CHAPTER 1
INTRODUCTION

The agricultural practices such as irrigation, crop rotation, fertilizers, pesticides and animals were developed long ago, but have made great strides in the past century. The history of agriculture has played a major role in human history, as agricultural progress has been a crucial factor in worldwide socio-economic change. The concern of better quality agricultural products from the consumers made the farmers adapt to latest agricultural techniques by implementing modern technologies for producing better agricultural products. Among the important things which are taken into consideration by the farmers are the qualities of agricultural land, weather conditions etc. Traditional farming involves a human labor. With proper data the farmer will be able to deliver the quality product to the consumer. In this paper we have discussed about online monitoring of agriculture parameter using multiple sensors are like temperature, humidity, water level sensor, etc.

We update the parameter result from the sensor node data is transferred to the GSM to another end server PC. From the PC, the sensor values are transferred to the client so the farmer may know the status of their agricultural field. The ability to monitor environmental conditions is crucial to research in fields ranging from climate variability to agriculture and zoology. Being able to document baseline and changing environmental parameters over time is increasingly essential important and researchers are relying more and more on unattended weather stations for this propose.

Plant eco-physiological monitoring system is a typical multi-sensor system. The authors Wang Cheng et.al presented power reduction in plant eco-physiological monitoring system, and low power strategy on both the hardware designing and software controlling. Sensors are used in everyday objects such as touch-sensitive elevator buttons and lamps which dim or brighten by touching the base. There are also innumerable applications for sensors of which most people are never aware. Applications include cars, machines, aerospace, medicine, manufacturing and robotics. The authors proposed a system to locate workers by using fixed sensor nodes in green houses or outdoors, and to determine yield by exploiting information sensed from weight sensors on harvest carts of workers. It could plan efficient arrangement of workers by using sensed information to collect production and environmental information for each area, and could utilize as a reference for making optimum growth conditions of crops in green houses in the future by storing conditions in green houses and environmental information of high-yield regions through real-time monitoring into a database. The authors Jeong-hwan Hwang and Hyun Yoe proposed the „Paprika greenhouse management system" based on wireless sensor network technology, which will establish the ubiquitous agricultural environment and improve the productivity of farmers. The proposed „Paprika greenhouse management system has WSN environmental sensors and CCTVs at inside/outside of paprika greenhouse.

These devices collect the growth-environment related information of paprika. The system collects and monitors the environmental information and video information of paprika greenhouse. They designed a low-cost real-time remote environmental monitoring system based on GSM short message was designed. It is made up of wireless environment monitoring equipment. Based on these literatures it is found that there are many architectural models for measuring agriculture parameters .However, the integration of advanced Web technology and remote monitoring with existing architectural models for agriculture application becomes a practical problem. It was felt that there is a need for research enhancement and development of effective remote monitoring of agriculture environment. The objectives of this paper are:

- Agriculture environmental parameters measurement
- The Data are received by the central monitoring server.
- The server transfers the result.

CHAPTER 2

LITERARY WORK

2.1 "Remote Monitoring in Agricultural Greenhouse Using Wireless Sensor and Short Message Service (SMS)" Izzat Din Abdul Aziz, Mohd Hilmi Hasan, Mohd Jimmy Ismail, Mazlina Mehat and Nazleeni Samiha Haroon

The concern with a lot of consumer needs and demands for agriculture products has stimulated awareness for the farmer to increase their products in the market by implementing new technologies in this industry. Among the important things that may come to the farmers' interest is how to control the used of natural sources and natural environment which agricultures depend on. Therefore, this problem has captured farmers' interest to implement agro-environmental remote monitoring method in their agriculture industries. The agro-environmental remote monitoring method can be implemented in various situations such as in monitoring qualities of soil and water. However this research focuses solely in remotely monitoring levels of temperature in greenhouse. By utilizing proper technology, the natural environment and resource, in this case is temperature, which is very important for the plants can be monitored efficiently.

Previously, human labor plays a very important role in monitoring farm and plants in this industry. For some critical plants such as vegetables and flowers, they need 24 hours attention from human so that the quantities and qualities of the plant can be controlled. With proper management of collected data and information, this will provide them with strong foundation for future development and future growth of their plants. However, because of increasing size in farming areas, this type of manual practice is apparently time consuming and labor-intensive. However, with the improvement of management in agriculture techniques, modern telecommunication technologies can be implemented which provide great assistance for the industry.

Due to the fast development in telecommunication technologies, it is believed that wireless communication is a good practice for remote sensing in the agriculture industries. This research has fully utilized wireless sensor network, Global System for Mobile Communication (GSM) and short message service (SMS) to carry out data from the sensors to computers or directly alert the workers through their mobile phone. This practice has eliminated the used of wired technology and improved old method of collecting data in farming areas. This technology has seen to be suitable in the current era of wireless age.

Moreover, this research focuses on the study on remote monitoring system in greenhouse which has capability of sending alert notification messages to farmers using GSM and SMS technology. The proposed system is aimed to be a reliable and cost effective. There are a lot of technologies that have been created to perform the operation; however, many of the existing technologies would still require a great deal of human intervention. A part from that, existing technology for detecting level of temperature works based on reactive measurement whereby it only alert workers when the levels reach at certain values. Therefore we propose a proactive system which can predict possible changes of temperature level so that early precaution steps can be taken.

In this research, we took a strawberry farm as a case study. In one of the data collecting activities in this research, we interviewed Malaysian Agricultural Research and Development Institute (MARDI), an agency which delivers the research and development in Malaysia’s agriculture industry. Based on MARDI, it is significantly hard to monitor the greenhouse particularly strawberry farm which requires scheduled monitoring for every 3 hours. They believe that it will be very helpful if remote monitoring system and alert mechanism can be implemented in the greenhouse since the existing method is costly and time consuming.

2.2 “New wireless sensor network technology for precision agriculture” Maris Alberts1, Ugis Grinbergs, Dzidra Kreismane, Andris Kalejs

Institute of Mathematics and Computer Science (IMCS) of the University of Latvia is implementing the project “Development of Long Range Wireless sensor network for precision farming applications in Latvia” (The Project). The Project has two main directions of research. The first is development of new long range Wireless Sensor Network (WSN) nodes providing radio link in a long distances (more than 300m), the second is development of energy efficient operating system (FarmOS) for large scale WSNs with main focus on robust easy to use agricultural applications. Development of current WSN nodes is based on Texas Instrument’s hardware and AgroSeNET technology drafted by Cominfo Inc. FarmOS is being developed in cooperation with Institute of Electronics and Computer Science. In framework of the Project IMCS is implementing field trial of large scale Long Range WSN technology for automated radiation frost protection of cranberry fields. Farm OS supports mash topology of WSN. For small networks star and multi hop topologies could be used. The main goal of the Project is to build WSN prototype with newly designed 50 long range nodes running Farm OS to provide automated cranberry field protection with intelligent radiation frost prediction and decision making features. Depending on data gathered in the real time the intelligence of the system will provide immediate decision whether fog generator, water spryer system or just wind blowers would be chosen. Farmer's end user client software will deliver Software as a Service concept.

Fossil fuel, extensive land use, and agriculture are three main causes of the increase of greenhouse gases observed over the past 250 years. Intergovernmental Panel on Climate Change (IPCC) agreed that about 25% of carbon dioxide emissions are produced by agricultural sources, deforestation, use of fossil fuel-based fertilizers, and burning of biomass. Conventional tillage and fertilizer application release about 70% of the nitrous oxide emissions. On one hand over the past centuries substantial increase in crop yield is achieved with development of technologies on the other hand intensive agricultural methods have detrimental effects on the environment (Agriculture, 2012).

On one hand intensive soil tillage reduces soil organic matter through aerobic mineralization, on the other hand low tillage and the maintenance of a permanent soil cover increases soil organic matter. No or low tilled soil conserves the structure of soil for fauna and related macrospores to serve as drainage channels for excess water. Surface mulch cover protects soil from excess temperatures and evaporation losses and can reduce crop water requirements by 30 percent. Conservation and organic agriculture that combine zero or low tillage and permanent soil cover are facilitating adaptation options for soil ability to increase organic carbon level reduce mineral fertilizers use and reduce on farm energy costs (Adaptation to climate..., 2007). Autonomous adaptation is the farmer reaction to precipitation patterns changing crops or uses different harvest and planting or sowing dates. Long term adaptation includes structural changes in land use to increase yield under new conditions, to bring into effect new technologies and land management and water use efficiency related techniques.

Early warning and risk management systems (EWIS) are efficient contributors that can further adaptation to climate change. Important information on databases (DB) are a historical climate data archives, an archive on climate impacts on agriculture, monitoring tools using systematic meteorological observations, climate data analysis, information on the characteristics of system vulnerability and adaptation effectiveness such as resilience, critical thresholds and coping mechanisms. Food and Agriculture Organization of the United Nations (FAO) is a leader in implementation new data format standards of new data types and specific tools (methods and software) and methods such as data interpolation in time and area, and analysis tools at different levels. These activities need to focus on securing agricultural productivity in a sustainable way. Familiar and well-considered are EWIS and Disaster Information Management System (DIMS) that can be used for estimation while contributing to disaster readiness and elimination of potential risks.

2.3 "Wireless Sensor/Actor Networks for Real–Time Climate Control and Monitoring of Greenhouses" Angelo Cenedese, Luca Schenato and Stefano Vitturi.

