide-spread implementation of data communication applications into the system. The GSM standard has been an advantage to both consumers, who may benefit from the ability to roam and switch carriers without replacing phones, and also to network operators, who can choose equipment from many GSM equipment vendors. GSM also pioneered low-cost implementation of the short message service (SMS), also called text messaging, which has since been supported on other mobile phone standards as well.

2.2 GSM Specifications

Frequency: 900 MHz or 1800 MHz (Some countries in the Americas including Canada and the United States use the 850 MHz and 1900 MHz bands, 400 and 450 MHz frequency bands are assigned in some countries, notably Scandinavia)

Modulation: Modulation is a form of change process where we change the input information into a suitable format for the transmission medium. We also changed the information by demodulating the signal at the receiving end. The GSM uses Gaussian Minimum Shift Keying (GMSK) modulation method.

Access Methods: Because radio spectrum is a limited resource shared by all users, a method must be devised to divide up the bandwidth among as many users as possible.GSM chose a combination of TDMA/FDMA as its method. The FDMA part involves the division by frequency of the total 25 MHz bandwidth into 124 carrier frequencies of 200 kHz bandwidth. One or more carrier frequencies are then assigned to each BS. Each of these carrier frequencies is then divided in time, using a TDMA scheme, into eight time slots. One time slot is used for transmission by the mobile and one for reception. They are separated in time so that the mobile unit does not receive and transmit at the same time.

Transmission Rate: The total symbol rate for GSM at 1 bit per symbol in GMSK produces270.833 K symbols/second. The gross transmission rate of the time slot is 22.8 Kbps.

Frequency Band: The uplink frequency range specified for GSM is 933 - 960 MHz (basic 900 MHz band only). The downlink frequency band 890 - 915 MHz (basic 900 MHz band only).

Channel Spacing: This indicates separation between adjacent carrier frequencies. In GSM, this is 200 kHz.

Speech Coding: GSM uses linear predictive coding (LPC). The purpose of LPC is to reduce the bit rate. The LPC provides parameters for a filter that mimics the vocal tract. The signal passes through this filter, leaving behind a residual signal. Speech is encoded at 13 kbps.

Duplex Distance: The duplex distance is 80 MHz Duplex distance is the distance between the uplink and downlink frequencies. A channel has two frequencies, 80 MHz apart.

2.3 GSM Modem

GSM modem is a specialized type of modem which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone. From the mobile operator perspective, a GSM modem looks just like a mobile phone. A wireless modem behaves like a dial-up modem. The main difference between them is that a dial-up modem sends and receives data through a fixed telephone line while a wireless modem sends and receives data through radio waves.

A GSM modem can be an external device or a PC Card / PCMCIA Card. Typically, an external GSM modem is connected to a computer through a serial cable or a USB cable. A GSM modem in the form of a PC Card / PCMCIA Card is designed for use with a laptop computer. It should be inserted into one of the PC Card / PCMCIA Card slots of a laptop computer. Like a GSM mobile phone, a GSM modem requires a SIM card from a wireless carrier in order to operate. Both GSM modems and dial-up modems support a common set of standard AT commands. You can use a GSM modem just like a dial-up modem.

In a GSM network, the user terminal is called a mobile station. A mobile station is made up of a SIM (Subscriber Identity Module) card allowing the user to be uniquely identified and a mobile terminal. The terminals (devices) are identified by a unique 15-digit identification number called IMEI (International Mobile Equipment Identity). Each SIM card also has a unique (and secret) identification number called IMSI (International Mobile Subscriber Identity). This code can be protected using a 4-digit key called a PIN code.

The SIM card therefore allows each user to be identified independently of the terminal used during communication with a base station. Communications occur through a radio link (air interface) between a mobile station and a base station.

