

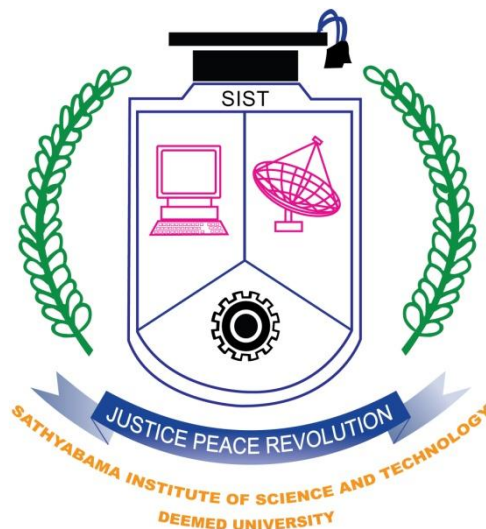
PRECISION AGRICULTURE USING WIRELESS SENSOR NETWORKS

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Engineering Degree in
Electrical and Electronics Engineering

by

PUNITHAVALLI R (Register No. 37140065)

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**DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
SCHOOL OF ELECTRICAL AND ELECTRONICS ENGINEERING**

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

**Accredited with Grade "A" by NAAC | 12B Status by UGC | Approved by
AICTE**

JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119

APRIL 2021



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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **PUNITHAVALLI R**(Reg. No. 37140065) and **UMAMAKESWARI M** (Reg. No. 37140090) who carried out the project entitled "**PRECISION AGRICULTURE USING WIRELESS SENSOR NETWORKS**" under our supervision from December 2020 to April 2021.

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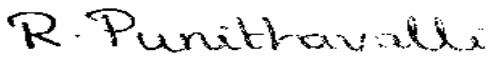
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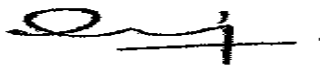
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DECLARATION

We **PUNITHAVALLI R**(Reg. No. 37140065) and **UMAMAKESWARI M** (Reg. No. 37140090) hereby declare that the Project Report entitled “**PRECISION AGRICULTURE USING WIRELESS SENSORS NETWORKS**” done by us under the guidance of **Dr. S. RADHIKA** is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Electrical and Electronics Engineering.

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We are pleased to acknowledge our sincere thanks to Board of Management of **SATHYABAMA** for their kind encouragement in doing this project and for completing it successfully. We are grateful to them.

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ABSTRACT

For More than 60 percent of the population in the India, agriculture is the primary occupation. In recent years, due to increase in labor shortage of labor interest has grown for the development of the autonomous vehicles in the agriculture. A system called agribothave been designed for agricultural purposes. It is designed to minimize the labor of farmers in addition to increasing the speed and accuracy of the work. The Proposed system aims at designing multipurpose autonomous agricultural vehicle which can be controlled through RF Signals and used for monitoring the soil conditions and transfer data via wireless networks. These systems are used to reduce human intervention, ensuring high yield and efficient utilization of resources. The proposed system uses sensor for monitoring of temperature ,humidity, pH, nutrition sensor and soil moisture sensor. Therefore ,the system can be used to monitor the these condition without human intervention .Hence the proposed system ensures high yield and efficiency utilization of resources. Therefore the problem of labor shortage and the increase labour cost is minimized by use of our system. We can be obtain the following from our proposed system are

1) the total of monitoring the soil is minimized.

2)The labour shortage sum is managed.

3)The soil temperature through the measuring the temperature of the soil of the environment the correct level of water can be given by suitably measuring the pH and nitrogen value can be adjusted. The proposed system can be viewed for improving the yield of the crops. In future this project can enhance the agricultural yield.

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CHAPTER-1

1.INTRODUCTION

In the agricultural info developments, the data as sortment technology is indispensable to agricultural research administration. The low price and high intelligent equipments area unit utilized in the fields to boost the normal agricultural technique continued assessment of the spatial availability within the field. It identifies the critical factors wherever the yield is proscribed by manageable factors. it's primarily a lot of precise farm management created potential by fashionable technology. The variations occurring in crop or soil properties inside a field area unit noted, mapped and also the management actions area unit taken as a consequence. In agricultural could be a practiced for uniform application of fertilizers, herbicides, pesticides, fungicides and irrigation while not concerns abstraction variability. To all eviate the ill-effects of over and below usage of inputs, the new ideas of exactness agriculture has emerged. It ends up in property development, spatially variable crop production and to an outsized extent is technology driven. The new tools applicable to exactness agriculture area unit the advances in natural philosophy and computers like RS, GPS, and GIS. The technology covers 3 aspects like knowledge assortment, analysis or process of recorded info and proposals supported offered info. within the returning year, it's expected that the wireless device network (WSN) are going to be used usually in application in shopper natural philosophy, personal care, toys and games, industrial management and watching, agriculture, etc. Considering the positioning of the device node with fairly high exactness, the researchers use a planned network instead of a network with ad-hoc routing. WSN provides route diversity and multiple transmissions. The total price of AN ownership of a wireless network is lower than the wired network. Another described a exactness agriculture design supported WSN. They deployed a large-scale device network and purchased valuable experiences. it's terribly helpful reference for WSN application within the intelligent agricultural field.

