COVER PAGE

DESIGN AND IMPLEMENTATION OF A GSM BASED IRRIGATION AUTOMATION SYSTEM

ILESANMI S.A

NOVEMBER 2017

DECLARATION

I hereby declare that the project work entitled "Automatic Irrigation Alert System" submitted to mechatronics engineering department federal university Oye Ekiti, is a record of an original work done by me under the supervision of Egnr. Martins, lecturer in mechatronics engineering, federal university Oye Ekiti, and this project work is submitted in part fulfilment of the requirement for the award of the degree of bachelor of engineering in mechatronics engineering. This project report has not been submitted to any other institution for the award of degree.

ILESANMI SAMUEL ABIODUN

MEE/12/0862

APPROVAL

THIS PROJECT REPORT HAS BEEN APPROVED FOR ACCEPTANCE BY THE MECHATRONICS ENGINEERING DEPARTMENT, FEDERAL UNIVERSITY OYE-EKITI, EKITI STATE AND MEETS THE REGULATIONS GOVERNING THE AWARD OF BACHELOR OF ENGINEERING OF FUOYE.

BY

SUPERVISOR

NAME: ____________________

SIGNATURE: ____________________

DATE: ____________________

HEAD OF DEPARTMENT

NAME____________________

SIGNATURE: ____________________

DATE: ____________________

EXTERNAL EXAMINAR

NAME____________________

SIGNATURE: ____________________

DATE: ____________________

Dedication

I dedicate this project to Almighty God my creator, the Lord of Host, my strength and my pillar. Also to the best parent in the world which is my Mother who make herself available as source of encouragement and source of finance. And to the redeemed Christian fellowship, also to all my brothers and sisters and also to my good colleagues we are best together.

ACKNOWLEDGEMENT

I have taken efforts in this project. However, it would not have been possible without the kind support and help of many individuals and organizations. I would like to extend my sincere thanks to all of them.

I am highly indebted to God almighty for his guidance, protection, and provision over my life for the past five years in this great institution and also for the success of the project, may his name be highly praised forever. Amen

I would like to express my gratitude towards my mother Mrs. V. Ilesanmi, my aunty Mrs. F Bosede, Mrs. Victoria and also to my amiable guardian Mr. Oniya and my brothers Ilesanmi Stephen, Ilesanmi Johnson, Ilesanmi Mathew and my sister Miss. Bobadoye Mercy for their kind co-operation and encouragement which help me in completion of this project.

I would like to express my special gratitude and thanks to my supervisor Engr. Martins and for giving me such attention and time.

I would like to express my special gratitude and thanks to Engr. Adebinpe, Engr. Otenaike, and to all technologist in mechatronics engineering department for giving me more attention concerning my project development.

My gratitude also go to The Redeemed Christian Fellowship Ikole campus for their prayers and advice anytime I feel like giving up on the project, I will always remember you

My thanks and appreciations also go to my colleague Abereola Oluwaseun, Bello Okikioluwa, oluwayemisi, and others in developing the project and people who have willingly helped me out with their abilities.

Contents

LIST OF FIGURES

LIST OF PLATES

LIST OF TABLE

ABSTRACT

Irrigation is the artificial application of water to the soil or plant, in the required quantity and at the time needed, is a risk management tool for agricultural production. Irrigation farming has increased in Nigeria in the recent times. The risk of yield reduction due to drought is minimized with irrigation. This is a risk management tool for agricultural production, to Promotes soil solution and nutrient uptake Irrigation water becomes the medium into which soil nutrients are dissolved (soil solution) and through which nutrients are made available for plant uptake. This project give a solution on problem face by farmer so as to irrigate the land, which explain the application of GSM based irrigation automation system in controlling irrigation process without going to the farm. Due to the variable atmospheric circumstances these conditions sometimes may vary from place to place in large farmhouse which more effective sensor actually need to be employ but for this project a small area 0is used for practical, which makes very difficult to maintain the uniformity at all the places. In the farmhouse manually GSM (Global System for Mobile Communication) is used to inform the user about the exact field condition with the assistance of its module process through a controller and device. The information is passed onto the user request in the form of SMS (short messaging service) and calls. Which will wait for response from the user to control the water pump and as soon as the water is enough it will send another messages to the user or call the user to send another control to device for the pump to stop working. The result showed that the device can be used as long as there is water in the reservoir and it can be simulate using proteus software. The information obtain from the module that is sent to the user inform of SMS (short messaging service) comes like "the land need wetting, initialized is present and so on

CHAPTER ONE

INTRODUCTION

Irrigation farming has increased in Nigeria in the recent times. The possible reason for this is the increased awareness from the Fadama project jointly funded by World Bank, Federal Government and State Governments. This work was carried out to assess the income generating potential of irrigation farming which may reduce poverty and hunger and directly achieve an important aspect of the Millennium Development Goals. The study which was conducted between October 2005 and April 2006 covered towns and villages within South Western region of Nigeria using data collected from a sample of four hundred and fifty Fadama (irrigation) farmers. Structured questionnaires were administered to irrigation farmers in selected towns of two randomly selected Local Governments of two selected states (Oyo and Ogun States). (Asenso, 2011)

The result of the study showed that irrigation farming is a profitable venture. Farmers realized an average net income (profit) of N109, 750 from irrigation farming for the period. Furthermore, irrigation farming was found to be capable of alleviating poverty among farming households because they were able to live above US $1/day/person which is the threshold for poverty level. Hence irrigation farming can be used to achieve the MDG of reducing poverty and hunger. (Asolkar, P.S and Bhadade,, .Feb. 2015)

The Ordinary Least Square (OLS) regression showed that farm size, years of irrigation experience, seed, labor and fertilizer were found to have significant effects on profit realized from irrigation farming. Major crops grown are vegetables (such as Okra, Chocorus olitorus, Telferia spp and Amaranthus).

In a Farming Field area, there is a need of proper water supply to prevent it from drying and avoiding the over flow condition. If the water level in a reservoir connected near to the field drops below the threshold level for irrigation and Field starts drying and also its pump motor may get air-locked or even burn out due to dry running. It is inconvenient for farmers to walk all the way to their fields at night just to switch the pump motor 'off.' Besides, he may never get to know the problem. This problem can be solved by using this GSM-based system that will automatically give the user a call on his mobile phone when the water level in the Borewell drops below or rises to the threshold level for pumping. The user can also remotely 'switch on' or 'switch off' the pump motor by sending a sms from mobile phone.

To reduce wasting of water and to avoid over flooded or not enough water to the plant, then a system has to be used to help in the irrigation system.

Therefore to makes the work of irrigation easy, this project explain a device that can be used to automate the irrigation process with a form of alert. For the project drip irrigation is use to channel the water the root of the plant in a mini greenhouse.

1.1. Objective

1. To design and implement a GSM based Irrigation Automation System.
2. Test and analyze the performance design and implement a GSM based Irrigation Automation System.
3. To develop effective and convenient automatic irrigation system to increase the productivity of crops.
4. To develop system that automatically regulate the moisture of the soil.
5. To minimize human labor used in irrigation.
6. To provide convenience in accessing the system from anywhere at any time.
7. To save the time of the owner for the large fields.

Aim

To design and implement a GSM based Irrigation Automation System

CHAPTER TWO

LITERATURE REVIEW

Veena Divya,k, AyushAkhouri "A Real time implementation of a GSM based Automated Irrigation Control System using dr+ip Irrigation Methology"deal GSM based Irrigation Control System, which could give the facilities of maintaining uniform environmental conditions. (VeenaDivyak, May 2013)). For this, a software stack called Android is used for mobile devices that include an operating system, middleware and key applications. The Android SDK the tools and APIs necessary to begin developing applications on the Android platform using the Java programming language. Mobile phones have almost become an integral part of us serving multiple needs of humans. This application makes use of the GPRS feature of mobile phone as a solution for irrigation control system.

This system covered lower range of agriculture land and not economically. In Mansour "Impact The Automatic Control Of Closed Circuits Raingun Irrigation System On Yellow Corn Growth And Yield" this research paper deals of automatic control of closed circuits drip irrigation system as a modified irrigation system on yellow corn crop vegetative and yield parameters under (KSA) Saudi Arabia conditions at Al-Hasa region. The field experiment carried out under automatic irrigation system for three irrigation lateral lines 40, 60, 80 m under the following three drip irrigation circuits (DIC) of: a) one manifold for lateral lines or closed circuits with one manifold of drip irrigation system (CM1DIS); b) closed circuits with two manifolds for lateral lines (CM2DIS), order to compensate for ETc and salt leaching requirement. And take more power.