Climate control and monitoring of greenhouses is an important aspect for several agricultural applications. In particular, it appears to be strictly connected to the concepts of precision agriculture a trend of farming that has drawn more and more interest in recent years both for research and commercial applications. In the precision agriculture framework the focus is mainly on understanding the environment through the interpretation of a wide variety of data coming from GPS systems, satellite imaging, and in-field sensors. Moreover, the control action is limited to the optimization of sowing density and the distribution of fertilizer and chemicals. Differently, in greenhouse cultivation, the sensing action is used not only for monitoring purposes but also for exerting active control of climate parameters.

In this context, there is the need to obtain the best climate conditions inside a greenhouse in order to ensure effective cultivation. This is usually achieved by controlling the behavior of some key variables such as, for example, temperature, humidity and luminosity. Thus in a greenhouse, similarly to industrial automation systems, input signals deriving from sensors devices have to be conveyed to controllers where they are elaborated by suitable control algorithms and, subsequently, the resulting output signals are issued to a set of actuators. Besides the typical problems related to control theory, when dealing with large plants as greenhouses, some additional peculiar characteristics have to be carefully taken into account.

Specifically, the number of involved input/output signals may be considerable (hundreds of signals) and, more importantly, sensors/actuators can be distributed on very large geographical areas (thousands squared meters) thus raising many issues such as cumbersome expensive cabling, communication delays, loss of information, etc, which negatively affect the overall behavior of the control system. Moreover, as described in real–

time control is typically required. The data exchange which takes place in climate control and monitoring systems of greenhouses is similar to that of more general industrial automation systems, which, typically, handle both cyclic and acyclic data. Cyclic data traffic is mainly due to the periodic transmission of signals from sensors (plant states, measurements) and to actuators (plant commands, control set–points) necessary for the correct control and monitoring actions. Conversely, acyclic traffic is typically related either to configuration/parameterization functions or to anomalous conditions such as those deriving from alarms. Differently from some very time– critical industrial applications, in climate control cyclic traffic typically ranges from several seconds to minutes, reflecting the sampling times of control loops that regulate variables such as temperature and humidity. Conversely, alarms may require much faster reactions: for example, a sudden increase of the temperature measured by one or more sensors, which could account for a potentially dangerous situation, has to be notified within a few seconds.

From the architectural point of view, greenhouse control systems may be considered as specific implementations of traditional hierarchical control, which comprise different levels from the process connection up to the management functions. These systems, in the past years, have been effectively implemented by means of either Programmable Logic Controllers (PLCs) or Distributed Control Systems (DCSs). However, such solutions often revealed to be quite expensive. Moreover, due to their structure, which extensively uses wired connections between distributed equipment, these systems have limited versatility, preventing possible reconfigurations that could be necessary in some applications. For example, switching from one type of cultivation to another, could require a different location of the sensors.

The recent introduction of wireless sensor/actor networks (WSANs) offers interesting opportunities for the implementation of innovative greenhouses climate control and monitoring systems. Indeed, these networks allow to acquire signals from a large number of sensors and, after their elaboration, to undertake the appropriate actions on the plant. Since communication between network nodes is wireless, all the problems and the costs related to the cabling are avoided, thus making such an architecture particularly appealing. Obviously, as a side effect of this opportunity, some other issues arise such as, reliability, energy consumption, interference effects.

2.4 "Effective monitoring of agriculture" Jeffrey D. Sachs,Roseline Remans,Sean M. Smukler

The development of effective agricultural monitoring networks is essential to track, anticipate and manage changes in the social, economic and environmental aspects of agriculture. We welcome the perspective of Lindenmayer and Likens (J. Environ. Monit., 2011, 13, 1559) as published in the Journal of Environmental Monitoring on our earlier paper, ''Monitoring the World's Agriculture'' (Sachs et al., Nature, 2010, 466, 558–560). In this response, we address their three main critiques labeled as 'the passive approach', 'the problem with uniform metrics' and 'the problem with composite metrics'. We expand on specific research questions at the core of the network design, on the distinction between key universal and site-specific metrics to detect change over time and across scales, and on the need for composite metrics in decision-making. We believe that simultaneously measuring indicators of the three pillars of sustainability (environmentally sound, social responsible and economically viable) in an effectively integrated monitoring system will ultimately allow scientists and land managers alike to find solutions to the most pressing problems facing global food security.

Farmers around the world, be they poor smallholder or rich industrial scale corporations, are connected in a system through markets, policy and the environment. The current global agriculture system is not sustainable. It is marked by widespread hunger and malnutrition, rural poverty, vulnerability to climate change and environmental degradation and pollution. Solutions to agriculture challenges are elusive because tradeoffs among goals such as food security, economic development, and environmental sustainability are not being addressed. In a previous paper,2.3 we argued that a global network for monitoring agricultural landscapes can empower scientists to more effectively quantify the costs and benefits of agricultural practices within the context of multiple outcomes across spatial and temporal scales. A major motivation of our short opinion paper was to instigate new thinking and engage participation for stronger agricultural monitoring.3–5 By responding to the critique by Lindenmayer and Likens, we aim to advance the science underlying such global a network.

Overall, Lindenmayer and Likens' perspective1 is predominantly oriented toward ecological monitoring paradigms and objectives. The monitoring program we suggest emphasizes and aims to monitor the social, economic and environmental outcomes of agriculture, including food and nutrition security, human health, economic viability, social well-being and environmental sustainability. Taking into account this trans disciplinary approach involving scientists, policy-makers, farmers and others, we would like to comment and expand on each of the three major concerns they identified with the monitoring network suggested in Sachs et al.2 A major critique is labeled as the ‘‘passive approach’’, lacking scientifically tractable questions and an explicit and robust experimental design.

First, we agree that in order to build an effective monitoring program, it is critical to start from a set of well-defined research questions. The central questions of our network are outlined in box 1, together with some specific examples from a recent list of the top 100 critical questions about global agriculture.6 While these questions were implicitly present in Sachs et al.,2 we agree they should be stated explicitly. We further embrace the paradigm of adaptive monitoring as previously described by Lindenmayer and Likens7 that would allow for the incorporation of new questions generated using research outcomes. In addition, we believe that the development of these questions should be a participatory and iterative process involving multiple stakeholders to facilitate not only adaptive monitoring but also adaptive management. Second, Lindenmayer and Likens1 emphasize the need for a strong experimental design and they use the Rothamsted monitoring program as an example. We certainly recognize the need and critical value of long-term experiments. A difference in approach is that the proposed network aims to provide a bridge between these plot- and farm-level experiments and monitoring real-time changes and programs at a larger scale, i.e. at the landscape, national, regional and global scale.

2.5 “How Wireless Will Change Agriculture” G. Vellidis, V. Garrick, S. Pocknee, C. Perry, C. Kvien, M. Tucker

For many, the term ’wireless’ is daunting because it brings forth a whole lexicon of additional terms and acronyms such as Wi-Fi, ZigBee, RFID, WLAN, Bluetooth and 802.11x that are new and intimidating. But what does wireless truly mean? Today, it is most commonly defined as any type of electrical or electronic operation which is accomplished without the use of a “hard wired” connection (Wikipedia, 2006). For nearly two decades, the most important wireless application was the television remote control. But in the last decade, that has been surpassed by the spectacular growth of cellular networks and wireless broadband internet. Wireless broadband internet networks are widespread. PDAs (personal digital assistants) such as the ubiquitous Blackberry® which combine cellular phone service, internet access and computing services are in general use. Despite the spectacular growth of cellular networks, predictions are that they will occupy as little as 3% of the available wireless bandwidth by the end of the decade (Sensors Magazine, 2004; Wang et al., 2006).

The consensus is that at the dawn of the 21st century, there is a wireless revolution. With some exceptions, this revolution appears to be largely absent in agriculture. Precision agriculture and precision livestock farming – disciplines heavily reliant on data collection and subsequent control, have not taken advantage of these technologies as much as other business sectors. This paper addresses the lack of take up of wireless networks as well as looking at the potential for adoption of wireless technologies in agriculture.

Competitive pressures and economies of scale are forcing farms to become larger. In many cases, this means that farms are also becoming more dispersed as farmers purchase or rent non-contiguous properties. Consequently, farmers are spending more and more time and energy traveling between locations as they monitor ongoing activities such as irrigation, planting, harvesting and grain drying, or check on livestock; collect information from rain gauges, soil moisture sensors and other devices; control equipment (start pumps, close gates, etc); and communicate with employees. Technological advances make it conceivable to build and deploy wireless sensor and control networks to automate many of these tasks.

However, most farms do not have remote sensing and control capabilities. Farmers do not like wasting time and fuel and would not drive to a remote part of the farm to check on an employee or turn on an irrigation pump if there was a better way. That these tasks are not done remotely bears testimony to the fact that current wireless technologies are too expensive, too unreliable or too complicated (or any combination of the above) for the farm (Pocknee, 2005).

Yet it is wrong to assume that wireless applications have not penetrated the agricultural sector at all. 2-way radios and “push-to-talk” cell phones are two examples. These are wireless tools that are relatively cheap, reliable and very simple to use. For several generations, farmers in countries with large farms have used 2-way radios to communicate with employees. Because farmers already understood the benefits of wireless communications, they were some of the earliest adopters of cell phone technology, especially “push-to-talk” cell phones. These devices gave them the mobility to contact their employees, farm supplier, equipment dealer, extension agent, buying point or spouse from anywhere at any time. Today, the cell phone is indispensable to farming (Kvien, 2005).