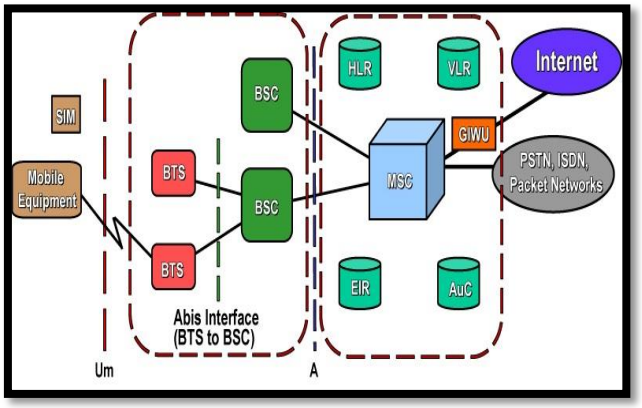

Fig.2.2 GSM Architecture

All the base stations of a cellular network are connected to a base station controller (BSC) which is responsible for managing distribution of the resources. The system consisting of the base station controller and its connected base stations is called the Base Station Subsystem (BSS).Finally, the base station controllers are themselves physically connected to the Mobile Switching Centre (MSC), managed by the telephone network operator, which connects them to the public telephone network

and the Internet. The MSC belongs to a Network Station Subsystem (NSS), which is responsible for managing user identities, their location and establishment of communications with other subscribers. The MSC is generally connected to databases that provide additional functions:

- The Home Location Register (HLR) is a database containing information (geographic position, administrative information etc.) of the subscribers registered in the area of the switch (MSC).
- The Visitor Location Register (VLR) is a database containing information of users other than the local subscribers. The VLR retrieves the data of a new user from the HLR of the user's subscriber zone. The data is maintained as long as the user is in the zone and is deleted when the user leaves or after a long period of inactivity (terminal off).
- The Equipment Identify Register (EIR) is a database listing the mobile terminals.
- The Authentication Centre (AUC) is responsible for verifying user identities.
- The cellular network formed in this way is designed to support mobility via management of handovers (movements from one cell to another).

III.IMPLEMENTATION

The paper is designed and developed for agricultural sector where environmental fault parameters monitor and control. In generally, the humidity, unwanted entry, lighting system, heating system, water level of plants etc . All these system are to be monitored continuously. All these sensors are interfaced with a controller to monitor.

In this paper, 5 sensors are used. LDR (RD0), thermistor (RD1), water level (RD2, RD3, RD4) and PIR (RD5), humidity (RD6). When any of these sensors generates a low signal, the controller enables the GSM modem to send the message of the particular parameter and display the ON condition on LCD by 4 – bit initialization. For every parameter, a controlling part is designed. These controlling loads are interfaced with microcontroller through a relay. The relay switch ON / OFF the load as per the input data from sensor. The Lighting system is controlled by LDR sensor. During day time, the LDR sensor will be off and an active low signal (0v) is given. Hence the DC load (Fan) will be off. During Night time, the LDR sensor will be ON and gives active high signal to relay. Hence the DC load (Fan ON).

The Heating system is controlled by Temperature sensor. When Thermistor is OFF (No heat is observed), AC load (Bulb) OFF. When Thermistor is ON (heat is observed), AC load (Bulb) ON. Here for every load, corresponding relay will get ON. When water level sensor generates active low signal (dry condition), the controller enable the GSM modem and sends the message to the register person mobile. The person needs to react with the SMS to control the motor. When he sent a message of particular SMS say *1, the particular load (Motor) is get ON. When he sent a message of particular SMS say *0, the particular load (Motor) is get OFF. The PIR Sensor restricts the unwanted entry. When any person enters into the field, an active low signal is given to PD5.This makes PIR ON. When person do not enter into the field, an active high signal is given to PD5.This makes PIR OFF and Humidity detects the moisture in the air. If there is moisture in the air, an active low signal is given to PD6.This makes Humidity ON. If there is no moisture in the air, an active high signal is given to PD6.This makes Humidity OFF.