2.1. The Role of Irrigation Water in Agriculture Systems

a. Sustains soil biological and chemical activity and mineralization during dry periods: In seasonally dry areas, irrigation water artificially extends the time period in which soil biological activity and nutrient release are elevated-creating more optimal growing conditions for cultivated crops

b. Promotes soil solution and nutrient uptake: Irrigation water becomes the medium into which soil nutrients are dissolved (soil solution) and through which nutrients are made available for plant uptake

c. Provides carbohydrate building block: $6 CO_2 + 6 H_2O \longrightarrow C_6H_{12}O_6 + 6 O_2$: Through the process of photosynthesis, water molecules taken up by plants are broken down and their constituent atoms rearranged to form new molecules: carbohydrates and oxygen

d. Provides plant structure/support: Water molecules contained within the water-conducting vascular bundles and other tissues of plants serve to provide physical support for the plant itself

e. Promotes the maintenance of optimal temperatures within the plant: The loss of water through the process of evapotranspiration (defined below) liberates heat from the plant, thereby regulating plant temperature

f. Protects crops from frost damage: Irrigation water is commonly used to lower the freezing temperature in orchard systems during threats of damaging frost

g. Reduces plant stress: By reducing stress on the plant, proper irrigation improves plants' resistance to pest and disease damage and improves crop quality

7.2. Profitability of irrigation farming

Farmers realized an average net income (profit) of N109, 750 (about US $915) from irrigation farming. It should be noted however that Fadama (irrigation farming) is not done throughout the years and farmers reported an average period of two months for which they are engaged in irrigation farming. If this net income is divided by sixty days (two months), it means an average farmer realizes N1, 829.17k per day from irrigation farming. However, it should be noted that an average farmer has the responsibility of catering for the household and it should be recalled that the average household size was six people per household. In the light of the above, the average net income per person per day from irrigation farming (that is 1,829.17 / 6) is N304.86k (about US $2.54) per day. This is quite above US $1 per day suggested by the United Nations as the poverty threshold. It has been recommended that for an individual to live above poverty level, he/she must be able to spend at least $1 /day. Furthermore, the rate of Return on Investment (RRI) was found to be 2.00 which imply that for every one naira invested in the irrigation farming business a net profit of two naira accrues to the farmer. This rate of return can be considered to be very high and lucrative compare to many other businesses available around. This also confirms that Fadama farming is a potential vehicle capable of taking people away from poverty to prosperity. Major crops planted are okra, Amaranthus spp and C. olitorius. Maize is sparsely planted.

7.3. Soil Moisture Assessment

a. Soil saturation: When all the pores of a given soil are filled with water. Soil rarely remains saturated once watering (rain or irrigation) stops because gravitational water percolates (drains) down to deeper soil strata.

b. Gravitational water: The water that will drain from a saturated soil if no additional water is added. This water is not available for plant growth.

c. 100% of field capacity: The point reached when no additional gravitational water drains from a previously saturated soil. At 100% field capacity the largest pores of the soil structure (macropores) have been drained of water and replaced with air, while micropores still retain water. This water is available to plants, which have the ability to move water against gravity due to the upward pulling force produced by transpiration. At field capacity, an improved soil retains the maximum amount of water available to plants, as well as optimal air space for aerobic microbial activity and plant growth.

d. 50% of field capacity: The amount of water remaining in the soil when 1/2 of the water held in the soil at field capacity has evaporated, drained, and/or has been transpired by growing plants; 50%–60% of field capacity in the root zone of the crop is the soil moisture level at which most crops should be irrigated

e. Permanent wilting point (PWP): The point at which soil moisture has been reduced to where the plant cannot absorb it fast enough to grow or stay alive

f. Plant available water (PAW): The water content held in the soil between field capacity and permanent wilting point that is available for uptake by plants

g. Soil water potential: The amount of energy required to remove water from the soil. This measurement increases as soils dry, which then increases the possibility of transpiration rates exceeding the rate of uptake, leading to plant stress.

h. Management allowable depletion (MAD): Maximum amount of soil water the irrigation manager allows the crop to extract from the active rooting zone between irrigations. This amount can vary with crop, stage of growth, potential for rainfall, and the soil's water holding capacity.

2.4. Determining When to Irrigate and How Much Water to Apply

1. Measuring soil moisture by feel: A qualitative approach

   a) Measuring soil moisture by feel includes learning how to judge soil moisture by forming soil into a cast or ball, and by "ribboning" soil (see Appendix 4 and the NRCS publication Estimating Soil Moisture by Feel and Appearance noted in the Resources). This takes practice! Knowing the percent of soil moisture present can help determine whether irrigation is needed.

   b) Shovels, trowels, and soil augers can be used to obtain soil samples to a depth of up to 12 inches in the crop root zone for accurate moisture assessment.

2. Considerations for determining irrigation scheduling using the "feel" approach

   a) The "feel" method is more commonly used by irrigation managers in garden and small farm systems as a low-tech, low-cost way to assess irrigation needs in diverse cropping systems

b) Irrigation managers must be familiar with soil type and appropriate methods of soil moisture assessment to make accurate irrigation scheduling decisions

c) The "feel" approach to irrigation management requires a high level of intuition and experience, and an extensive knowledge of the specific requirements of the various crops being irrigated. Once understood, it can be a quick decision-making tool.

d) In deciding when and how much to irrigate, the irrigation manager must take into account a variety of factors in addition to soil moisture, including crop needs, and timing of harvest as well as weed management operations to determine an optimum application time and rate

3. Determining irrigation scheduling using the water budget approach

a) Water budgeting is often compared to managing a savings account: The starting point is field capacity (see definitions, above), and as water is removed and the "savings balance" drops, it is replaced as needed by the crop. Water budgeting is a quantitative approach using existing models that analyze temperature and crop water use to determine evapotranspiration (ET) rates. Growers use these models to determine irrigation timing and amounts.

b) When seasonal ET exceeds precipitation, irrigation is required to sustain planted crops

c) Resources for determining regional average ET (e.g., CIMIS; see Resources section); you can use this regional average when determining a water budget.

d) Replacing estimated water loss through ET with calibrated irrigation systems i. Once the ET rate of your site is determined, this estimated volume of water may be replaced through the use of calibrated irrigation systems that deliver water at a known rate and volume. The Hands-on Exercises in this unit offer examples of how to calculate the irrigation time and frequency required to replace water with a calibrated irrigation system.

e) Irrigation scheduling in different systems based on water budgeting approach i. Once the evapotranspiration rate for a crop in full canopy (in gallons/week) and the water delivery rates (in gallons/hour) of the irrigation system are estimated, the amount of time required to replace water lost may be calculated (see Hands-On Exercises). This calculation will provide the total number of hours required to replace the water lost through evapotranspiration. (An additional 10% should be calculated in to compensate for delivery system inefficiencies.) ii. The frequency of irrigation should correspond to the time period required for the soil in the root zone of the crop to dry to approximately 50% of field capacity. Due to shallow root systems and greater susceptibility to water stress, annual crop culture often requires a higher frequency of irrigation (2–3 times/week for many crops). iii. Established orchards, which have deep root systems and are less susceptible to water stress, often require less frequent but larger volumes of water to be delivered in each irrigation. In both situations the estimated amount of water lost through ET is replaced as needed to maintain the health of the crop.

f) Once a decision is made to irrigate, and a volume is determined, the timing of the water application must take into account timing of future harvest and weed management operations

g) Disadvantages: Water budget approach is not easy to apply to small, diverse systems.

h) Advantages: Water budget approach can be an effective tool to increase water use efficiency

4. Determining irrigation scheduling using tension meters and other soil

a) As the cost of simple soil moisture sensors drops, many growers are beginning to incorporate these instruments in their systems to monitor soil moisture levels. Such devices provide site-specific data points that may be more accurate than CIMIS data and can be used in combination with other techniques to inform irrigation decisions.

I. Soil tension meters and Electrical Resistance Sensing Devices (ERSDs) are the instruments most commonly used to measure soil moisture on California's Central Coast farms. Both must be carefully installed directly in the wetted area of the crop's root zone at a number of sites throughout the field for accurate monitoring (see Supplement 3 for details).

II. Soil moisture sensors are often used in pairs at different depths, e.g., at 6 and 12 inches deep, to provide the irrigator with information on below-ground moisture dynamics

III. Tension meters and ERSDs provide soil/water tension readings that can be used to establish irrigation schedules adequate to maintain soil moisture at levels conducive to good crop growth and productivity 5. Other factors to consider when determining whether irrigation is needed a) how do the plants look? See above for list of general signs of water stress. b) Weather patterns: E.g., a crop may look stressed at midday, but knowing that the weather will cool overnight and be foggy in the morning may mean that irrigation is not immediately required. Therefore observing the crops throughout the day is important. c) After a cool period, the first hot day may trigger plants to look stressed, but in fact they may not need irrigation d) Soil type: Soil type and organic matter levels will determine in part how the soil holds water (see the NRCS reference *Estimating Soil Moisture by Feel and Appearance* in References) e) Type of crop: Different crops, different needs (Appendix 7, Irrigation for Various Vegetable Crops) f) Stage of development: Some crops benefit from being slightly water stressed early in their growth cycle (e.g., tomatoes, beans, cucumbers and other cucurbits), or do not need irrigation once the plants begin to die back (e.g., potatoes). Others, particularly small-seeded crops such as lettuce and carrots, require that soils be kept moist in order to germinate effectively. g) Optimal moisture for harvest: It is critical to maintain full turgor for leafy crops and cut flowers, particularly if they will not immediately go into a cooler or receive some form of hydro cooling, as is done with brassicas and similar crops (see more at C. Factors Influencing Frequency and Volume of Irrigation, above)

7.4.Problems with over applying Water

a) In many areas, fresh water is a limited resource. Irrigation practices that optimize the available supply are critical.

b) The energy and environmental costs involved in transferring water and "lifting" it to irrigation systems via pumps, etc., can be significant

Irrigation is the artificial application of water to the soil or plant, in the required quantity and at the time needed, is a risk management tool for agricultural production. The risk of yield reduction due to drought is minimized with irrigation. Irrigation is widely carried out through surface, sub-surface and pressurized systems, characterized by the mode of transport of the water onto the point of application. (Kay, 2001) When water is applied on the surface, a considerable amount is lost through evaporation, run off and deep percolation making it less efficient. Field application efficiency in most traditional irrigation methods is still very low, typically less than 50 % (sprinkler irrigation) and often as low as 30 % (surface irrigation). (Mansour,H.A, YousifEl-Melhem ,impactth E, 2013) Excessive application of water generally entails losses because of surface run-off from the field and deep percolation below the root zone within the field. Both run-off and deep percolation losses are difficult to control under furrow irrigation system, where a large volume of water is applied at a single instance. An alternative water application method such as the drip irrigation method allow for much more uniform distribution as well as more precise control of the amount of water applied and also decreases nutrient leaching (Asenso, 2011)

7.5.**Drip irrigation** is defined as "the slow, frequent application of small volumes of irrigation water to the base or root zone of plants" (Smeal, 2007). More widespread adoption of this technology in recent years began in the late 1960s to early 1970s. Drip irrigation also commonly referred to as micro-Irrigation, trickle irrigation, low volume irrigation or xerigation. This is a method of irrigation which efficiently delivers water to the soil surface or the root zone; this is done by having water drip slowly from emission devices, most commonly called "drip emitters"

Drip irrigation is quickly becoming the standard irrigation method for many applications such as home gardens and landscapes, greenhouses, vineyards, row crops and orchards. The technology and materials have seen some significant changes throughout the years, but the basic concepts have generally remained constant.