2.6 “Development of a “Smart” Wireless Soil Monitoring Sensor Prototype Using RFID Technology” T. K. Hamrita, E. C. Hoffacker

Radio Frequency Identification (RFID) technology is becoming increasingly viable as a commercial and technological solution to wireless identification. Since its invention, this technology has found numerous applications in commercial areas where remotely powered automated non−intrusive identification of the tagged subject is preferred over more traditional methods of inventory control, or as an anti−theft measure such as in warehousing or retail outlets. RFID is also used in livestock identification, and ISO has established standards ISO 11784 and 11785 to aid the shape and growth of this technology (Finkenzeller, 1999). Millions of RFID tags have been sold since the 1980s (Troyk, 1999).

RFID technology is typically and primarily used for identification and tracking purposes. However, due to the success of commercially available RFID tags, some research labs have explored their use in the development of wireless sensors. Crosslink (Boulder, Colo.), a company that specializes in wireless electronics for the trucking industry, has recently developed a proprietary RFID−based temperature− pressure sensor for wireless monitoring of tires in heavy vehicles (RFID Journal, 2003). RFID tags have also been used successfully by medical labs in the development of injectable medical implants (Troyk, 1999).

In this article, the goal was to explore the feasibility of using off−the−shelf passive RFID tags as a telemetry link in a wireless sensor for real−time monitoring of soil properties such as temperature. RFID tags are produced in very large quantities. They are versatile, generic, small, and they don’t require their own communication channels. RFID tags are either passive or active. Active tags are powered by internal batteries whereas passive tags operate battery free through power provided by the reading unit or interrogator. This lack of power source on a passive RFID tag makes it much smaller and cheaper than an active one. Some passive tags could be as small as half a grain of sand and as cheap as a few cents(McCullah, 2003). Additionally, active tags have a limited operating life, whereas passive tags have virtually an unlimited lifetime. Moreover, the same RFID system could be used for various types of sensors (Troyk, 1999).

The work presented in this article was motivated by the need for a rapid solution to wireless monitoring of soil properties without having to design telemetry equipment or purchase costly custom hardware. Soil temperature is an important variable, which affects germination and over all health of the soil. Its measurements could be used in determining soil temperature profiles as well as soil thermal conductivity and heat capacity. Additionally, soil temperature is very important in developing crop modeling algorithms (Schomberg et al., 2002; Luo et al., 2001; Irmak et al.,2001). Therefore, soil temperature was chosen as the variable of interest for the developed sensor prototype. Although the use of off–the–shelf RFID equipment in wireless sensor development is a fairly novel approach, the concept of using radio telemetry for wireless monitoring of soil properties is not new. NASA researchers have recently developed a wireless mesh of radio sensors for monitoring heat, humidity, and soil moisture (Huang, 2003). Cromer and McLendon (1984) developed a wireless soil moisture telemetry system that had multiple individually addressable moisture sensors in the field. The base station would query all the sensors in turn using Radio Frequency (RF) transmission, and the appropriate sensor would transmit data in reply, also over RF.

The long–term goals of the work presented in this article isto expand the developed wireless sensor platform to other types of sensors such as a moisture sensor and use these in precision farming applications. Precision farming is a fast growing farm management practice that has great potential for maximizing crop yields while minimizing waste of resources such as water, fertilizer or pesticides by directing materials where crops need it most (Blahovec and Kutilek,2003). Historically, application of resources in the field was a matter of anecdotal experience and observation, or based on end of season crop yields. Precision farming requires real–time monitoring of important variables to determine how much resources should be applied and where. As a result of this new direction in agriculture, there’s a growing demand for monitoring important soil variables such as moisture, temperature, and nitrogen levels in an automatic and wireless manner.

2.7 “Remote Sensing Monitoring Operation System for Agriculture” Shuo YANG

The research and application of remote sensing technology in agriculture started in late 1970s in China. Over past 30 years of development and on the basis of technical introduction, R&D, the remote sensing technology in the Chinese Ministry of Agriculture has become one of elementary means in monitoring growth of main crops, production prediction and soil moisture content etc. The general objectives of remote sensing monitoring system in the Ministry of Agriculture are to establish a dynamic monitoring system covering the whole country, with complete system, combination of remote sensing with ground and stable operation. The focus is on constructions of systems of conducting main crop remote sensing monitoring, agricultural resource monitoring, and demonstration of digital and fine agriculture in terms of monitoring. This paper is to present existing status of remote sensing monitoring operation system of Remote Sensing Application Centre of the Ministry of Agriculture, including major contents of remote sensing monitoring, adoption of key technology and framework of operation system and outlook for further development**.**

CHAPTER 3

SYSTEM INTEGRATION

Monitoring agricultural environment for various factors such as temperature and humidity along with other factors can be of significance. A traditional approach to measure these factors in an agricultural environment meant individuals manually taking measurements and checking them at various times. This paper investigates a remote monitoring system using ZigBee. These nodes send data wirelessly to a central server, which collects the data, stores it and will allow it to be analyzed then displayed as needed and can also be sent to the client mobile.

The agricultural practices such as irrigation, crop rotation, fertilizers, pesticides and animals were developed long ago, but have made great strides in the past century. The history of agriculture has played a major role in human history, as agricultural progress has been a crucial factor in worldwide socio-economic change. The concern of better quality agricultural products from the consumers made the farmers adapt to latest agricultural techniques by implementing modern technologies for producing better agricultural products. Among the important things which are taken into consideration by the farmers are the qualities of agricultural land, weather conditions etc. Traditional farming involves a human labour. With proper data the farmer will be able to deliver the quality product to the consumer. In this paper we have discussed about online monitoring of agriculture parameter using multiple sensors are like temperature, humidity and water level sensor, Zigbee wireless technology. We update the parameter result from the sensor node data is transferred to the Zigbee to another end server PC.

From the PC, the sensor values are transferred to the client so the farmer may know the status of their agricultural field. The ability to monitor environmental conditions is crucial to research in fields ranging from climate variability to agriculture and zoology. Being able to document baseline and changing environmental parameters over time is increasingly essential important and researchers are relying more and more on unattended weather stations for this propose.

The author Haefke. M designed and developed A Zigbee Based Smart Sensing Platform for Monitoring Environmental Parameters. Zigbee wireless sensor network usually works in a complex environment, and the energy of sensor node is very limited, so energy consumption is a big problem in Zigbee wireless sensor network especially in the multi-sensor system. Plant eco-physiological monitoring system is a typical multi-sensor system. The authors Wang Cheng et at presented power reduction in plant eco-physiological monitoring system, and low power strategy on both the hardware designing and software controlling. Sensors are used in everyday objects such as touch-sensitive elevator buttons and lamps which dim or brighten by touching the base. There are also innumerable applications for sensors of which most people are never aware. Applications include cars, machines, aerospace, medicine, manufacturing and robotics.

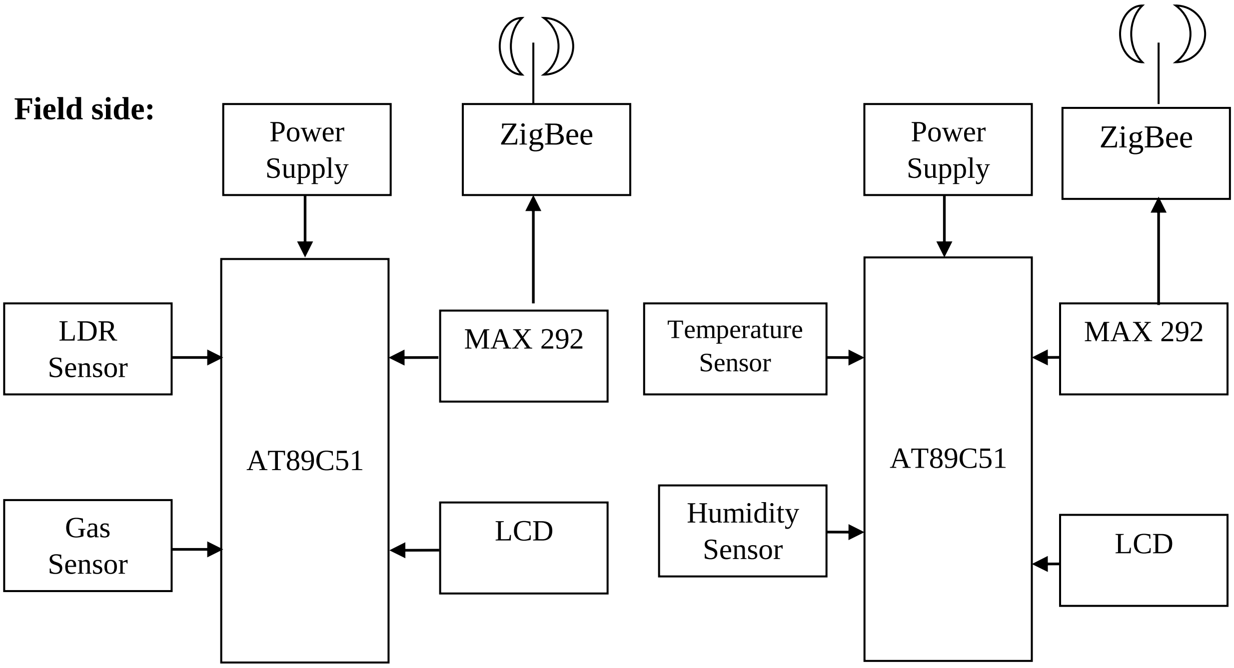
The authors proposed a system to locate workers by using fixed sensor nodes in green houses or outdoors, and to determine yield by exploiting information sensed from weight sensors on harvest carts of workers. It could plan efficient arrangement of workers by using sensed information to collect production and environmental information for each area, and could utilize as a reference for making optimum growth conditions of crops in green houses in the future by storing conditions in green houses and environmental information of high-yield regions through real-time monitoring into a database. The authors Jeong-hwan Hwang and Hyun Yoe proposed the „Paprika greenhouse management system" based on wireless sensor network technology, which will establish the ubiquitous agricultural environment and improve the productivity of farmers. The proposed Paprika greenhouse management system" has WSN environmental sensors and CCTVs at inside/outside of paprika greenhouse. These devices collect the growth-environment related information of paprika.