However, they need a touch bit liability. they will gather the environmental info, however they're weak to regulate the setting of the sector. The system design of the agricultural system is bestowed from the detector node hardware within the bottom to management sub-system within the high and is evaluated within the real-deployment. The thanks to management the setting exploitation the feedback from the gathered info is represented. A greenhouse may be a construction building as an area to grow and shield plants from extreme weather (wind, rain, ultraviolet radiation) and bug disturbances and permits for urban farming. This technique provides the nutrients required by plants through binary compound solutions. Some environmental factors that must be thought-about embrace natural action, salinity, temperature, light intensity, photoperiod, air wetness, pH and conduction of nutrient solutions. throughout now, plant observation is dispensed manually with a measuring device and comes to the situation directly and also the provision of plant nutrition supported the age of the plant, but this does not absolutely suit the wants of the plant. as a result of the plant cannot convey its condition directly at any time to the farmer. Efforts to regulate the wants in agriculture are referred to as exactness agriculture. Precision agriculture is info and technology in agricultural process systems by providing exactness treatment to get optimum and property edges. the conclusion of precise environmental conditions with human power is taken into account ineffective. Humans typically forget and are inconsistent once doing repetitive work. Therefore, the automation system is required and can be systematically operating to satisfy the wants of plants

properly. many exactness agricultural researches are dispensed together with automation of fertiliser, intelligent irrigation, and smart greenhouse.

The analysis utilizes technology together with the appliance of the Wireless detector Network (WSN) in agriculture. WSN may be a resolution to facilitate the conclusion of exactness agriculture within the field of data technology. WSN consists of three main elements, particularly detector nodes, gateways, and software package. detector nodes serve to supply knowledge on environmental conditions. The data is delivered wirelessly through the entryway to be collected, processed and displayed exploitation the software. the fundamental principle of exploitation net technology and WSN are going to be the idea for the application of the net of Things (IoT). net of Things (IoT) connects objects to share knowledge via the net. IoT is commonly integrated with cloud computing to beat the constraints of IoT devices and needs communication protocols within the method of sharing knowledge. supported these descriptions, this analysis combines the benefits of comparable analysis within the use of technology for agriculture exactness. The system accustomed monitor and management environmental conditions consisting of temperature, humidity, lighting and plant organic process desires within the greenhouse in real time. Integration exploitation cloud computing provides broad access for users to observe and management anyplace and anytime via the website. Wireless device networks (WSNs) area unit the networks that area unit composed of device nodes. These device nodes facilitate in sensing, gathering and activity the data from the surroundings wherever they're deployed and transmit the information to the users. A WSN has little or we can say no infrastructure and having range of device nodes in it from 10 to thousands which works along to observe a space wherever they're deployed. WSN area unit area unit into two classes structured and unstructured. Structured WSN area unit those that area unit deploy in correct manner into a specific space and may be simply simply if there's any drawback in a adult male nodes whereas unstructured WSN area unit those during which sensors nodes area unit deploy in bulk with none correct design these form of WSN area unit in the main found in those space where it's it's humans to achieve simply and acquire knowledge from that space. In unstructured WSN, it is it's beware of device nodes if they close up or issue of node failure happens.

Wireless device network area unit area unit into five varieties to observe the parameters of surface of earth, underground conditions, underwater conditions, transmission and to monitor the world by the assistance of movement of sensors. These five sorts of sensors area unit area unit as Terrestrial WSN- In this sort of WSNs, immense range of nodes area unit deploy into a surface of land that can facilitate to look at the conditions of land. Underground WSN- because the name depict underground WSN area unit networks of device nodes that area unit deployed in caves, mines or underground surface for observance the condition of soil, wet and military boarder observance. Underwater WSN- during this WSNs, sensors area unit deployed within the region of oceans, rivers for underwater surveillance Multi-media WSN- It may be a network consists of sensors nodes that have ability to store, method and access multi-media knowledge like video knowledge, audio files and footage. Mobile WSN- during this network, device nodes have the flexibility to maneuver from one place to alternative. the applying of such networks is military police work, observance of space, tracking of target, observance beneath water. In WSNs, sensors area unit integrated with a radio transceiver and a collection of physics components that helps in transmission of information from supply to destination. device nodes have capability to arrange themselves to make impromptu, multi-hop network that helps in making communication link between nodes. User will provide commands to sensors; as a response of those commands sensors will transmit knowledge to the user as an example a particular limit of temperature is assign to the device with the assistance of embedded language if temperature exceeds from that assigned worth than device provides data to the user.