Advantages of drip irrigation system include: less water loss, reduction in weed growth, less labour requirements, minimal evaporation compared to other watering methods, less usage of fertilizer, reduced soil erosion, equitable water distribution and higher crop production.

Disadvantages of this technology are minimal when compared to the advantages of this system. Some of these include: clogging of drip holes, high initial cost, algae growth and easy damage to drip lines

Field application efficiency in most traditional irrigation methods is still very low, typically less than 50 % (sprinkler irrigation) and often as low as 30 % (surface irrigation) (Molden *et al.* 1998). Excessive application of water generally entails losses because of surface run-off from the field and deep percolation below the root zone within the field. Both run-off and deep percolation losses are difficult to control under furrow irrigation system, where a large volume of water is applied at a single instance (Asenso, 2011).

An alternative water application method such as the drip irrigation method allow for much more uniform distribution as well as more precise control of the amount of water applied and also decreases nutrient leaching. (A A. A., 2009)

Small-scale agriculture is the production of crops and livestock on a small-piece of land without using advanced and expensive technologies. Though the definition of size of these farms is a source of debate, it can be argued that farming on family pieces of land, on traditional lands and smallholdings on the periphery of urban areas, fall in this category. This type of farming is usually characterized by intensive labor and in most cases, animal traction, limited use of agrochemicals and supply to the local or surrounding markets. Unlike large-scale commercial agriculture, it plays a dual role of being a source of household food security as well as income from sale of surplus. Although some claim small-scale agriculture is less efficient in output as compared to commercial agriculture. (Asolkar, P.S and Bhadade,, ,Feb. 2015) It is ecologically friendly in that less land is cleared for cultivation, there are less emissions due to less use of fuel-driven machinery and the market is usually local implying less carbon miles. On the other hand permaculturalists and others claim that per unit of area small-scale agriculture is far more productive than commercial agriculture in terms of total output from the piece of land. Economically, small scale agriculture enhances local economic development as it is a source of employment and keeps most of the income local as the market is predominantly localized. Socially, especially on traditional lands, the produce is first meant to feed the household thereby contributing to food security (Kutya, 2016)

It is inconvenient for farmers to walk all the way to their fields at night just to switch the pump motor 'off.' Besides, he may never get to know the problem. This problem can be solved by using this GSM-based system that will automatically give the user a call on his mobile phone when the water level in the Bore well drops below or rises to the threshold level for pumping. The user can also remotely 'switch on' or 'switch off' the pump motor by sending a SMS from mobile phone.

The network consists of sensing stations & a weather station. Each of the sensing station contained data logger, a soil temperature sensor & GSM communication. The development is based on microcontrollers & communication technologies, it can improve the current methods of monitoring to support the response in real time. The aim of implementation was to demonstrate that the water deployment system can be used to reduce water use. The soil moisture & temperature sensors deployed in plant root zones. The sensor measurements are transmitted to a microcontroller based receiver. This gateway permits the automated activation of irrigation when the threshold values of soil moisture & temperature are reached. The communication between the sensor nodes & data receiver is via GSM module. GSM module is the new wireless technology it uses 2.4 GHz frequency band with having IEEE 802.15.4a protocol. When we are receiving this information from the wireless sensor network we want to monitor the parameters & control this parameter wirelessly form remote station. It is possible that the internet connection allows the data inspection in real time on a website, where soil moisture & temperature levels are displayed through an application interface & store in database server.

7.6. GSM module

When a field is in the dry condition, the sensing logic senses the state of the field and intimates it to the microcontroller. It in response makes the motor on. We can know the status of the field by sending a message to the GSM modem which is placed at the field. Through our mobile we can switch on-off the motor by sending the respective commands to the kit through the GSM modem. Thus the irrigation motor can be controlled through our mobiles using GSM technology.

Therefore when a current flows through the coil, the resulting magnetic field attracts an armature that is mechanically linked to a moving contact. The movement either makes or breaks a connection with a fixed contact. When the current to the coil is switched off, the armature is returned by a force approximately half as strong as the magnetic force to its relaxed position. Usually this is a spring, but gravity is also used commonly in industrial motor starters. Most relays are manufactured to operate quickly. In a low voltage application, this is to reduce noise. In a high voltage or high current application, this is to reduce arcing.

7.7.LCD (Liquid Crystal Display): Display takes varying amounts of time to accomplish the functions as listed. LCD bit 7 is monitored for logic high (busy) to ensure the display is overwritten. A slightly more complicated LCD display (4 lines*40 characters) is currently being used in medical diagnostic systems to run a very similar program.

These project is been tested with a greenhouse to verify the working principle of the project. Maize is planted in the green house.

N. G. Shah & I. Das developed a system for precision irrigation using sensor network mainly aimed for monitoring soil moisture and estimating evapotranspiration by considering soil moisture, soil temperature and relative humidity as parameters for measurement. The objectives of the system were to provide precision agriculture and irrigation, to increase the agricultural production, to provide precise monitoring system and to use resources at the fullest extends so as to give efficient system. The system was analyzed for 3-4 months for calculating evapotranspiration rate. For more precise results, the system should be analyzed for 3-4 seasons. Some of the researchers developed a remote monitoring system in agricultural greenhouse using wireless sensor and short message service (SMS). The system was applied to strawberry farm and has capability to measure different levels of temperature and thus providing the necessary information to the farmers so that early precaution steps can be taken. System was divided into four parts namely data acquisition, data communication, data presentation and alert notification which also allowed the reverse communication i.e. from farmer side to the base station. The system was cost effective and reliable. The system can be made more effective by considering other environmental parameters and by using recent technologies such as artificial intelligence, neural network, etc.

CHAPTER THREE

METHODOLOGY

In the existing system farmers have to travel to fields often at odd hours just to switch ON/OFF the motor due to erratic power supply. Existing aids like auto starters are unreliable and incapable of communicating the operating state of the motor, to the farmer, especially when a farmer has more than one motor pump set; he has to run around to make sure that all the motor pumps are working when the power is available. At times, motor pumps are left running for longer than what is necessary because of the effort involved in switching OFF the motor. This leads to wastage of both electricity and water.

The connections between the two mobiles are done using GSM. The GSM module and microcontroller are connected using UART (universal asynchronous receiver / transmitter). When the moisture sensor senses the low moisture content of the soil, it gives a signal to the microcontroller. The microcontroller then gives a signal to the called mobile (which is kept in the auto answering mode). The called mobile activates the buzzer.