3.1 IMPLEMENTATION

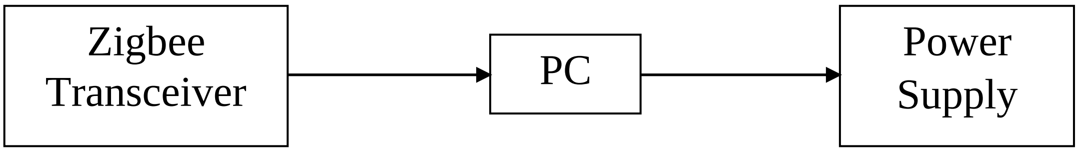
The system which is implemented is divided into three parts. They are field side, server side and client side. The architecture diagram in figure 1 shows the implementation.

The hardware circuit in the field side measure the soil parameters using the sensors such as Humidity sensor, Gas sensor, and Light sensor and Temperature sensor. This information is collected by the hardware controller and transmitted using Zigbee transceiver. On the other side all this information are received by the Zigbee transceiver which is stored in the server computer .Then the information which is collected is send to the mobile of the user using the drop box technology. A. Field Side Two prototype hardware controller circuits have been developed and shown below:

Field side:



Server side:



Clint side:

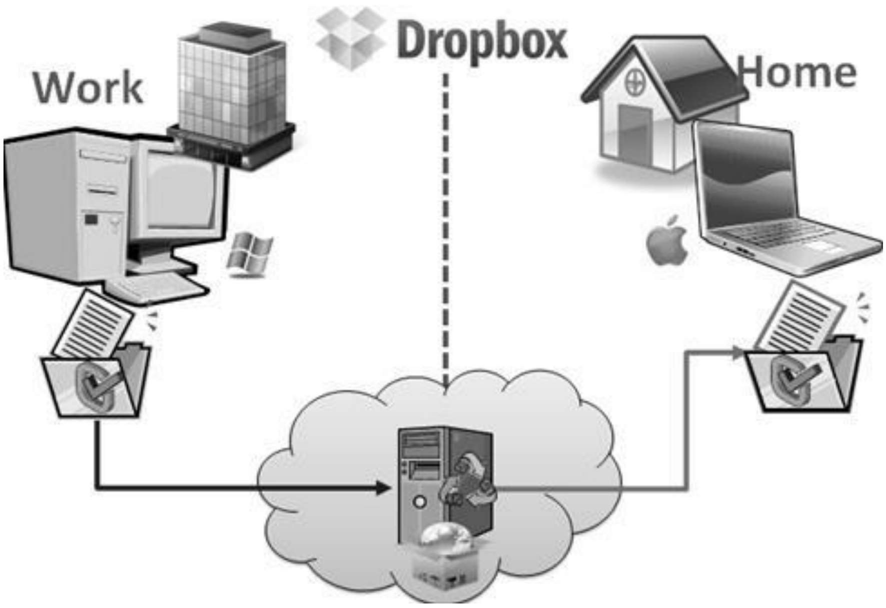


Figure 3.1. Architectural Diagram

3.2 FIELD SIDE

Two prototype hardware controller circuits have been developed and shown below:

Figure3.2. Prototype Hardware Boards 1 and 2

A prototype hardware board has been implemented .In this prototype the hardware gets the Humidity and temperature from corresponding sensor in hardware circuit 1 and light and gas form corresponding sensor in hardware circuit 2 then it send all the information to the server using the Zigbee transceivers .

3.3 SERVER SIDE

In the server prototype the gathered values from the Zigbee transceivers are saved in the form of Microsoft Excel format and then it is transferred to user as mobile data using Drop Box technique so that it can be retrieved immediately and also for future references. The connection between Zigbee and server side computer is shown in figure1 and screenshot of server side is shown in figure3.

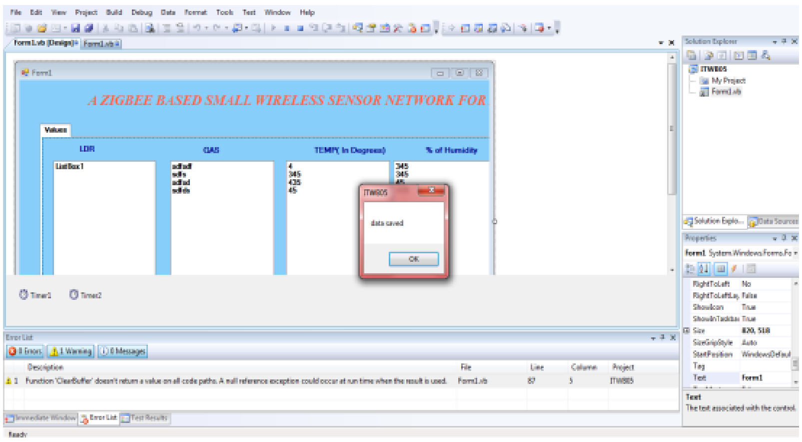


Figure 3.3 Screenshot in Saving Data Records

3.4 CLIENT SIDE

The received data is stored in the server pc for later reference and also the stored real time information is securely send to user or client by using drop box synchronizing technique between mobile and server. So that user can able to get real-time information about the land at anywhere at any time. The received data in mobile is shown in the Figure 3.4.

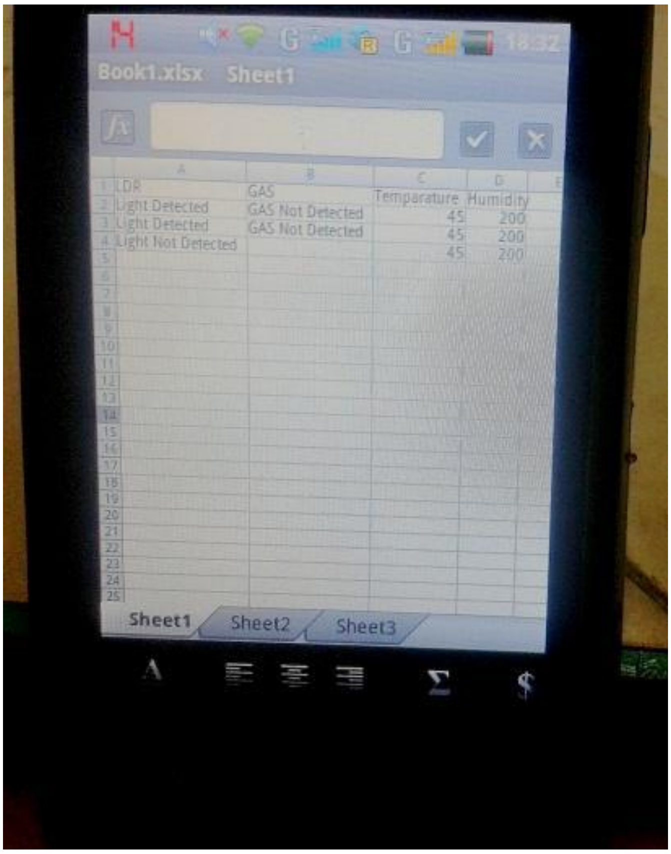


Figure 3.4 Screenshot in Sync Using Drop Box

CHAPTER 4

MONITORING AND TRANSMITTING DATA USING GSM MODEM

4.1 OVERALL WORK:

BLOCK DIAGRAM:

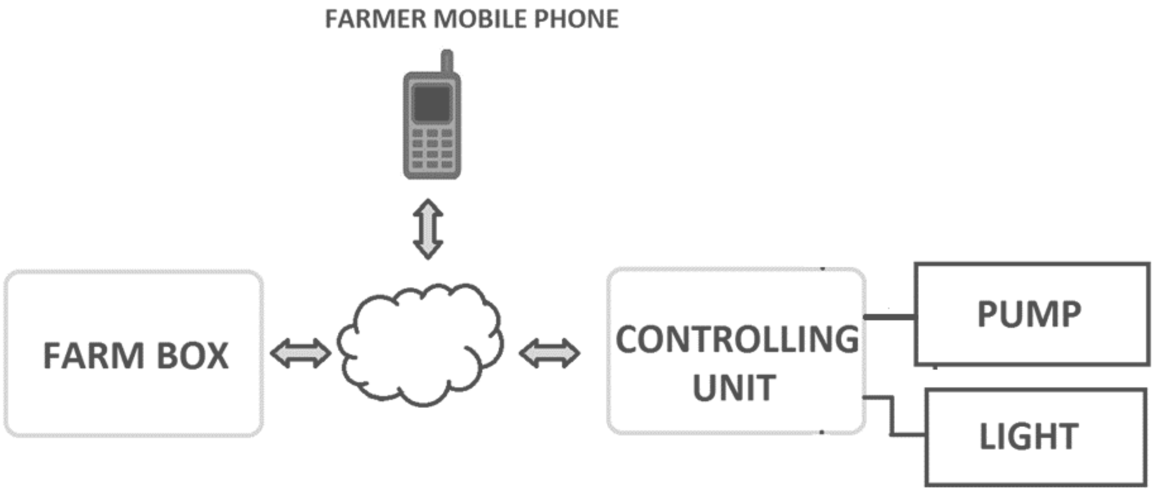


Figure 4.1 Block Diagram

The purpose of the project is to measure the various parameters in the farm land and to convert that corresponding parameter into a user readable parameter. In this project there is two sides namely field side and farmer side

- In the field side, the FARM BOX is used. The farm box consist of various sensors which measures the parameter in particular area in the farm land.
- In farmer side, is a controlling unit it will control the pump motor and light in the farm land. Apply

4.2 FARM BOX:

The Farm box is a small compactable wooden box that contains the moisture sensors, temperature sensor, humidity sensor and Light sensor as an input and a microcontroller. The GSM modem as output part and zigbee is the controlling of receiver part.