A wireless detector network (WSN) is additionally referred to as a wireless detector or wireless detector advance network (WSAN) and may be a assortment of free sensors that screen physical or steady conditions, such as temperature, sound, and weight. This info is transmitted through the network to a focal area. Current networks ar bi-directional and change detector management. Advanced WSNs are used for military applications as battle zone affirmation Movement varieties (like satellite trajectories), detector systems, network readiness, pervasive figuring, and also the associated choice support improve the define and vital association limits. Wireless detector networks in ar a set of specific transducers with associate degree exchange base to watch and record the conditions at nodes, that habitually embody the parameters of temperature, stickiness, weight, wind headings, and pace. This info helps inspire and drive stipulations, key body. Such networks are utilized in numerous mechanical and client applications for event watching, network standing assessment, machine accomplishment sensing, etc. Sensors ar wont to gather info regarding common physical quantities; but, actuators ar used to react to and management the according circumstances. The sensors collect info that describes the item or atmosphere and ar wont to offer info on individuals, areas, objects, and their states. Association securing shows the conditions of areas that have social events at the time of assortment, as well as for business enterprise. There ar many applications of detector networks. These embody frustration encouraging operations, drop detector focus from a plane over a quickly spreading hearth wherever each purpose measures the temperature to derive a "temperature map." additionally, these sensors will generate biodiversity maps or watch life. Intelligent networks (or expansions) will facilitate scale back position waste supported the fashioned viscousness, ventilation, and cooling management. this enables estimating area inhabitation, temperature, and wind streams. Such networks will screen mechanical problems once earthquakes and machine acknowledgment for preventive maintenance.

Embedded sensing/control distinguishes changes in systems, like tire weight checking or accurately crucial the standing of compost/pesticides/watering systems. within the health trade, such applications embody semipermanent perception of regularly unfit patients or the older. Sensors are used for a protracted time in numerous networks. The rule indoor controller was established in 1883, and plenty of think about this because the basic, contemporary, assembled detector. Infrared sensors are around since the late Nineteen Forties and have recently become commonplace devices. Progression markers are used for several years. The sink node assembles information in wireless detector systems, which implies that information gathering could skip samples or perform multibounce wherever all sensors store information that's sent to the bottom station, that is named the sink focus. each middle purpose within the detector network contains 3 subsystems. the primary senses the atmosphere, the second readies the system to perform neighborhood estimation on the perceived information, and also the third handles message exchange.

CHAPTER 2

2. LITERATURE REVIEW

Balakrishna Kempegowda ,(2016) describes a real-time soil monitoring for the agriculture farm lands to provide optimal and integrated data collections. Real-time monitoring provides reliable, timely information of crop and soil status plays an important role within the deciding within the crop production improvement.

Ashish Lalwani, MrunmaiBhide, S. K. Shah, Autonomous Agribot for Smart Farming(2017) proposes increasing population requires the food production to be increased which requires better Cultivation in the form of proper utilization of seeds and fertilizers with minimum labour work. The main objective of autonomous agribot and to reduces and to reduce labour work.

Helmy, Marsha GresiaMahaidayu, ArifNursyahid, Thomas AgungSetyawan, Abu Hasan, Nutrient Film Technique (NFT) Hydroponic Monitoring System Based on Wireless Sensor Network(2017) presents Hydroponic is one of the farming method without soil, but it uses water that contain Nutrition. Nutrient solution is very important to define the successful of hydroponic cultivation. One of hydroponic technique is Nutrient Film Technique(NFT). System NFT uses nutrient solution to drain on the root area.

Dasari Naga Vinod, Autonomous Farming and Surveillance Agribot in Adjacent Boundary (2018)The stives to implement the agricultural farming robot which can move instinctively, involuntarily for ploughing in different depths depending upon soil, seeding and irrigation in adjacent field. This research also contributes to strengthen functionality of agribot within the sector for surveillance.

Maherin Mizan Maha, Md Masduzzaman, Smart Board for Precision Farming Using Wireless Sensor Network, 2019 We live in a world which is rapidly moving toward smart systems to make every aspect of living easy and versatile. Smart farming systems are being adapted by farmers throughout the world . This paper is going to venture through smart arable farming system for the farmers of Bangladesh with the concept of internet of things(IoT).

Alexandros Zervopoulos, Athanasios Tsipis, Aikaterini Georgia Alvanou, Konstantinos Bezas, Georgios Tsoumanis, Vasileios Komianos, George Koufoudakis, Wireless Sensor Network Synchronization for Precision Agriculture Applications, 2020The advent of Internet of Things has propelled the agricultural domain through the integration of sensory devices, capable of monitoring and wirelessly propagating information to producers; thus, they employ Wireless Sensor Network. For example, a need for network synchronization arises in such networks to correlate acquired measurements.