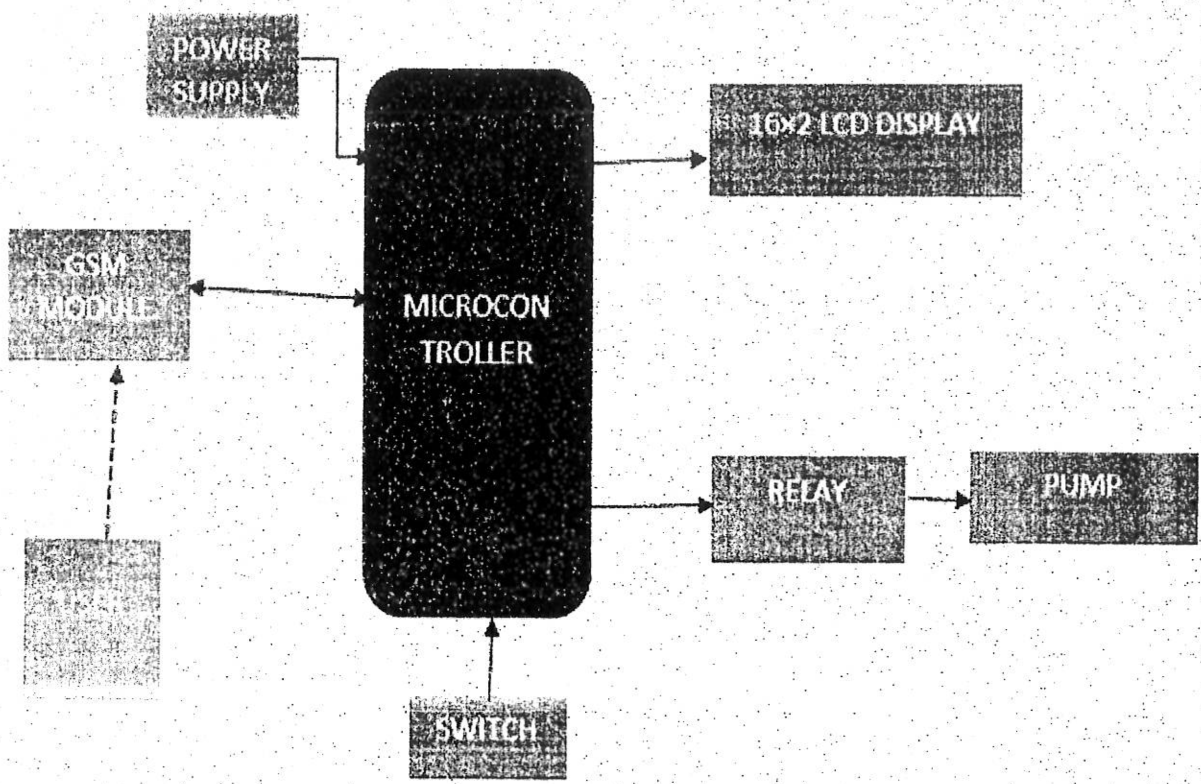


Figure 3.0: block diagram of Design and Implementation of a GSM Based Irrigation Automation System

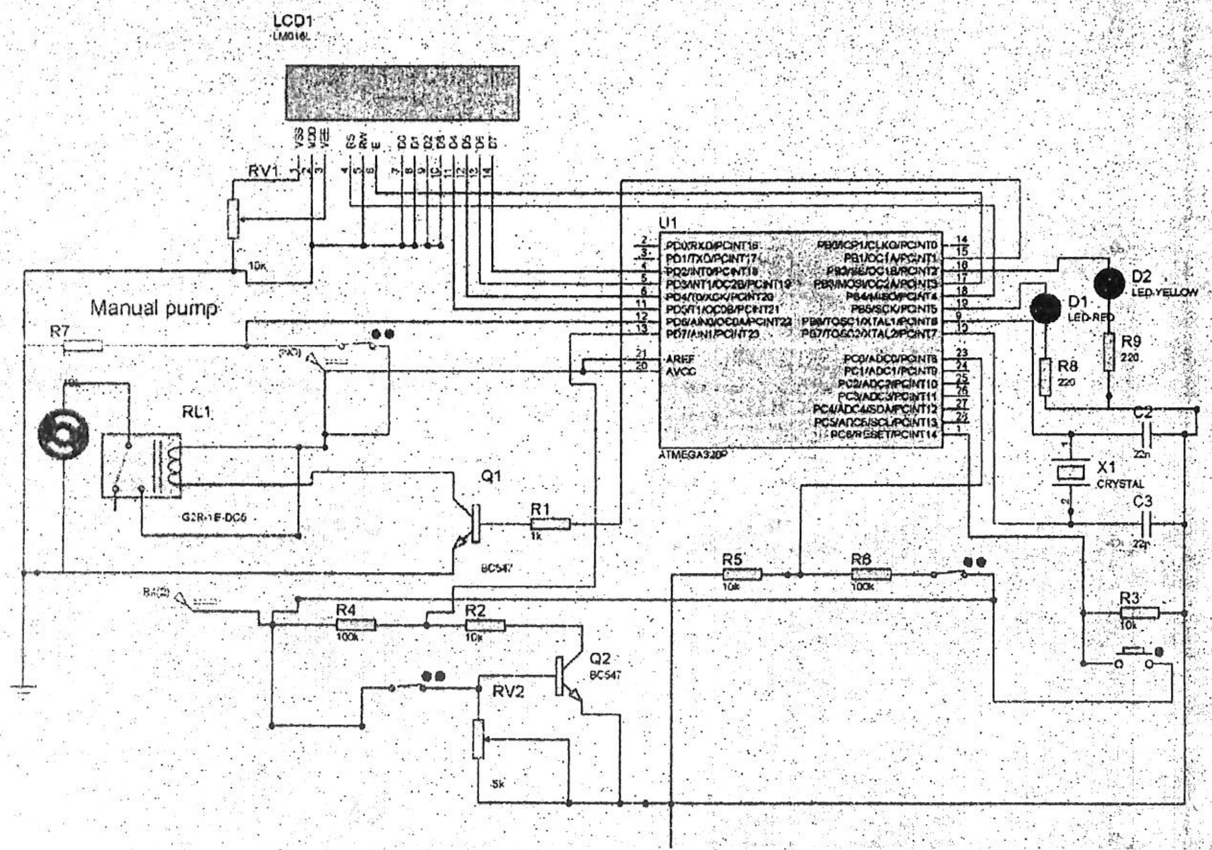


Figure3.2: Circuit Diagram of Design and Implementation of a GSM Based Irrigation Automation System

Therefore when calling mobile calls, its indicating the valve needs to be open. By pressing the button in the called function, the signal is given back to the microcontroller. The microcontroller gives signal to the valves which causes it to get open. The water is given to the root of the plant drop by drop, and when the moisture content becomes sufficient, the sensor senses this and gives back the signal microcontroller. Then by pressing the button in the calling function again, the valve is made off. The power supply needed by the controlling system is +5V. The entire unit is as shown in figure above. The only extra devices attached are line driver chips capable of transforming the TTL level signals to line voltages and vice versa. The Atmel AVR core combines a rich instruction set with 32 general purpose working registers. All the 32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in a single instruction executed in one clock cycle. The resulting architecture is more code efficient while achieving throughputs up to ten times faster than conventional CISC microcontrollers.

The ATmega328/P provides the following features: 32Kbytes of In-System Programmable Flash with Read-While-Write capabilities, 1Kbytes EEPROM, 2Kbytes SRAM, 23 general purpose I/O lines, 32 general purpose working registers, Real Time Counter (RTC), three flexible Timer/Counters with compare modes and PWM, 1 serial programmable USARTs , 1 byte-oriented 2-wire Serial Interface (I2C), a 6-channel 10-bit ADC (8 channels in TQFP and QFN/MLF packages) , a programmable Watchdog Timer with internal Oscillator, an SPI serial port, and six software selectable power saving modes. The Idle mode stops the CPU while allowing the SRAM, Timer/Counters, SPI port, and interrupt system to continue functioning. The Power-down mode saves the register contents but freezes the Oscillator, disabling all other chip functions until the next interrupt or hardware reset. In Power-save mode, the asynchronous timer continues to run, allowing the user to maintain a timer base while the rest of the device is sleeping. The ADC Noise Reduction mode stops the CPU and all I/O modules except asynchronous timer and ADC to minimize switching noise during ADC conversions. In Standby mode, the crystal/resonator oscillator is running while the rest of the device is sleeping. This allows very fast start-up combined with low power consumption. In Extended Standby mode, both the main oscillator and the asynchronous timer continue to run. Atmel offers the Q Touch library for embedding capacitive touch buttons, sliders and wheels functionality into AVR microcontrollers. The patented charge-transfer signal acquisition offers robust sensing and includes fully de-bounced reporting of touch keys and includes Adjacent Key Suppression technology for unambiguous detection of key events. The easy-to-use Q Touch Suite tool chain allows you to explore, develop and debug your own touch applications. The device is manufactured using Atmel's high density non-volatile memory technology. The On-chip ISP Flash allows the program memory to be reprogrammed In-System through an SPI serial interface, by a conventional nonvolatile memory programmer, or by an On-chip Boot program running on the AVR core.

The Boot program can use any interface to download the application program in the Application Flash memory. Software in the Boot Flash section will continue to run while the Application Flash section is updated, providing true Read-While-Write operation. By combining an 8-bit RISC CPU with In-System Self-Programmable Flash on a monolithic chip, the Atmel ATmega328/P is a powerful microcontroller that provides a highly flexible and cost effective solution to many embedded control applications.

The ATmega328 is supported with a full suite of program and system development tools including: C, Compilers, Macro Assemblers, and Program Debugger/Simulators, In-Circuit Emulators, and Evaluation kits.

3.0. **Pin Descriptions**

I. **VCC**

Digital supply voltage.

II. **GND**

Ground.

III. **Port B (PB [7:0]) XTAL1/XTAL2/TOSC1/TOSC2**

Port B is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit).

The Port B output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port B pins that are externally pulled low will source current if the pull-up resistors are activated.

The PortB pins are tri-stated when a reset condition becomes active, even if the clock is not running.

Port C (PC[5:0])

Port C is a 7-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The PC[5:0] output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port C pins that are externally pulled low will source current if the pull-up resistors are activated. The Port C pins are tri-stated when a reset condition becomes active, even if the clock is not running.

IV. **PC6/RESET**

If the RSTDISBL Fuse is programmed, PC6 is used as an I/O pin. Note that the electrical characteristics of PC6 differ from those of the other pins of Port C. If the RSTDISBL Fuse is programmed, PC6 is used as a Reset input. A low level on this pin for longer than the minimum pulse length will generate a Reset, even if the clock is not running. Shorter pulses are not guaranteed to generate a Reset.

The various special features of Port C, are elaborated in the Alternate Functions of Port C section.

V. **Port D (PD[7:0])**

Port D is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port D output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port D pins that are externally pulled low will source current if the pull-up resistors are activated. The Port D pins are tri-stated when a reset condition becomes active, even if the clock is not running.