In the receiver section there are two relay connected in microcontroller and the relay is switched on and off by the controlled. zigbee RF communication will help to communicate with form box.

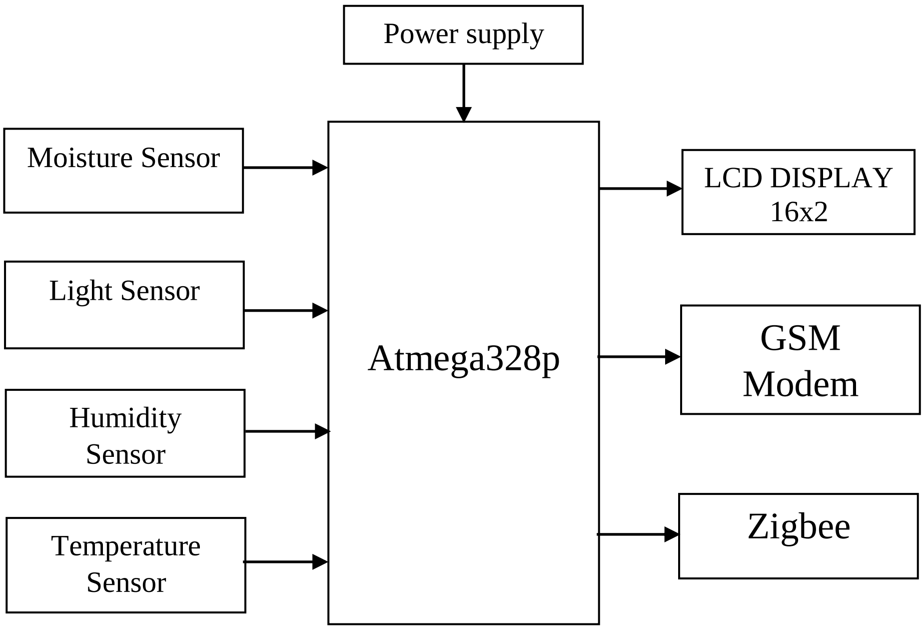


Figure 4.2 Block diagram of Farm Box

4.3 CIRCUIT DIAGRAM:

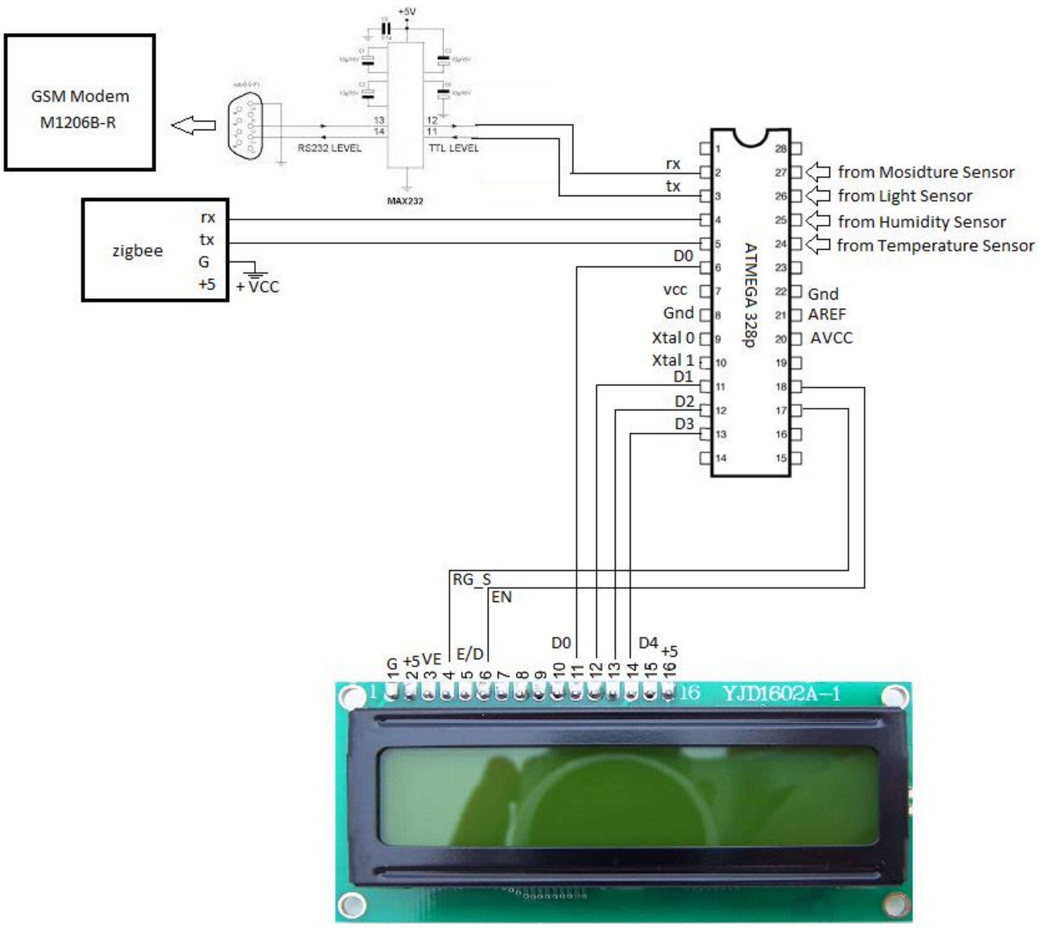


Figure 4.3 circuit diagram

Sensors:

Moisture Sensor Module	-	Moisture Sensor
SY-HS-230	-	Humidity Sensor
LM35	-	Temperature Sensor
LDR	-	light Sensor

Controller:

ATMEGA328p	-	Microcontroller

Output Devices:

GSM SIM 900 Module	-	GSM Modem
MAX232	-	GSM Driver(converter)
CC2500	-	Zigbee module

4.3.1 ATMEGA328p:

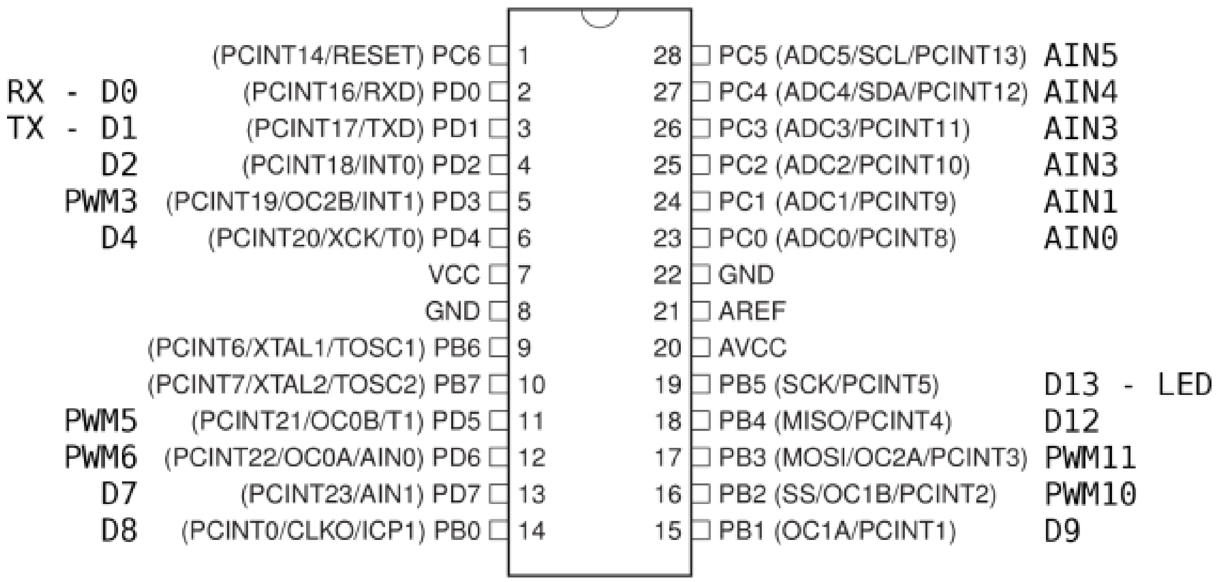


Figure 4.4 PIN detail of Atmega328p

The high-performance Atmel Pico Power 8-bit AVR RISC-based microcontroller combines 32KB ISP flash memory with read-while-write capabilities, 1024B EEPROM, 2KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, a 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts.

By executing powerful instructions in a single clock cycle, the device achieves throughputs approaching 1 MIPS per MHz, balancing power consumption and processing speed.