Mr. Kunal Goel, Dr. Amit Kumar Bindal, Wireless Sensor Network in Precision Agriculture presents the importance of precision agriculture over the tradition agriculture that how farmers can get the exact details about their cultivation land while deploying the sensor and measure the varied parameters of the land then do the farming consistent with that parameters in order that they can earn more and thru the deployment of sensor in land also helps the farmers in excellent crop yield.

Pavankumar Naik, Arun Kumbi, Kirthishree Katti, Nagaraj Telkar, Automation of Irrigation system using IoT, 2018 describes the system we are using various sensors like temperature, humidity, soil

moisture sensors which senses the varied parameters of the soil and based on soil moisture value land gets automatically irrigated by ON/OFF of the motor. These sensed parameters and motor status are getting to be displayed on user android application.

Roopa G K, Radhika Shetty, IOT & Wireless Sensor Networks in Precision Agriculture, 2019. Presents the Internet of Things enables various applications in Digital Agriculture domain. Precision agriculture is set to provide higher productivity and a better use of resources when compared to traditional methods and this will result in lower costs with higher yields. As water supplies become of elimatically change, there is an urgent need to irrigate more efficiently in order to optimize water use.

Divyansh Thakur, Yugal Kumar, Arvind Kumar, Pradeep Kumar Singh, Applicability of Wireless Sensor Networks in Precision Agriculture, 2019. This paper mainly present the adoption of WSNs in PA is to measure the different environmental parameters such as humidity, temperature, oil moisture, PH value of soil etc., for enhancing the quantity and quality of crops.

There are diverse applications of zigbee based wireless sensor network in agriculture like checking of environmental conditions like weather, soil moisture content, soil temperature, soil fertility, weed-disease detection, monitoring leaf temperature/moisture content and nursing growth of the crop, precision agriculture, irrigation facility, storage of agricultural products.

The limitation with the aforementioned work is it focuses on the aggregated routing mechanism used. Context aware mechanism has to be implemented for resource constraint network. In the authors proposed a model consists of a wireless conjunction node, sensor nodes and the server. A sensor node comprises a data sampling module which finalizes the real-time dimension of temperature and humidity, and a wireless transceiver module which obtains the data sampled by the data sampling module and directs the data to the conjunction node. Node failure is a major challenge. The limitation of this work is that single point of disaster may occur and data loss also may happen due to block sat server.

The soil pH value gained from the sensor is poised by the base station node and reported to the PC attached to it. The proposed WSN system will be able to connect data poised to the farmer's mobile via GSM technology and to activate the water sprinklers during the period of water scarcity. The limitation of this work is that congestion of data from node is not addressed. Queuing technique may be used to avoid data clogging. This scenario may be a failure if there is no mobile network. The wireless connection is implemented to acquire data from the various sensors. The limitation of this work is that Data clogging may occur.

Queuing technique might be used and priority can be assigned for packets. The switch tool of micro climate into greenhouses through the employment of infrastructure of Wireless Sensors Networks to switch environmental parameters. Sensor data accumulation efficiency is a Challenge and producing a dynamic routing scheme in case of link failure is also a challenge. Checking soil moisture under current in the top soil to a detail, in both space and time, apt to analyse the interaction between soil moisture dynamics and plant physiology. The arrangement consists of 27 locations (verticals) linked by a multi hop WSN. Dynamic routing is a major challenge and accurateness of data collected from sensor and delay arose in aggregating data is also a challenge.

A WSN system was deployed that consists of an array with a centrally situated receiver connected to a laptop computer and multiple sensor nodes in a field. The system has shown results with cotton as crop. Node failure/single point of failure may occur. Aggregated data analysis should

be done in the receiver for better decision-making process. A WSN system was developed that determines the water holding capacity for the soil. Properties of soil like organic matter, organic carbon, claycontent, bulk density and plasticity index are estimated.

Uses simple device like wheel gauge to find depth thus system is not very expensive Natural fertilizers are used for the crops making it healthier. Burstiness of data may occur at the sink / aggregator node. Aggregated data analysis should be done in the receiver for better decision-making process. An integrated sensing system was developed that can assess the soil moisture and provide decisions related to crop growth. Open GIS standards are used to provide long term access to construct sensor data and corresponding metadata.

Reliability is questionable. Data cleansing has to be done to remove duplicate values measured from sensors in different location. A hybrid wireless sensor network is deployed and tested in soil thus making it applicable to several moistures and frequencies of soil. The system is a breakthrough to the traditional sensor networks. It communicates in the soil thus determining all the characteristics of the soil to help in irrigation and fertilizer management. Queuing management is a challenge and data fusion wouldn't be optimized due to burst traffic.