VI. AVCC is the supply voltage pin for the A/D Converter, PC [3:0], and PE [3:2]. It should be externally connected to VCC, even if the ADC is not used. If the ADC is used, it should be connected to VCC through a low-pass filter. Note that PC [6:4] use digital supply voltage, VCC.

VII. **AREF**

AREF is the analog reference pin for the A/D Converter.

VIII. **ADC [7:6] (TQFP and VFQFN Package Only)**

In the TQFP and VFQFN package, ADC[7:6] serve as analog inputs to the A/D converter. These pins are powered from the analog supply and serve as 10-bit ADC channels.

SOFTWARE USED

3.1. Proteus Design Suite

The Proteus Design Suite is a proprietary software tool suite used primarily for electronic design automation. The software is used mainly by electronic design engineers and technicians to create schematics and electronic prints for manufacturing printed circuit boards.

It was developed in Yorkshire, England by Lab center Electronics Ltd and is available in English, French, Spanish and Chinese

The first version of what is now the Proteus Design Suite was called PC-B and was written by the company chairman, John Jameson, for DOS in 1988. Schematic Capture support followed in 1990, with a port to the Windows environment shortly thereafter. Mixed mode SPICE Simulation was first integrated into Proteus in 1996 and microcontroller simulation then arrived in Proteus in 1998. Shape based auto routing was added in 2002 and 2006 saw another major product update with 3D Board Visualization. More recently, a dedicated IDE for simulation was added in 2011 and MCAD import/export was included in 2015. Feature led product releases are typically biannual, while maintenance based service packs are released as required. The Proteus Design Suite is a Windows application for schematic capture, simulation, and PCB layout design. It can be purchased in many configurations, depending on the size of designs being produced and the requirements for microcontroller simulation. All PCB Design products include an auto-router and basic mixed mode SPICE simulation capabilities Schematic capture in the Proteus Design Suite is used for both the simulation of designs and as the design phase of a PCB layout project. It is therefore a core component and is included with all product configurations.

3.2. Arduino

Open-source hardware shares much of the principles and approach of free and open-source software. In particular, we believe that people should be able to study our hardware to understand how it works, make changes to it, and share those changes. To facilitate this, we release all of the original design files (Eagle CAD) for the Arduino hardware. These files are licensed under a Creative Commons Attribution Share-Alike license, which allows for both personal and commercial derivative works, as long as they credit Arduino and release their designs under the same license. The Arduino software is also open-source. The source code for the Java environment is released under the GPL and the C/C++ microcontroller libraries are under the LGPL.

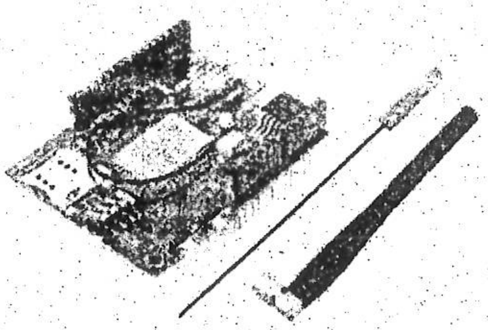
You can buy an Arduino board from the official store online or from one of the distributors listed on this page. If you'd prefer to build your own, see the Arduino Single-Sided Serial board, which can be easily etched and assembled.

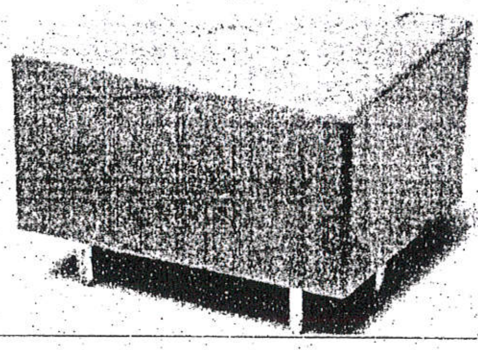
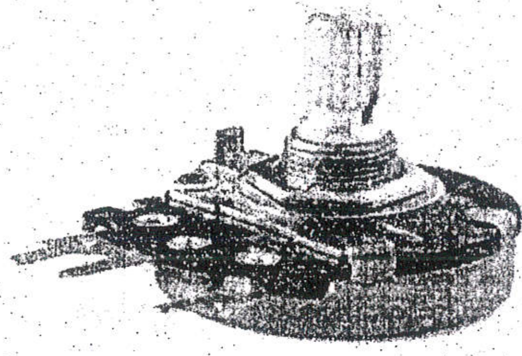
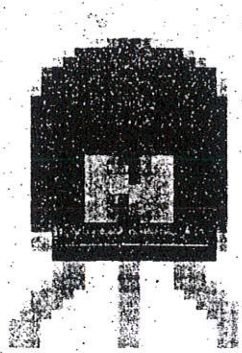
The official Arduino boards are the ones listed on the product page. These are boards whose manufacturers work with the Arduino team to ensure a good user experience, compatibility with the Arduino software, and a quality product. In return for their status as official boards, the manufacturers pay a licensing fee to the Arduino team to support the further development of the project.

3.2.1. Arduino Software

The Arduino language is merely a set of C/C++ functions that can be called from your code. Your sketch undergoes minor changes (e.g. automatic generation of function prototypes) and then is passed directly to a C/C++ compiler (avr-g++). All standard C and C++ constructs supported by avr-g++ should work in Arduino. For more details, see the page on the Arduino build process.

3.3. MATERIALS USED

S/n	Name of component	Diagram	function
1	GPRS A6 Serial GPRS / GSM Module GPRS Pro Serial A6 GPRS GSM Module Core DIY Development Board		This is professional version serial GSM / GPRS core development board based on GPRS A6 module. It supports dual-band GSM/GPRS network, available for GPRS and SMS message data remote transmission.
2	AC 220V 3W EU Plug Submersible Water Pump		It's submersible water pump whether in fresh water saltwater. Flow rate is adjustable with knob in front of the pump. With 2 suction cups at the bottom and to be used in water only
3	**Push button switch**		a switch is an electronic electronics, a switch is an electrical component that can break an electric circuit, interrupting the current or diverting it from one conductor to another.

4	**LED**		Led's are connect to the ports of microcontroller by using transistors and resisters. Led's are glow from external supply instead of microcontroller
5	RELAYS		is an electromagnetic device which is used to isolate two circuits electrically and connect them magnetically
6	**POTENTIOMETER**		Is a three-terminal resistor with a sliding or rotating contact that forms an adjustable voltage divider, If only two terminals are used, one end and the wiper, it acts as a variable resistor or rheostat.
7	**TRANSISTORS**		A Transistor is a semiconductor device used to amplify and switch electronic signals and electrical power. Transistors works wonderfully for computer production. With smart engineering, Transistors help computers power through huge numbers of calculations in a short time

	LCD DISPLAY		To generate any desired character that can be formed using a dot matrix. To distinguish between these two data areas, the hex command byte 80 will be used to signify that the display RAM address 00h will be chosen Port1 is used to furnish the command or data type, and ports 3.2 to 3.4 furnish register select and read/write levels.

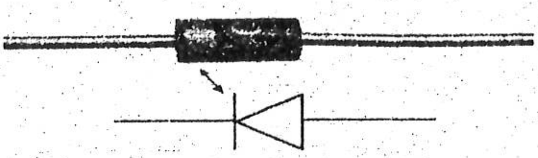
DIODES		A Diode is a semiconductor device, which allows the current to flow easily in one direction, and provides a very high resistance when the current flows in the reverse direction. The direction in which current flow easily, with little resistance, is called forward direction and the opposing direction is called reverse direction.
ATmega328		The Atmel AVR core combines a rich instruction set with 32 general purpose working registers. All the 32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in a single instruction executed in one clock cycle. The resulting architecture is more code efficient while achieving throughputs up to ten times faster than conventional CISC microcontrollers.

Table: materials used

CHAPTER FOUR

RESULTS AND DISCUSSIONS

The system is design to irrigate a farmland with respect to the control given by the user, the simulation below shows the process how it done. The soil moisture sensor start by giving the report on the moisture condition of the land at the particular time, wet soil will be more conductive than dry soil. The soil moisture sensor module has a comparator in it.

The voltage from the prongs and the predefined voltage are compared and the output of the comparator is high only when the soil condition is dry.

This output from the soil moisture sensor is given to the analogue input pin (Pin 2 – RA0) of the microcontroller. The microcontroller continuously monitors the analogue input pin.

When the moisture in the soil is above the threshold, the microcontroller displays a message mentioning the same and the motor is off.

When the output from the soil moisture sensor is high i.e. the moisture of the soil is less. This will trigger the microcontroller and displays an appropriate message on the LCD and the output of the microcontroller, which is connected to the base of the transistor is high.

When the transistor is turned on, the relay coil gets energized and turns on the motor. The LED is also turned on and acts as an indicator.

When the moisture of the soil reaches the threshold value, the output of the soil moisture sensor send a signal to the controller which make it to send messages to the user so as to send a control to the system, and message received by the user makes the motor turn off.