Key Parameters

Parameter	**Value**
Flash (Kbytes):	32 Kbytes
Pin Count:	32
Max. Operating Freq. (MHz):	20 MHz
CPU:	8-bit AVR
No. of Touch Channels:	16
Hardware Q Touch Acquisition:	No
Max I/O Pins:	23
Ext Interrupts:	24

4.3.2 Moisture sensor module:

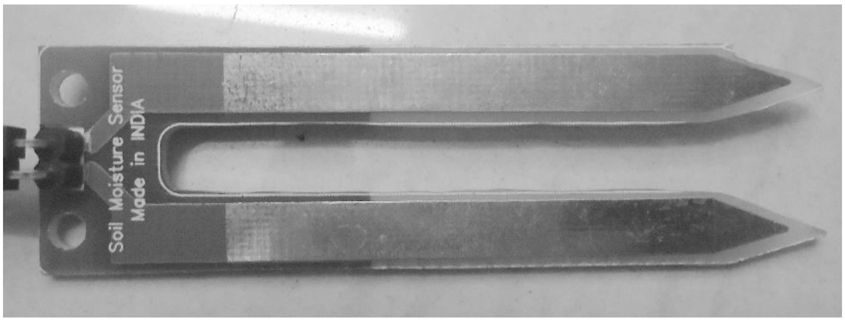


Figure 4.5 Moisture Sensor

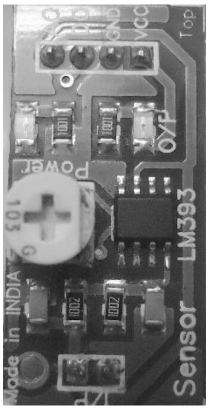


Figure 4.6 Moisture Sensor Driver

In the figure 4.3 and 4.4 the above diagram of moisture sensor is shown. The circuit required a 5v DC voltage supply. The input of the sensor driver is connected to the moisture rod and the output will be connected to the ANALOG A4 (PIN 27) input in Atmega328p Microcontroller.

The Moisture sensor is used to measure the amount of water present in the Soil. It consist of a moisture rod and a driver module.

First the input signal is transferred into a driver module. In that Moisture driver LM393 is used. LM393 is consist of two independent precision voltage comparators. So as per the water amount the output voltage of the comparator will varies.

For example if the water is present in the soil the output GREEN LED will glow. If the water is absent in the soil GREEN LED will off. The moisture module consist of two output namely ANALOG (A0) and DIGITAL (D0).

4.3.3 HUMIDITY SENSOR MODULE:

Figure 4.7 Humidity Sensor Module

Figure 4.5 Humidity is simply vaporized water in the air. The percentage of water vapour in the air at a specific temperature, compared to the amount of water vapour the air is capable of holding at that temperature is most often referred to as “relative humidity.” Relative humidity that is too high or too low can be problematic to your home, your health, and your comfort. Hence, humidity sensing is very important, especially in the monitoring and control systems for agriculture environment.

Warm air holds more water vapour than cold air holds. When air at a certain temperature contains all the water vapour it can hold at that temperature, its relative humidity is 100 percent. If it contains only half the water vapour it is capable of holding at that temperature, the relative humidity is 50 percent.

SY-HS-230 is a humidity sensor used. It is used to measure the humidity level in the agriculture environment.

The humidity sensor module consist of four terminals. The pin 1 is +5v and pin 3 is GND. And pin 4 is OUTPUT. Pin 4 is temperature output.

In this part we interfaced the humidity sensor module output in the Atmega328p in ANALOG A2 on PIN 25.

SPECIFICATION:

ITEMS	**DETAILS**
Rated voltage	DC 5.0V
Rated Power	<3.0mA
Operating temperature	0~60*C
Operating Humidity	10~90% RH
Storage Humidity	Within 95% RH
Storage temperature	-30~85*C
Accuracy	+-5%RH (at 25*C, 60%RH)

4.3.4 TEMPRATURE SENSOR MODULE:

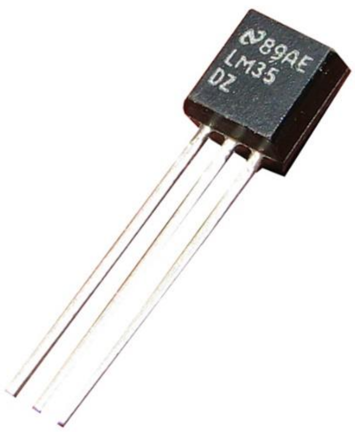


Figure 4.8 Temperature Sensor LM35

Figure 4.6 The LM35 series are precision integrated-circuit temperature sensors, with an output voltage linearly proportional to the Centigrade temperature. Thus the LM35 has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade scaling.

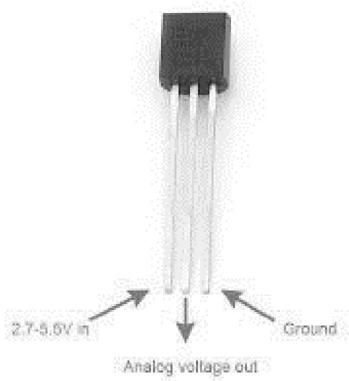


Figure 4.9 LM35 Pin details

The LM35 output is connected in the ANALOG A1 (PIN 24) of Atmega328p mc. And the +5v is connected to the VCC with respected to ground.

FEATURES:

- Calibrated Directly in ° Celsius (Centigrade)
- Linear + 10 mV/°C Scale Factor
- 0.5°C Ensured Accuracy (at +25°C)
- Rated for Full −55°C to +150°C Range
- Low Cost Due to Wafer-Level Trimming
- Operates from 4 to 30 V
- Less than 60-µA Current Drain
- Low Self-Heating, 0.08°C in Still Air.
- Nonlinearity Only ±¼°C Typical
- Low Impedance Output, 0.1 Ω for 1 mA Load

4.3.5 LIGHT SENSOR:

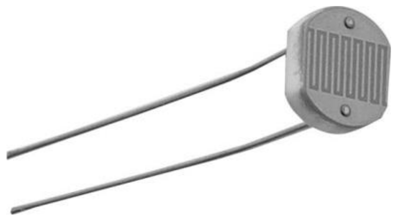


Figure 4.10 LDR (Light sensor)

Figure 4.8 is LDR (Light dependent resistance) it is used to measure the intensity of the light. The LDR has a phenomena of changing the resistance when the light fall on it.

When the light is present the resistance of the LDR will be in M Ohm. And when there is no light the resistance of LDR will be in Ohm.

The LDR is connected with the microcontroller by a push pull resistance. The output will be connected to the ANALOG A3 (PIN 26) of Atmega328p microcontroller.

Features:

- Wide Spectral response
- Low Cost
- Wide ambient temperature range

4.3.6 ZIGBEE MODULE:

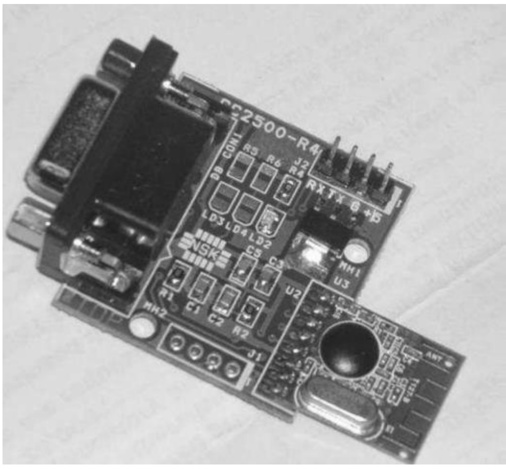


Figure 4.11 CC2500 Zigbee module

Figure 4.9 CC2500 Zigbee Module is a transreceiver module which provides easy to use RF communication at 2.4 Ghz. It can be used to transmit and receive data at 9600 baud rates from any standard CMOS/TTL source.

This module is a direct line in replacement for your serial communication it requires no extra hardware and no extra coding to it works in Half Duplex mode i.e. it provides communication in both directions, but only one direction at same time.

For the CC2500 Zigbee module digital pin 0 & 1 or PIN 4 & 5 is converted into RX & TX Serial configuration. And interface with CC2500 module.

Features:

- Supports Multiple Baud rates (9600)
- Works on ISM band (2.4 GHz)
- No complex wireless connection software or intimate knowledge of RF is required to connect our serial devices.
- Designed to be as easy to use as cables.
- No external Antenna required.
- Plug and play device.
- Works on 5 DC supply.

Specifications:

- Input Voltage - 5Volts DC
- Baud Rate - 9600
- RS 232 Interface & TTL Interface
- Range – Max 30 Mtrs - Line of Sight
- Channels - 3 Ch - JP1 & JP2 - Ch 1 On – On

4.3.7 MAX232:

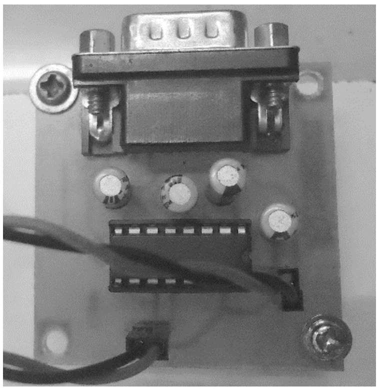


Figure 4.12 MAX232

The MAX232 is an IC, that converts signals from an RS-232 serial port to signals suitable for use in TTL compatible digital logic circuits. The MAX232 is a dual driver/receiver and typically converts the RX, TX, CTS and RTS signals.

The drivers provide RS-232 voltage level outputs (approx. ± 7.5 V) from a single + 5 V supply via on-chip charge pumps and external capacitors. This makes it useful for implementing RS-232 in devices that otherwise do not need any voltages outside the 0 V to + 5 V range, as power supply design does not need to be made more complicated just for driving the RS-232 in this case.