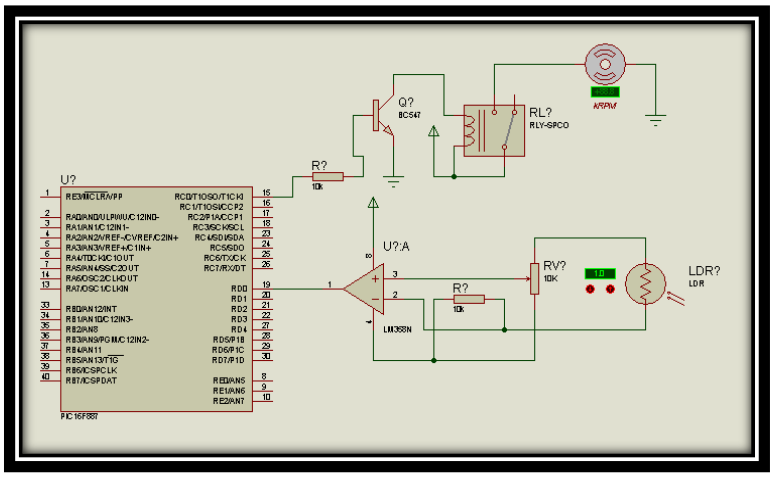

Fig.3.1 Interfacing LDR Sensor to Microcontroller

An LDR sensor with Op-Amp is interfaced with microcontroller to port D (PD0) and load is interfaced with microcontroller to the port C (PC0) using electromagnetic relays. The LDR acts as resistor in night time. The intensity of light and resistance are inversely proportional. During day time, the resistance is zero, hence an active low signal is given to PD0. So that MCU gives an active low output to the PC0. This makes relay OFF and DC Fan OFF.

During night time, the resistance is high, hence an active high signal is given to PD0. So that MCU gives an active high output to the PC0. This makes relay ON and DC Fan ON.

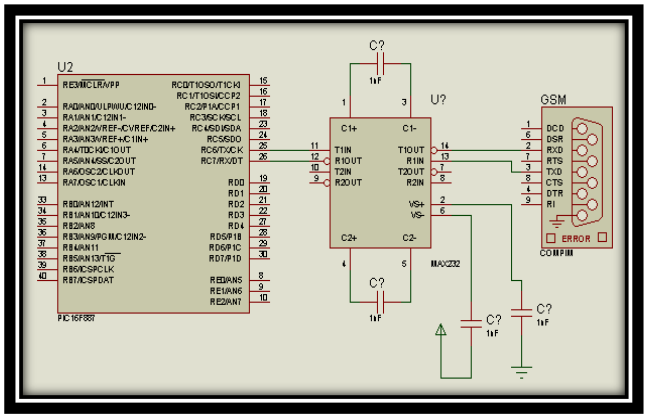

Fig.3.2 Interfacing GSM to Microcontroller

In this paper GSM Modem is interfaced with the microcontroller through rs232 interface. Since the voltage levels of the microcontroller are different with that of the GSM modem we use a voltage converter or the line driver such as MAX232 to make them rs232 compatible. A GSM modem with MAX 232 is interfaced with microcontroller to port C (PC6, RC7).

IV. RESULT AND EXPERIMENTAL TOOLS

The paper designed with input and output devices such as sensors, ac load, dc fan, relay and GSM.AC load is connected to Thermistor. DC fan is connected to LDR sensor. These loads are interfaced with different relays. These loads are controlled as per the condition level of sensors. The relays are driven by driver IC called ULN2003.