As soon as the system is power on, it gives a display on the LCD as show in the diagram below from simulation

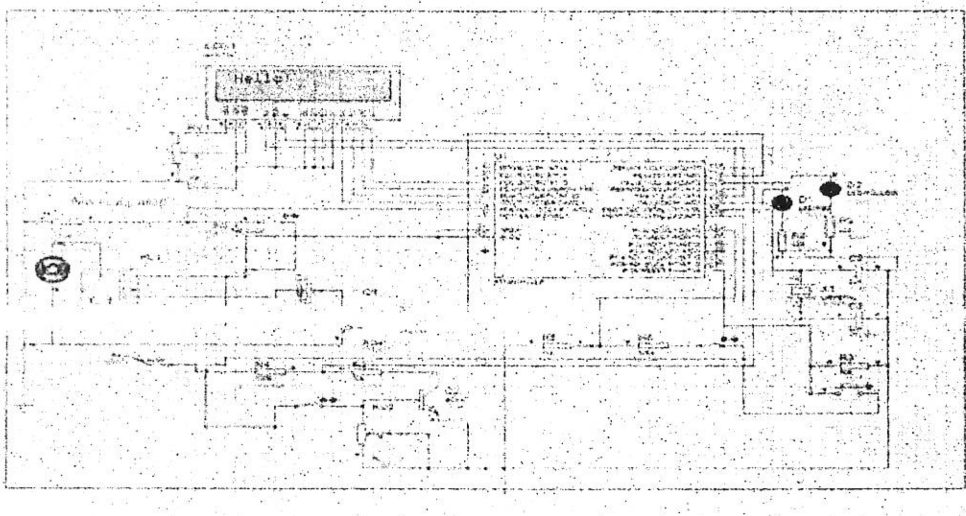


Figure 4.1: simulation result 1

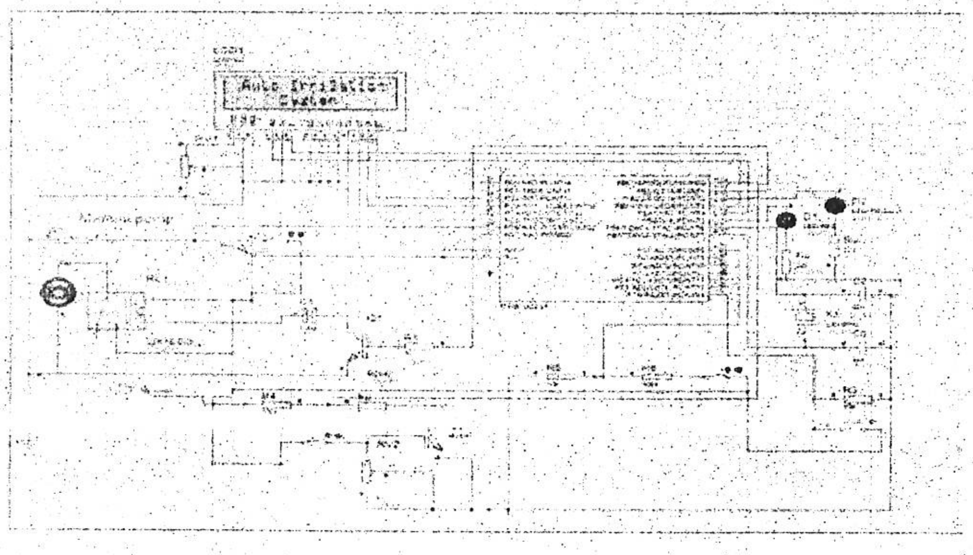


Figure 4.2: simulation result 2

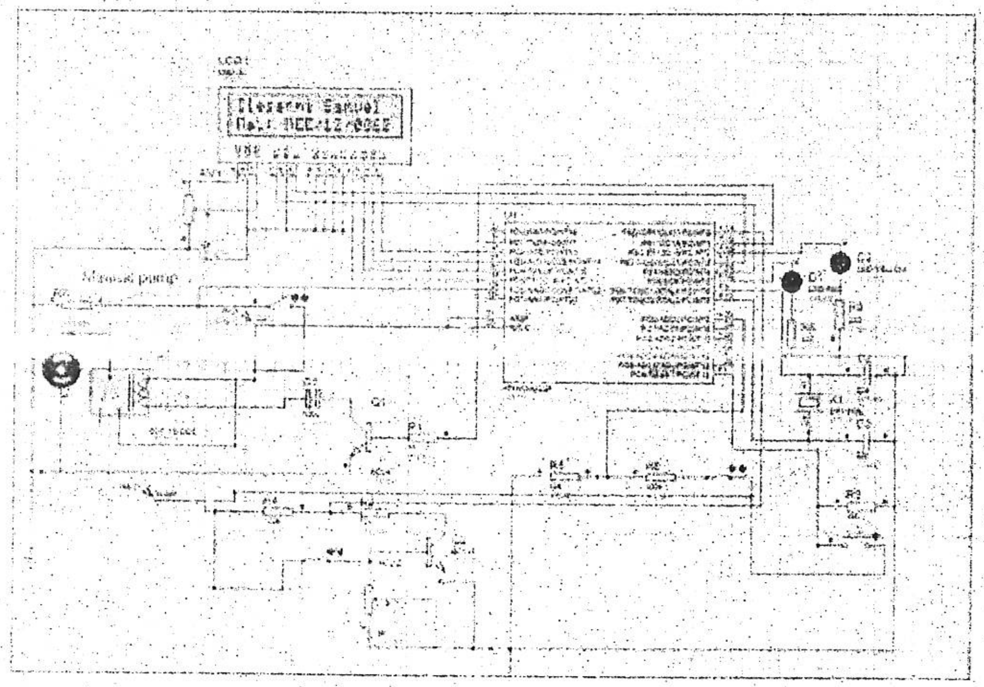


Figure 4.3: simulation result 3

Then soil moisture sensor will send a signal to LCD to state the present condition of the soil maybe water is needed or not to carefully acknowledge the present state, whereby if the present state of the land is dry it sends signals to the controller to let the GSM module opt for a a request from the user in messaging or calling. The system use calling at initial to let the user know that water is needed as a matter of urgent, if the user was unable to get the call it now then sends a message to the user.

The message that will be send to the user is show below;

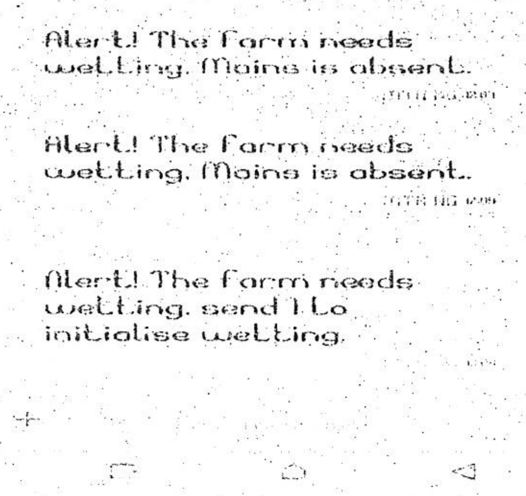


Figure 4.4: simulation result 4

Therefore the response of the user will control the system, if the user send 1 as show Above the system will wet the land and as soon as the soil moisture discovered that the soil moisture is in good condition it will send another message to the user for control the system to stop the wetting and as soon as the user send a response message to stop the pump to the system, the pump stop immediately.

Also if at initial the soil moisture is good then the system remain in waiting mode till the sensor sense dryness.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

Irrigation has been the backbone of human civilization since man has started agriculture. As the generation evolved, man developed many methods of irrigation to supply water to the land. In the present scenario on conservation of water is of high importance. Present work is attempts to save the natural resources available for human kind. By continuously monitoring the status of the soil, we can control the flow of water and thereby reduce the wastage. By knowing the status of moisture and temperature through GSM with the use of moisture and temperature sensors, water flow can be controlled by just sending a message from our mobile. Conservation of water and labor: Since the systems are automatic, they do not require continuous monitoring by labor. System and operational flexibility: As desired, any valve can be controlled along with the pump and increases the efficiency of water use. If water is stored in tanks at irrigation lands, one can get the status of the status of the water level, temperature sensor and moisture content in soil through SMS generator by microcontroller present at the irrigation land. The design is low power, low cost, small size, robust and highly versatile. Thus, this system avoids over irrigation, under irrigation, top soil erosion and reduce the wastage of water. The main advantage is that the system's action can be changed according to the situation (crops, weather conditions, soil etc.). By implementing this system, agricultural, horticultural lands, parks, gardens, golf courses can be irrigated. Thus, this system is cheaper and efficient when compared to other type of automation system.

I recommend these project for further research on the amount of water required for each plant. In large scale applications, high sensitivity sensors can be implemented whereby a study can be conducted to know a typical sensor useful for a particular large areas of agricultural lands. A stand by battery or solar cells can be implemented for the module and the pump which comes into use in case of power cuts (cells). A secondary pump can be used in case of failure of the pump. Also a pump with higher efficiency can be used.

REFERENCES

Purnima, S.R.N Reddy,. (2012). *Design of Remote Monitoring andControl System with Automatic Irrigation System using GSMBluetooth.* IJCA.

A. (2012). Android OpenSourceProject.Google.Retrieved. *"Philosophy and Goals"*, 04-21.

A, A. A. (2009). Comparison among different irrigation systems for deficit-irrigated transgenic and non trangenicyellow corn in the Nile Valley". Agricultural Engineering International:. *the CIGR Ejournal. Manuscript LW 08 010.*, Vol. XI:1-25.

A., A. A. (2009). *Comparison among different irrigation systems for deficit-irrigated transgenic and non trangenicyellow corn in the Nile Valley.* Agricultural Engineering International: the CIGR Ejournal. Manuscript LW 08 010. Vol. XI:1-25.