4.3.8 GSM MODEM:

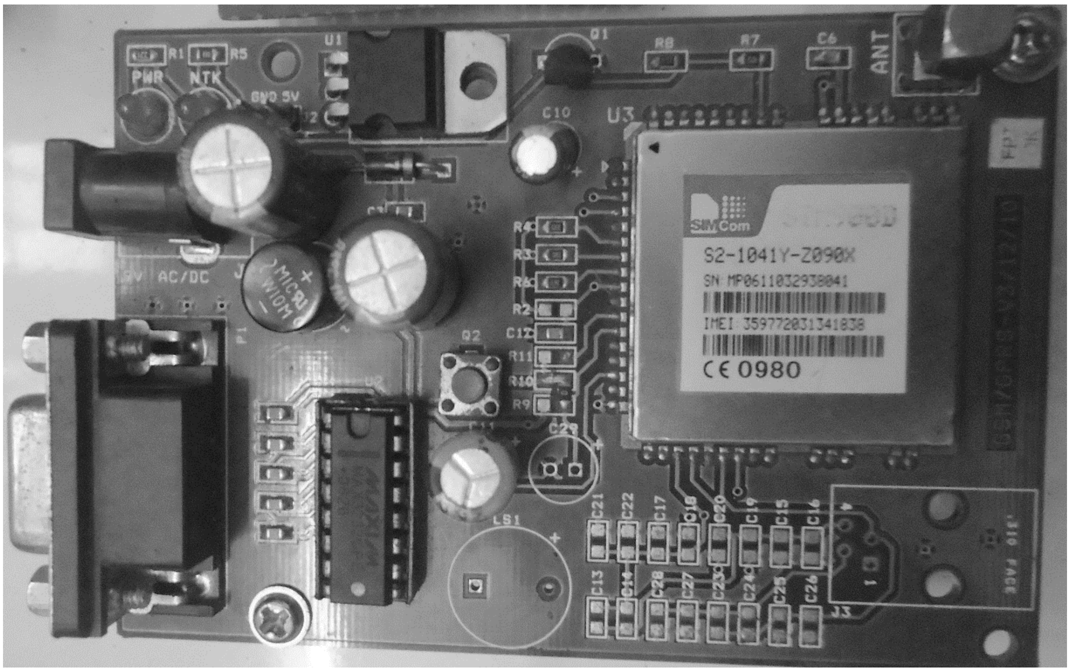


Figure 4.13 SIM900D module

SIMCom presents an ultra-compact and reliable wireless module-SIM900D. This is a complete Quad-band GSM/GPRS module in a SMT type and designed with a very powerful single-chip processor integrating AMR926EJ-S core, allowing you to benefit from small dimensions and cost-effective solutions.

Featuring an industry-standard interface, the SIM900D delivers GSM/GPRS 850/900/1800/1900MHz performance for voice, SMS, Data, and Fax in a small form factor and with low power consumption. With a tiny configuration of 33mm x 33mm x 3 mm, SIM900D can fit almost all the space requirements in your M2M applications, especially for slim and compact demands of design.

The SIM900D GSM MODEM is interfaced with the microcontroller using through a MAX232 driver on the Serial PIN 2 & 3 in Atmega328p.

General features:

- Quad-Band 850/ 900/ 1800/ 1900 MHz
- GPRS multi-slot class 10/8
- GPRS mobile station class B
- Compliant to GSM phase 2/2+
  - ➢ Class 4 (2 W @850/ 900 MHz)
  - ➢ Class 1 (1 W @ 1800/1900MHz)
- Dimensions: 33*33*3mm
- Weight: 6.2g
- Control via AT commands (GSM 07.07 ,07.05 and SIMCOM enhanced AT Commands)
- SIM application toolkit
- Supply voltage range : 3.2 ... 4.8V
- Low power consumption: 1.0mA(sleep mode)
- Operation temperature: -40°C to +85°C

4.4 FARMER's SIDE:

4.4.1 CIRCUIT DIAGRAM:

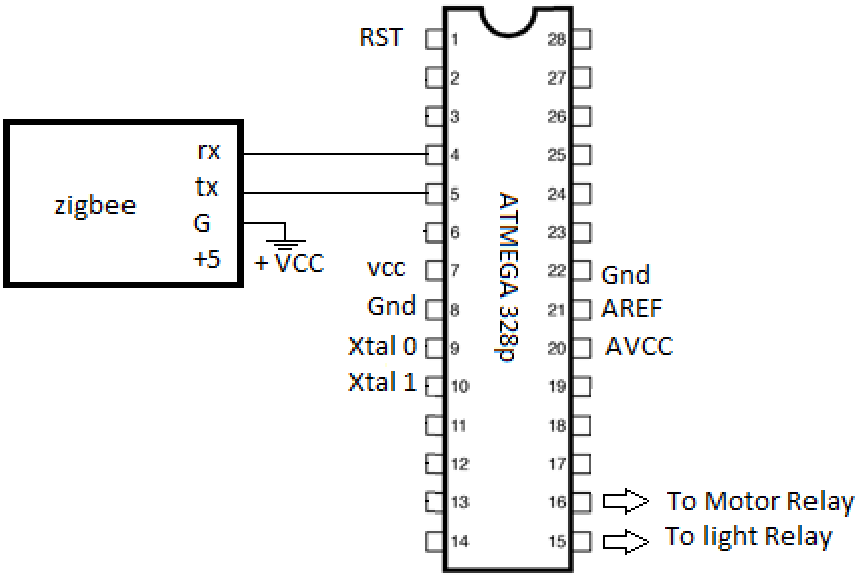


Figure 4.14 Circuit diagram

The Zigbee is interfaced in the pin 4 and 5 of the Atmega328p microcontroller. The pin 4 and 5 are Serial pin's which is used for Tx and Rx.

And in the pin 15 and 16 the light and motor is interfaced through a relay circuit.

4.4.2 RELAY:

Relays are devices which allow low power circuits to switch a relatively high Current/Voltage ON/OFF. For a relay to operate a suitable pull-in & holding current should be passed through its coil. Generally relay coils are designed to operate from a particular voltage often its 5V or 12V.

Figure 4.15 RELAY

Two relays are interface in the PIN 9 and PIN 10 in the Arduino Board. The relay are used to switch the High voltage devices through the low voltage devices. And LED is also present to show that the switching of RELAY.

A ULN2803 IC is used in between the RELAY and the Microcontroller Atmega328p. ULN2803 is and Driver IC to drive the RELAY in 12v because Microcontroller Output will be 5v in logic1 and 0v in logic 0.

CHAPTER 5

OUTPUT

5.1 MOISTURE SENSOR MODULE:

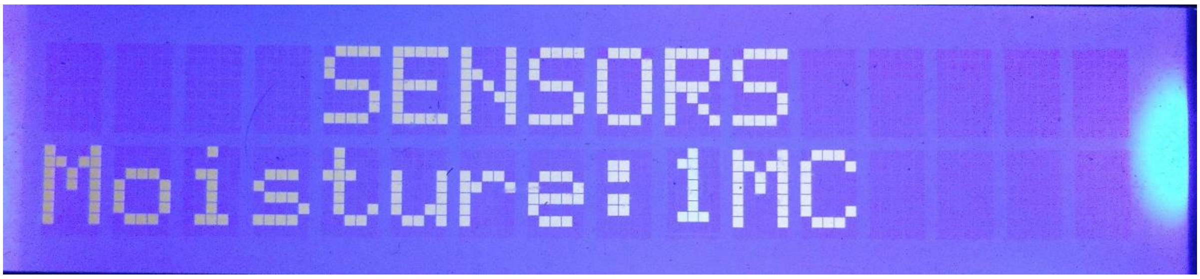


Figure 5.1 moisture sensor present of water in sand

Actual range of the moisture sensor is 1 – 10. For cultivation we need Less than 2 for Rise. When the water is present in the Farm Land the moisture sensor will sense the presents of water and give the corresponding output. The motor is controlled according to the moisture sensor when the moisture is high the motor will ON and when low the motor will OFF.