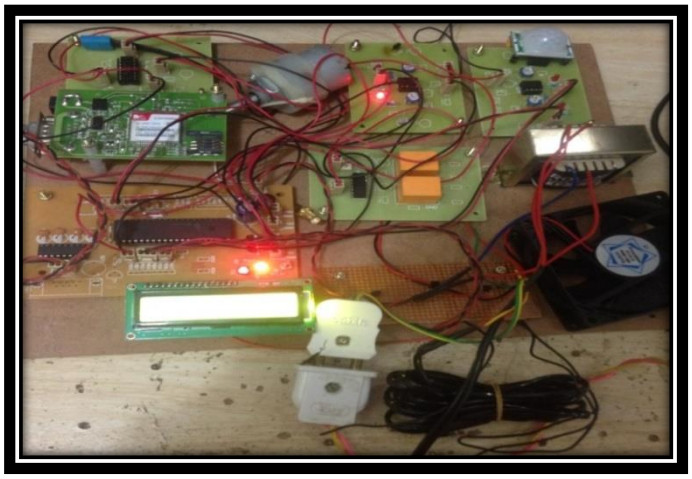

Fig 4.1 power supply given to system kit

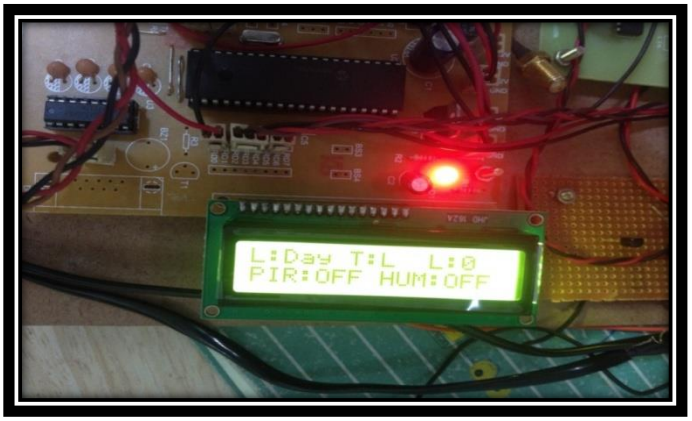

Fig.4.2 Loads are in OFF mode

When LCD Display gets on at the Initial Stage. The Title of the paper Displays on. The LCD the can take 4 bit data from microcontroller at a time. Every character send in the form of 4 bits say A=41 as per ASCII code system. Here 41 means 0100 0001(8bits).initially LSB bits are transferred i.e., 0001 then MSB follows. When LCD receives these data, the LCD displays corresponding character of data as per ASCII code. When we reset the circuit GSM will activate and a "Send message to store m obile number" will display on LCD screen and the registered number will also display.

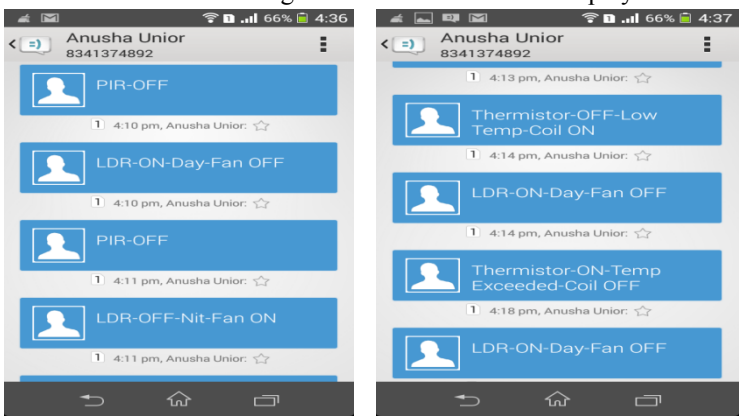

Fig.4.3 Message displays on mobile

The sensors data is displayed on the LCD and the controller enables GSM modem to send a message to a particular number through "AT COMMANDS". A serial communication is established between GSM and microcontroller. The microcontroller sends a packet data through GSM "ATCOMMANDS".

V. CONCLUSION

The paper has developed with simple electronic devices and all these sensors are giving the low bit of data to controller and controller is responding as per the fault parameter and giving relay to load and to GSM modem. The GSM modem is sending the message to the register mobile number by using AT Commands.. The relays are getting ON and OFF as per the output level of the sensor. The paper can develop in many other ways. It can develop using more sensors and can use raspberry controller to be more optimized in LINUX operating system. The system also designed with multiple parameter faults is read from different fields and can upload the data to control room. The system also can design with GPS system to get the exact location of fault parameter.

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