An ad-hoc based platform was established alike to the ones used to obtain environmental and meteorological data, where the manufacturing cost of the sensor node is curtailed, by an efficient selection of the system components. Node failure not addressed and dynamic routing scheme needs to be adapted as all the node in ad-hoc may be mobile. There are many problems faced by the Indian farming community inorder to maximize crop productivity. The proposed framework for cost active agriculture information dissemination system (AgrIDS), to distribute expert agricultural knowledge to the farming community in order to recover crop productivity. The success of a crop rest on the degree of avoiding the effect of the factors that disturb the crop.

CHAPTER-3

3.BLOCK DIAGRAM

In this chapter brief discussion of the proposed blocked diagram is given. So this chapter has two subdivisions as detailed block diagram is described into two sections namely Transmitter Section and Receiver Section.

The deep discussion of the Transmitter Section

3.1.TRANSMITTER SECTION

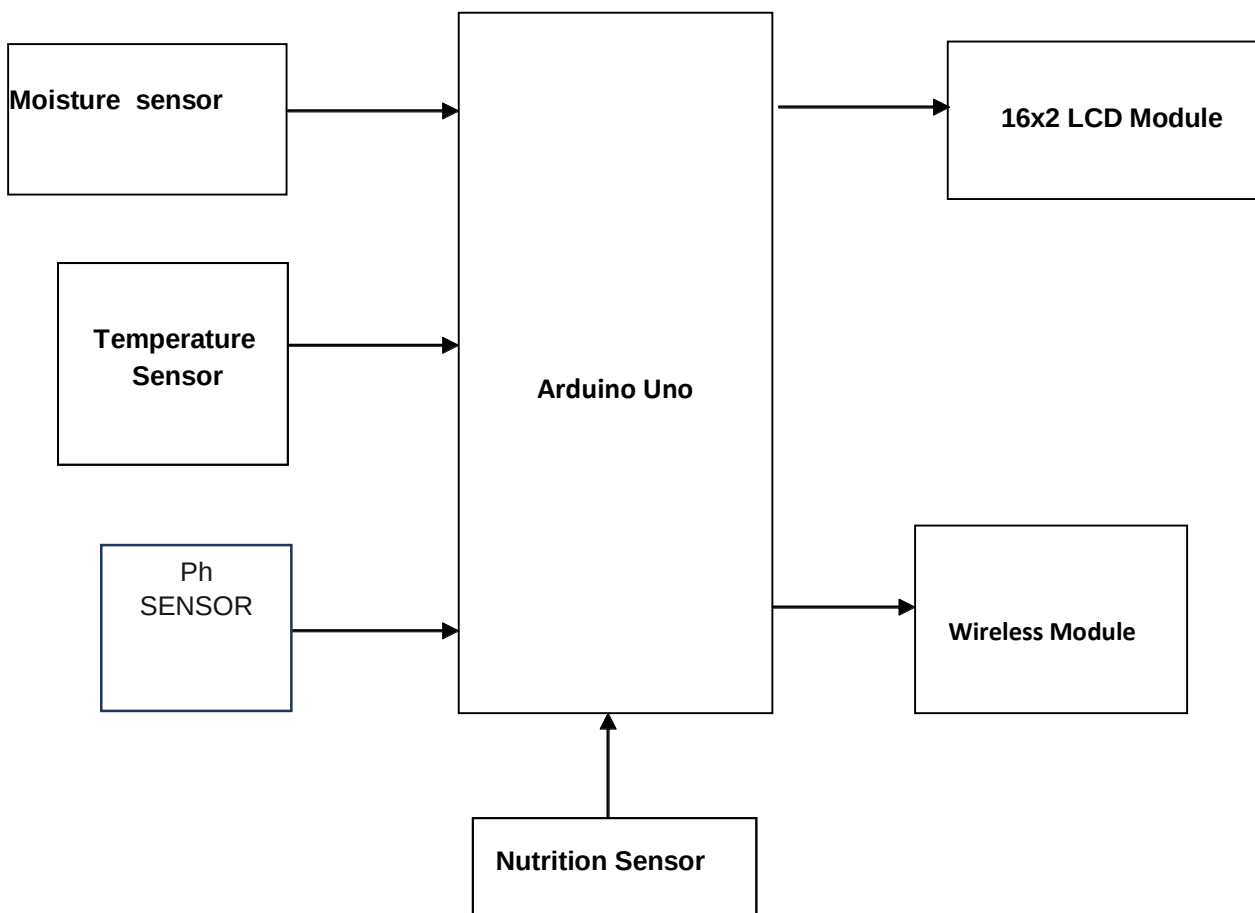


Fig 3.1 TRANSMITTER SECTION

Transmitter section the figure 3.1 illustrates the block diagram of transmitter section. The transmitter section is mainly met for transmitting the signal that is receive the different signal. The various units that makes the transimmitter section include the sensor unit ,the arduino unit and the crresponding display units. Such as LCD module and the wireless module for excusion transmission.