Air Jiang, , Fu-Ming Lu, En-Cheng Yang, Zong-Siou Wu, Chia-Pang Chen, Shih-Hsiang Lin, Kuang-Chang Lin, Chih-Sheng Liao. (july 2008). *Conceptual model of a future farm management information system.* science direct: Air Jiang, Chwan-Lu Tseng, Fu-Ming Lu, En-Cheng Yang, Zong-Siou Wu, Chia-Pang Chen, Shih-Hsiang Lin, Kuang-Chang Lin, Chih-Sheng Liao,".

Air Jiang, Chwan-Lu Tseng, Fu-Ming Lu, En-Cheng Yang, Zong-Siou Wu, Chia-Pang Chen, Shih-Hsiang Lin, Kuang-Chang Lin, Chih-Sheng Liao,. (2004). Conceptual model of a future farm management information system. *sciencedirect, Computers and Electronics in Agriculture*, pg 79-88 .

Asenso, E. (2011). *DESIGN AND EVALUATION OF A SIMPLE PVC DRIP IRRIGATION.* Kumasi.

Asolkar, P.S and Bhadade,. (,Feb. 2015). "An Effective Method of Controlling the Greenhouse and Crop Monitoring Using GSM",. *,IEEE Conference on Computing Communication Control and Automation (ICCUBEA), Vol- 69*, (pp. ,pages 214 219,). U.S.

Benzekri, A. M. (July 2007). PC-based automation of a multi-mode control for an irrigation system. *Proceedings of International symposium on industrial embedded systems*, pp. 310-315.

Benzekri, A., Meghriche, K., and Refoufi, L. (July 2007). PC-based automation of a multi-mode control for an irrigation system. *Proceedings of International symposium on industrial embedded systems,*, pp. 310-315. .

C.B. Hedley, J.W. Knox, S.R. Raine, R. Smith,s. (2014). " Water: Advanced Irrigation Technologie. *sciencedirect,Encyclopedia of Agriculture and Food Systems*, Pages 378406 .

Daniel K.Fisher and HirutKebed e. (2010). a Low Cost Microcontroller-Based System to Monitor Crop Temperature and Water Status. pp. 168-173,.

Daniel K.Fisher and HirutKebede. (2006). a Low Cost Microcontroller-Based System to Monitor . pg 135- 144.

Eddahhak, A.; Lachhab, A.; Ezzine, L.; Bouchikhi, B. (2007). Performance evaluation of a developing greenhouse climate control with a computer system. *AMSE Journal Modelling C*, pp.53-64.

F, C. (2001). programmationet applications. *LabVIEW Dunod*, pp. 415.

Fangmeier, D. D. (1990.). "Automated irrigation systems using plant and soil sensors. *American Society of Agricultural Engineers, ASAE Publication,*, pp. 533-537..

G, W. (Nov 2011). Based on Atmega 16 ultrasonic distance gauge . "",*IEEE Conference Publications on Electrical and Control Engineering (ICECE)*, 4394 – 4397.

H, E. (2005). La conduiteet le pilotage de l'irrigationgoutte-àgoutte en maraîchage., . *Bulletin mensueld'informationet de liaison duprogramme national de transfert de technologie en agriculture (PNTTA)*, pp. 124.

H, E. (2005). La conduiteet le pilotage de l'irrigationgoutte-àgoutte en maraîchage. *Bulletin mensueld'informationet de liaison duprogramme national de transfert de technologie en agriculture (PNTTA)*, pp. 124.

Howell, T. (2001). Agron. *Enhancing water use efficiency in irrigated agriculture.*, , pp. 281-289.

Joe-Air Jiang, Chwan-Lu Tseng, Fu-Ming Lu, En-Cheng Yang, Zong-Siou Wu, Chia-Pang Chen, Shih-Hsiang Lin, Kuang-Chang Lin, Chih-Sheng Liao. (2008). A GSMbased remote wireless automatic monitoring system for field. *sciencedirect,Computers and Electronics in Agriculture*, (pp. pg 108 - 110). india.

Kay, M. (2001). "Prospects for sub-Saharan Africa" International Program for Technology and Research in Irrigation and Drainage. *Smallholder irrigation technology:* , pp. 1–25.

Kutya, L. (2016, March 10). *SANGONeT*. Retrieved from SANGONeT website: www.ngopulse.org/article/small-scale-agriculture

M. guerbaoui, y. el afou, a. ed-dahhak, a. (January 2013). *lachhabpc-based automated drip irrigation system.*

Mansour,H.A, YousifEl-Melhem ,impactth E. (2013). automatic control of closed circuits raingun irrigation system on yellow corn growth and yield. *International Journal of Advanced Research*, 33-42).

N. Shah and I. Das. (April 2008). Precision Irrigation Sensor Network Based Irrigation. *a book on Problems, Perspectives and Challenges of Agricultural Water Management*, pp. 217–232,.

Nguyen Tang Kha Duy and Nguyen Dinh Tu and Tra Hoang Son and Luong Hong Duy Khanh. (2005). Automated monitoring and control system for shrimp farms based on embedded system and wireless sensor network". *",Electrical, Computer and Communication Technologies (ICECCT)*, (pp. 90-82). chicago: ,.

S. Barrett. (2009.). Embedded System Design with the Atmel AVR Microcontroller:Part II. *[Online].Available:http://ieeexplore.ieee.org/xpl/articleDetails.jsp?*, 6814198.

Sezen SM, Y. A. (2010.). Irrigation Management on Yield And Quality Of Tomatoes Grown in different Soilless Media in Glasshouse, . 41-48,.

Shinghal, K., Noor, A., Srivastava, N., and Singh, R., . (2010). Wireless sensor networks in agriculture for potato farming. *International Journal of Engineering, Science and Technology,*, pp. 3955-3963.

VeenaDivyak, A. (May 2013)). *A Real time implementation of a GSM based Automated Irrigation Control System using drip Irrigation Methology* . (Volume 4, Issue 5,.

Webin Huang, Guanglong Wang. (2011.). Research of Wireless Sensor Networks for an Intelligent Measurement System Based on ARM, . 1074-1079.

Zhang, F., Yang, M., and Ying, H. (2004). The application of GSM communication in agricultural automation. *Journal of Technology for Agriculture*,, 39-41.