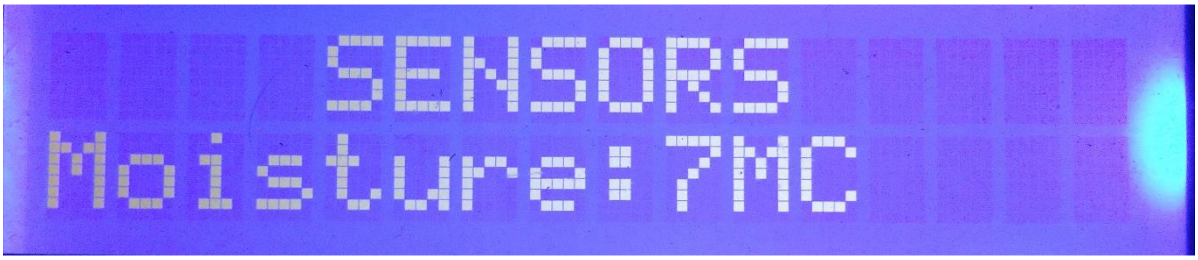


Figure 5.2: moisture sensor in dry sand

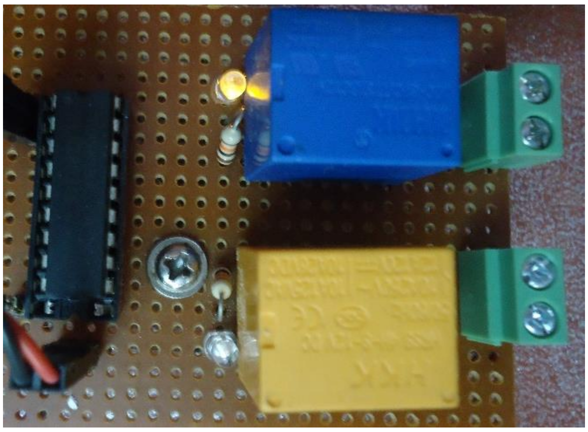


Figure 5.3 Motor relay ON state

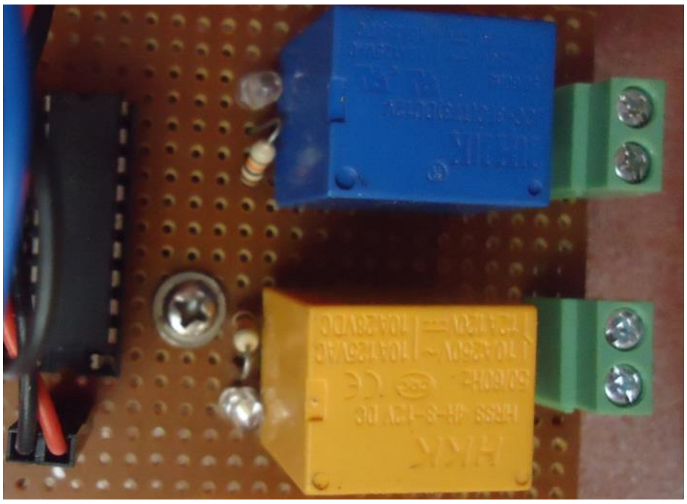


Figure 5.4 Motor relay OFF state

5.2 LIGHT SENSOR

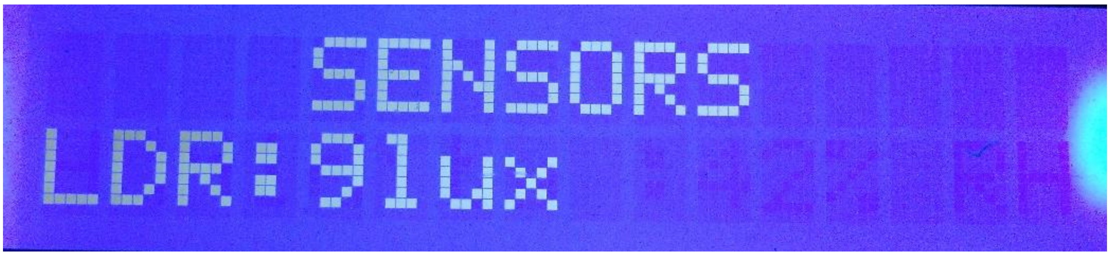


Figure 5.5 Light Sensor when absence of light

Actual rage of the light sensor is 1 – 10. We need 9 in day 0-1 in night time for a good growth of plants. LDR will have a high output in night time and low output in the day time. With this the light of the Farm land will be controlled. When the low output the light will OFF and when the high output the light will ON.

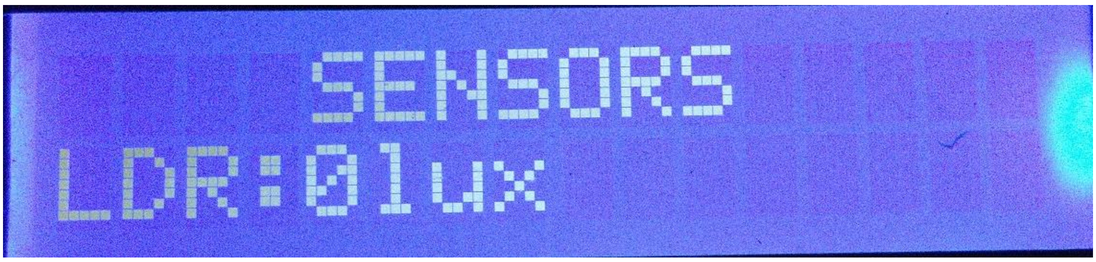


Figure 5.6 Light Sensor present of light

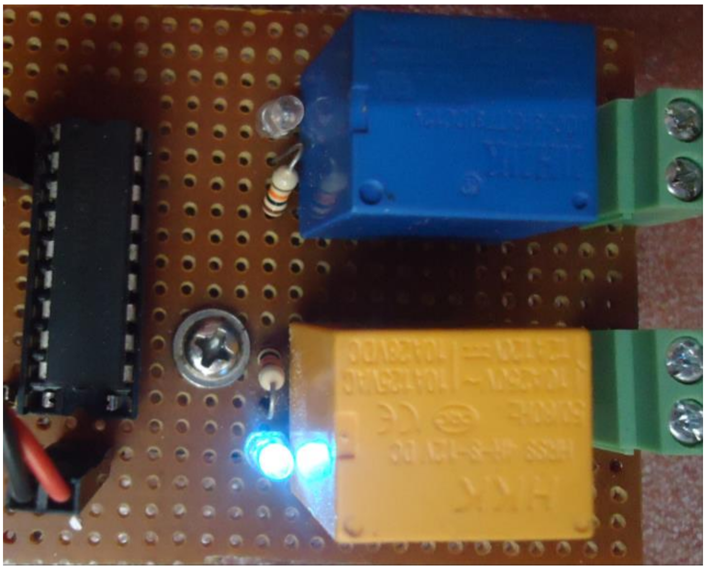


Figure 5.7 Light Relay ON state

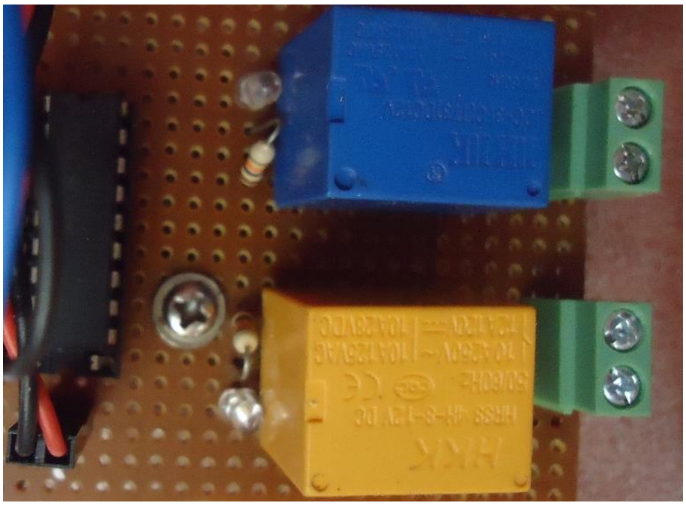


Figure 5.8 Light Relay OFF state

5.3 TEMPERATURE SENSOR

Figure 5.9 Temperature Sensor

Actually 28°C we need for cultivating Rise. 16°C to 20°C during growing season for rice and 18°C to 32°C in ripping season. For coffee plant the temperature of 20°C should be maintained. And some Lettuce and herbs the 18°C is needed. For Wets a temperature of 25°C to 30°C is must.

5.4 HUMIDITY SENSOR

Figure 5.10 Humidity Sensor

Humidity is just should maintain in 35 – 50 % RH. In winter 20%+ and in Summer No more than 60% RH.

5.4 FARMERS MOBILE

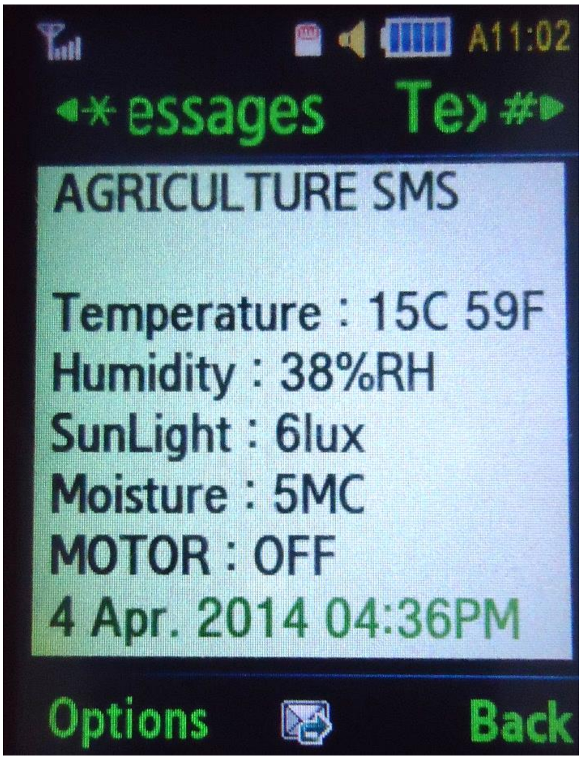


Figure 5.11 Farmers mobile

Figure 5.11 shows the SMS sent to the Farmer's mobile. The message shows the status of the Farm land in Temperature in °C and °F, Humidity in % RH, Sunlight in lux, moisture in MC and motor status. This message will be sent to the farmer's mobile for every half an hour. Farmer can know the status when he in another work in any remote place.

CHAPTER 6

CONCLUSION

Thus the output of the sensors are read through the microcontroller and the parameters are displayed on the 16x2 display. And the parameters are messaged to the farmer’s mobile through the SIM900D GSM modem on every Half an hour. When the water content is low and light is absent the controller will automatically control the pump motor and light in the farm land. This will help the former to know the status of the farm land on every half an hour. And he can remotely know the status using the mobile.

Feature Work:

In Future the motor is controlled by through SMS. And robot, automation machines can be used in the agriculture.

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