A moisture sensor is a type of sensor which is used to measure the moisture level in the

soil. There are various moisture sensors available. Out of the moisture sensors we have chosen this type of the sensor and the work of the sensor is convert moisture level present in the soil into corresponding with the values.

pH is that the numeric illustration of gram-equivalent per metric capacity unit of proton concentration in any answer. It varies between zero to 14. It's the exponent mensuration of moles of gas ions per metric capacity unit of answer. The solutions having hydrogen ion concentration price between zero to seven square measure acidic solutions with giant concentration of gas ions whereas solutions having hydrogen ion concentration price between eight to fourteen square measure basic solutions with little gas concentration. The solutions having hydrogen ion concentration price of seven square measure neutral solutions. mensuration the hydrogen ion concentration provides the live of pH scale or acidity of an answer.

In this system we tend to demonstrate AN automatic chemical science detector system for continuous nutrient determination. The flow-through chemical science detector system with 2 conductor system work supported flow injection analysis (FIA) technique for detection the nutrients. the first aim of this system to develop a sensitive and reliable chemical science detector system for observation the nutrients in soil sample for long-run applications. This type of chemical science detector is predicated on ISFET technology. The chemical science detector have the potential to be made in batches to terribly little size by victimisation MEMS-based small fabrication technology at low prices. Besides, little sized sensors need little volume of chemical agent and samples, which may conjointly scale back the value in soil testing.

The percentage of water gift within the air is termed as wetness. Water as gaseous state referred to as vapour. because the temperature of the air will increase a lot of water vapor is generate. Humidity mensuration in industries is essential as a result of it's going to have an effect on the business value of the product and therefore the health and safety of the personnel. So, its large importance of wetness detector is very vital, particularly within the management systems for industrial processes like chemical gas purification, dryers, ovens, film desiccation, paper and textile production, and food process. In agriculture, mensuration of wetness is vital for plantation protection (green house), soil moisture observation, etc.

This is a output device with a restricted viewing angle. the selection of digital display as AN output device was Because of its value of use and is best with alphabets when put next with a 7-segment junction rectifier display. we've got such a big amount of forms of digital display nowadays and our application needs a digital display with two lines and sixteen characters per line, this gets information from the microcontroller and displays identical. it's eight information lines, three management line, a provide voltage Vcc (+5v and a GND. This makes the complete device user friendly by showing the balance left within the card. This conjointly shoes the cardboard that's presently being used..

This RF module contains of AN RF Transmitter AND an RF Receiver. The transmitter/receiver (Tx/Rx) combine operates at a frequency of 434 megacycle. AN RF forty three transmitter receives serial information and transmits it wirelessly through RF through its antenna connected at pin4. The transmission happens at the speed of 1Kbps - 10Kbps. The transmitted information is received by AN RF receiver operative at identical frequency as that of the transmitter. This RF module contains of AN RF Transmitter AND an RF Receiver. The transmitter/receiver (Tx/Rx) combine operates at a frequency of 434 megacycle. AN RF forty three transmitter receives serial information and transmits it wirelessly through RF through its antenna connected at pin4. The

transmission happens at the speed of 1Kbps - 10Kbps. The transmitted information is received by AN RF receiver operative at identical frequency as that of the transmitter.

The purpose of the Arduino Uno could be a kind of processor wherever the info received from the various detector about the method and it's about to be sent to the digital display module. The Arduino Uno is programmed according to such input is taken from the various detector and output is given to the wireless module furthermore as the LCD module.

The deep discussion of the receiver section.