APPENDICES

CODES USED FOR PROGRAMING

```
#include <LiquidCrystal.h>
char phone_no[]="+2348068090635";

// initialize the library with the numbers of the interface pins
LiquidCrystal lcd(12, 11, 5, 4, 3, 2);

/// REGISTER SELECT PIN,ENABLE PIN,D4 PIN,D5 PIN, D6 PIN, D7 PIN
 int manual = 6;
 int soilsensor = 7;
int soilled =13;
 int pump = 9;
 int standby = 10;
int analogInput = 0;
float vout = 0.0;
float vin = 0.0;
float R1 = 100000.0; // resistance of R1 (100K) -see text!
float R2 = 10000.0; // resistance of R2 (10K) - see text!
int value = 0;


void setup() {
 Serial.begin(9600);
delay(2000);
pinMode(analogInput, INPUT);
  pinMode(manual, INPUT);
    pinMode(soilsensor, INPUT);
    pinMode(standby, OUTPUT);
      pinMode(soilled, OUTPUT);
```

```
digitalWrite(pump,LOW);
//digitalWrite(pumpon,LOW);
digitalWrite(soilled,LOW);
digitalWrite(standby,LOW);
}

void loop() {
int manualbt = digitalRead(manual);
int soilmoisture = digitalRead(soilsensor);
value = analogRead(analogInput);
vout =  value * (250.0 / 1024.0); // see text
vin = vout / (R2/(R1+R2));
if(manualbt ==HIGH){
lcd.setCursor(0,1);
lcd.print("Manual Mode        ");
delay(1000);

if (vin<24) {
lcd.setCursor(0,1);
lcd.print("MAINS ABSENT       ");
delay(1000);
digitalWrite(pump, LOW);
digitalWrite(soilled,HIGH);
delay(1000);
digitalWrite(soilled,LOW);
delay(1000);digitalWrite(soilled,HIGH);
delay(1000);
digitalWrite(soilled,LOW);
delay(1000);digitalWrite(soilled,HIGH);
delay(1000);
digitalWrite(soilled,LOW);
```

```
delay(1000);
vin=0.0;//statement to quash undesired reading !
} else{
lcd.setCursor(0,1);
lcd.print("MAINS PRESENT        ");
delay(2000);
lcd.setCursor(0, 1);
lcd.print("AC INPUT= ");
lcd.print(vin);
delay(2000);

int pumpmonitor =digitalRead(pump);
if(pumpmonitor == HIGH){

lcd.setCursor(0,1);
lcd.print("PUMP ON        ");
digitalWrite(pump, HIGH);
//digitalWrite(pumpon,HIGH);
digitalWrite(soilled,HIGH);
delay(1000);
digitalWrite(soilled,LOW);
delay(1000);digitalWrite(soilled,HIGH);
delay(1000);
digitalWrite(soilled,LOW);
delay(1000);digitalWrite(soilled,HIGH);
delay(1000);
digitalWrite(soilled,LOW);
delay(1000);
digitalWrite(standby,LOW);
}else{
lcd.setCursor(0,1);
```

```
lcd.print("Starting Pump>        ");
delay(2000);
lcd.setCursor(0,1);
lcd.print("Starting Pump>>       ");
delay(1000);
digitalWrite(pump, HIGH);
//digitalWrite(pumpon,HIGH);
}}}else{


//AUTOMATIC
if(soilmoisture ==LOW){
lcd.setCursor(0,1);
lcd.print("Plant is Wetted        ");
delay(1000);
digitalWrite(pump, LOW);
digitalWrite(soilled,LOW);
digitalWrite(standby,HIGH);
delay(1000);} else{
digitalWrite(soilled, HIGH);
lcd.setCursor(0,1);
lcd.print("Plant is Dry        ");
delay(1000);
digitalWrite(pump, LOW);
//digitalWrite(pumpon,LOW);

digitalWrite(standby,LOW);
delay(1000);
if (vin<24) {
lcd.setCursor(0,1);
lcd.print("MAINS ABSENT       ");
```

```
delay(1000);
  digitalWrite(pump, LOW);
digitalWrite(soilled, HIGH);
 vin=0.0;//statement to quash undesired reading !


} else {
  lcd.setCursor(0,1);
 lcd.print("MAINS PRESENT        ");
 delay(2000);
lcd.setCursor(0, 1);
lcd.print("AC INPUT= ");
lcd.print(vin);
delay(2000);
 //SMS
 lcd.setCursor(0,1);
lcd.print("Sending SMS.        ");
delay(2000);
 lcd.setCursor(0,1);
lcd.print("Sending SMS..       ");
delay(2000);
lcd.setCursor(0,1);
lcd.print("Sending SMS...      ");
delay(2000);
  lcd.setCursor(0,1);
lcd.print("Sending SMS....     ");
delay(2000);
lcd.setCursor(0,1);
lcd.print("Sending SMS.....    ");
delay(2000);
Serial.println("AT+CMGF=1");
```

```
delay(2000);
Serial.print("AT+CMGS=\"");
Serial.print(phone_no);
Serial.write(0x22);
Serial.write(0x0D);  // hex equivalent of Carraige return
Serial.write(0x0A);  // hex equivalent of newline
delay(2000);
Serial.print("Alert! MAINS is Present. The farm needs wetting, send 1 to initialise wetting.");
delay(500);
Serial.println (char(26));//the ASCII code of the ctrl+z is 26
delay(1000);
lcd.setCursor(0,1);
lcd.print("Message sent!       ");
delay(2000);
//RECEIVING MODE
Serial.println("AT+CMGF=1\r");
delay(2000);
Serial.println("AT+CNMI=2,2,0,0,0");
delay(2000);
lcd.setCursor(0,1);
lcd.print("Waiting.       ");
delay(1000);
lcd.setCursor(0,1);
lcd.print("Waiting..      ");
delay(1000);
lcd.setCursor(0,1);
lcd.print("Waiting...     ");
delay(1000);
lcd.setCursor(0,1);
lcd.print("Waiting....    ");
delay(1000);
```

```
  lcd.setCursor(0,1);
 lcd.print("Waiting.....       ");
 delay(1000);

boolean state =false;

   while (state == false)      //Nothing else will ever happen in the loop until state == true. This
allows you to wait for the button press
 {
 if (Serial.available()>0){
  switch(Serial.read())
 {
  case '1':
    digitalWrite(pump, HIGH);
    digitalWrite(soilled,HIGH);
 delay(1000);
  digitalWrite(soilled,LOW);
 delay(1000);
digitalWrite(soilled,HIGH);
delay(1000);
 digitalWrite(soilled,LOW);
delay(1000);
digitalWrite(soilled,HIGH);
delay(1000);
 digitalWrite(soilled,LOW);
delay(1000);
digitalWrite(standby,LOW);
  break;
delay(1000);

case '2':
```

```
if(soilmoisture ==LOW){
  lcd.setCursor(0,1);
 lcd.print("Plant is Wetted        ");
 delay(1000);
 digitalWrite(pump, LOW);
 digitalWrite(soilled,LOW);
 digitalWrite(standby,HIGH);
 delay(1000);
 //SMS
 lcd.setCursor(0,1);
lcd.print("Sending SMS.      ");
delay(2000);
 lcd.setCursor(0,1);
lcd.print("Sending SMS..      ");
delay(2000);
lcd.setCursor(0,1);
lcd.print("Sending SMS...      ");
delay(2000);
  lcd.setCursor(0,1);
lcd.print("Sending SMS....      ");
delay(2000);
lcd.setCursor(0,1);
lcd.print("Sending SMS.....      ");
delay(2000);
Serial.println("AT+CMGF=1");
delay(2000);
Serial.print("AT+CMGS=\"");
Serial.print(phone_no);
Serial.write(0x22);
Serial.write(0x0D);  // hex equivalent of Carraige return
Serial.write(0x0A);  // hex equivalent of newline
```

```
delay(2000);
Serial.print("Alert! Plant is wetted");
delay(500);
Serial.println (char(26));//the ASCII code of the ctrl+z is 26
delay(1000);
lcd.setCursor(0,1);
lcd.print("Message sent!       ");
delay(2000);


} else{
  digitalWrite(soilled, HIGH);
  lcd.setCursor(0,1);
lcd.print("Plant is Dry        ");
delay(1000);
digitalWrite(pump, LOW);
 //digitalWrite(pumpon,LOW);


digitalWrite(standby,LOW);
delay(1000);
if (vin<24) {
 lcd.setCursor(0,1);
lcd.print("MAINS ABSENT        ");
delay(1000);
 digitalWrite(pump, LOW);
digitalWrite(soilled, HIGH);
vin=0.0;//statement to quash undesired reading !
//SMS
lcd.setCursor(0,1);
lcd.print("Sending SMS.        ");
delay(2000);
```

```
lcd.setCursor(0,1);
lcd.print("Sending SMS..      ");
delay(2000);
lcd.setCursor(0,1);
lcd.print("Sending SMS...     ");
delay(2000);
lcd.setCursor(0,1);
lcd.print("Sending SMS....    ");
delay(2000);
lcd.setCursor(0,1);
lcd.print("Sending SMS.....   ");
delay(2000);
Serial.println("AT+CMGF=1");
delay(2000);
Serial.print("AT+CMGS=\"");
Serial.print(phone_no);
Serial.write(0x22);
Serial.write(0x0D); // hex equivalent of Carraige return
Serial.write(0x0A); // hex equivalent of newline
delay(2000);
Serial.print("Alert! MAINS is absent and the farm needs wetting");
delay(500);
Serial.println (char(26));//the ASCII code of the ctrl+z is 26
delay(1000);
lcd.setCursor(0,1);
lcd.print("Message sent!      ");
delay(2000);
//RECEIVING MODE
Serial.println("AT+CMGF=1\r");
delay(2000);
Serial.println("AT+CNMI=2,2,0,0,0");
```

```
delay(2000);
lcd.setCursor(0,1);
lcd.print("Waiting.       ");
delay(1000);
lcd.setCursor(0,1);
lcd.print("Waiting..      ");
delay(1000);
lcd.setCursor(0,1);
lcd.print("Waiting...     ");
delay(1000);
lcd.setCursor(0,1);
lcd.print("Waiting....    ");
delay(1000);
lcd.setCursor(0,1);
lcd.print("Waiting.....   ");
delay(1000);


} else{
lcd.setCursor(0,1);
lcd.print("MAINS PRESENT       ");
delay(2000);
lcd.setCursor(0, 1);
lcd.print("AC INPUT= ");
lcd.print(vin);
delay(2000);
//SMS
lcd.setCursor(0,1);
lcd.print("Sending SMS.       ");
delay(2000);
lcd.setCursor(0,1);
```

```
lcd.print("Sending SMS..       ");
delay(2000);
lcd.setCursor(0,1);
lcd.print("Sending SMS...      ");
delay(2000);
lcd.setCursor(0,1);
lcd.print("Sending SMS....     ");
delay(2000);
lcd.setCursor(0,1);
lcd.print("Sending SMS.....    ");
delay(2000);
Serial.println("AT+CMGF=1");
delay(2000);
Serial.print("AT+CMGS=\"");
Serial.print(phone_no);
Serial.write(0x22);
Serial.write(0x0D); // hex equivalent of Carraige return
Serial.write(0x0A); // hex equivalent of newline
delay(2000);
Serial.print("Alert! MAINS is Present. The farm needs wetting, send 1 to initialise wetting.");
delay(500);
Serial.println (char(26));//the ASCII code of the ctrl+z is 26
delay(1000);
lcd.setCursor(0,1);
lcd.print("Message sent!      ");
delay(2000);
//RECEIVING MODE
Serial.println("AT+CMGF=1\r");
delay(2000);
Serial.println("AT+CNMI=2,2,0,0,0");
delay(2000);
```

```
lcd.setCursor(0,1);
lcd.print("Waiting.      ");
delay(1000);
lcd.setCursor(0,1);
lcd.print("Waiting..      ");
delay(1000);
lcd.setCursor(0,1);
lcd.print("Waiting...      ");
delay(1000);
lcd.setCursor(0,1);
lcd.print("Waiting....      ");
delay(1000);
lcd.setCursor(0,1);
lcd.print("Waiting.....      ");
delay(1000);
break;

}
//Do all your I pressed a button stuff
state = true;          //The last thing you do after you do your press button stuff. Now the next time through the loop it will ignore this section and move on to the next which can
                       //be another while or if or whatever you want to happen while the state is true and you should be recording data. Just don't forget to check for your button
                       //in this section. Once you see the button again, do your stop stuff and set your state = false;
}
}

}}

}}}
```