2.2.RECEIVER SECTION

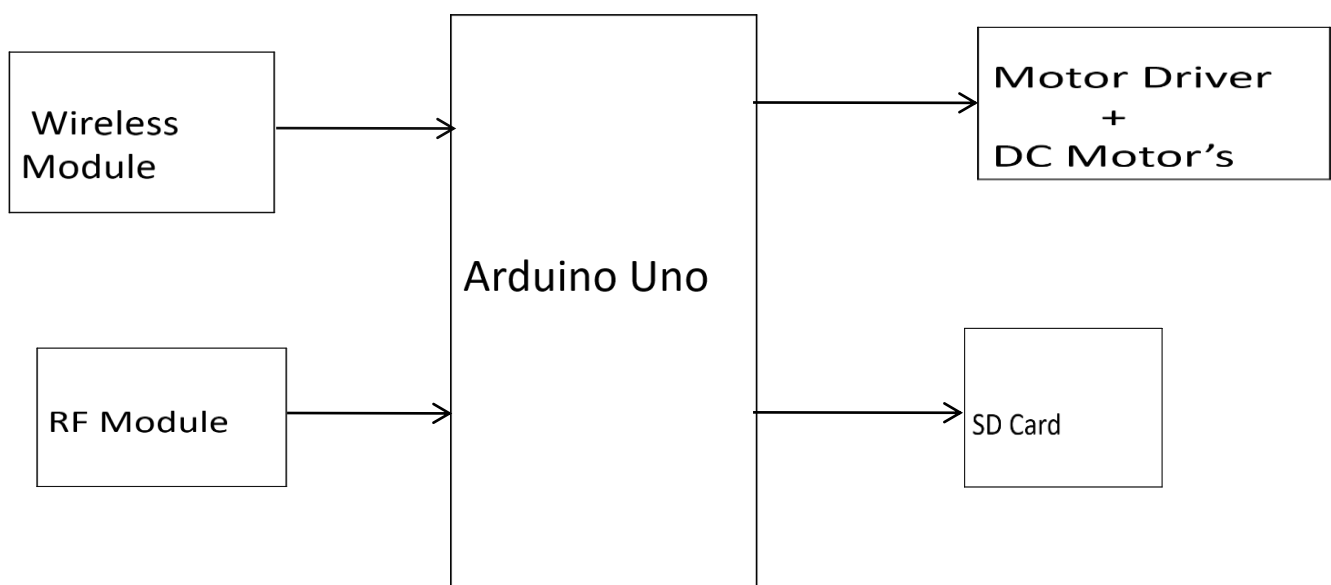


Fig 2.2 RECEIVER SECTION

ZigBee relies on IEEE (Institute of Electrical & natural philosophy Engineers) 802.15.4 normal that lays down specifications for the low rate wireless personal space network. ZigBee is primarily used for two-way communication between a detector and a sway system. Like Bluetooth and Wi-Fi, it is a short-range communication and offers property up to one hundred meters. On the opposite finish, Wi-Fi and Bluetooth area unit high rate standards that support the transfer of media files, software, etc.

An South Dakota card could be a solid-state device. this implies it's no moving elements so as to perform. This could be a massive improvement over older transportable storage devices. Floppy disks, for instance, had flimsy discs within that spun at high speeds and were subject to information loss once placed close to magnetic fields. CDs and DVDs

area unit larger and fewer sturdy, and their storage capability degrades quickly with uncountable rewrites. AN South Dakota card's elements area unit a part of its electronic equipment, and its packaging is tiny and sturdy compared to those predecessors.

In any motor, operation relies on easy electromagnetism. A current-carrying conductor generates a field of force; once this can be then placed in associate degree external magnetic field, it will expertise a force proportional to the present within the conductor, and to the strength of the external field of force. As you're cognizant of from fidgeting with magnets as a child, opposite (North and South) polarities attract, whereas like polarities (North and North, South and South) repel. the inner configuration of a DC motor is meant to harness the magnetic interaction between a current-carrying conductor associate degreeed an external field of force to generate move motion.

The RF module, because the name suggests, operates at oftenness. The corresponding frequency vary varies between thirty kilocycle & three hundred gigacycle per second. during this RF system, the digital information is drawn as variations within the amplitude of radio wave. this sort of modulation is thought as Amplitude Shift Keying (ASK).

2.3.DESCRPTION OF DIAGRAM

The architecture of the precision agriculture system based on wireless sensor networks consists of environmental monitoring nodes, hardware and software system. According to different functions, a large number of different sensors can be placed in the field and created a self organized network to watch the worth amendment together with temperature, humidity and moisture. The collection data is send to the sink by wireless mode. The control center can send the control information to anynode in the network. Likewise the remote information might be transmitted to the centre with the sink the system adopts the cluster topology and hierarchical routing protocols. All sensor nodes area unit divided into some cluster. every cluster is cherish a comparatively fastened self organizing network. The nodes are divided into the common node and the cluster head node the common nodes can collect the info that transmitted to the cluster head node. The data is stored to the database. Expert decision support system processes and analysis the info at constant time and send the values to the receiver section through wireless detector Networks (WSN). In the system, a controller collects the knowledge from totally different.

CHAPTER-4

In this chapter brief discussion the hardware and simulation work in our proposed system is described in detail.

HARDWARE DESCRIPTION:

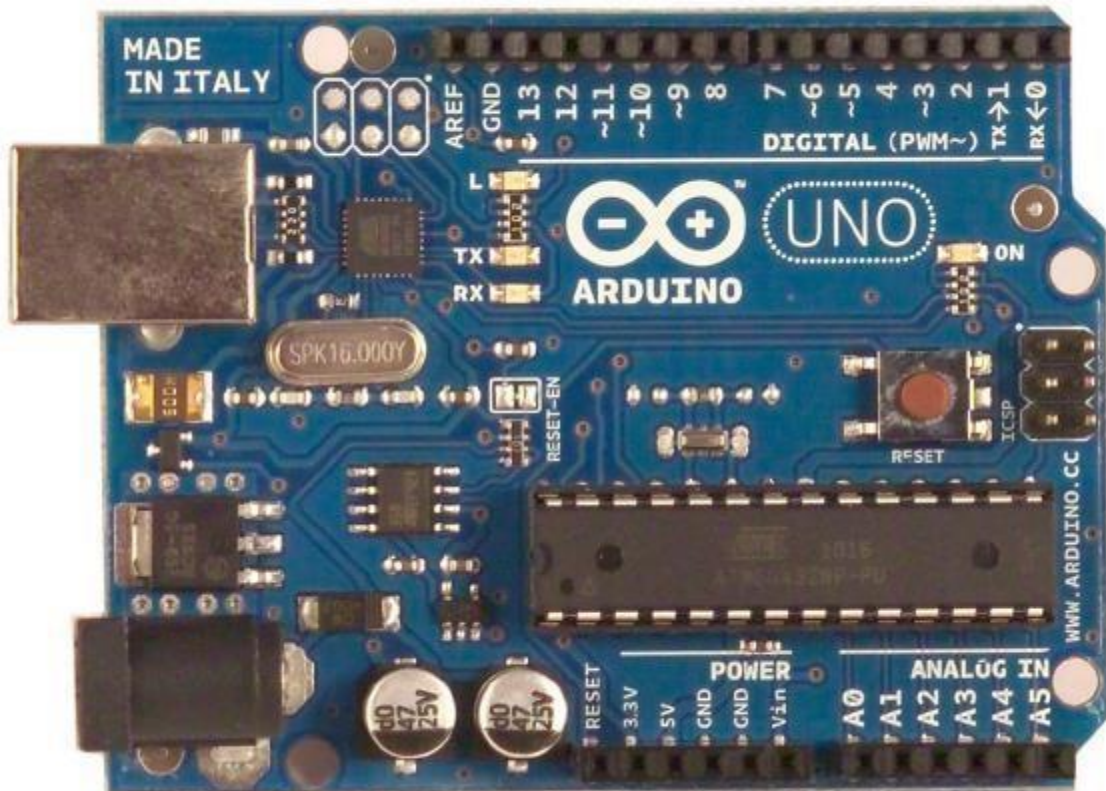


Fig 4.1 ARDUINO UNO BOARD

Arduino is a solitary board microcontroller to make utilizing hardware in multidisciplinary projects more available. The equipment comprises of an open source equipment board planned around a 8-bit Atmel AVR microcontroller, or a 32-cycle Atmel ARM. The product comprises of a norm programming language compiler and a boot loader that executes on the microcontroller. Arduino sheets can be bought pre-collected or as DIY units. .

4.1.1 PROGRAMMING:

The Arduino Uno can be customized with the Arduino Select "Arduino Uno from the Tools > Board menu (as indicated by the microcontroller on your board). For subtleties, see the reference and instructional exercises. The ATmega328 on the Arduino Uno comes preburned with a bootloader that permits you to transfer new code to it without the utilization of an outer equipment developer. It imparts utilizing the first STK500 convention You can likewise sidestep the bootloader and program the microcontroller through the ICSP (In - Circuit Serial Programming) header; The ATmega16U2 (or 8U2 in the rev1 and rev2 sheets) firmware source code is accessible . The ATmega16U2/8U2 is stacked with a DFU bootloader, which Can be enacted by: • On Rev1 sheets:

interfacing the bind jumper on the rear of the board and afterward resetting the 8U2. • On Rev2 or later sheets: there is a resistor that pulling the 8U2/16U2 HWB line to ground, making it simpler to place into DFU mode

Developer(s)	Arduino Software
Stable release	1.0.5 / May 15, 2013
Preview release	1.5.4Beta/September 10,2013
Written in	Java, C and C++
Operating system	Cross-platform
Type	Integrated development environment
License	LGPL or GPL license
Website	Arduino.cc

• `setup()`: a function run once at the start of a program that can initialize settings • `loop()`: a function called repeatedly until the board powers off A typical first program for a microcontroller simply blinks an LED on and off. In the Arduino environment, the user might write a program like this:

The integrated pin 13 LED

```
#define LED_PIN 13
void setup ()
{
  pinMode (LED_PIN, OUTPUT);
  // Enable pin 13 for digital output
}
void loop ()
{
  digitalWrite (LED_PIN, HIGH);
  // Turn on the LED delay (1000);
  // Wait one second (1000 milliseconds)
  digitalWrite (LED_PIN, LOW);
  // Turn off the LED delay (1000);
  // Wait one second }
```

4.2 MEASURING HUMIDITY AND TEMPERATURE USING SENSOR(DHT11):

The level of water present noticeable all around is named as mugginess. Water as vaporous state called fume. As the temperature of the air expands more water fume can be create. Dampness estimation in ventures is basic since it might influence the business cost of the item and the wellbeing and security of the work force. Along these lines, its colossal significance of dampness sensor is vital, particularly in the control frameworks for mechanical cycles like synthetic gas refinement, dryers, broilers, film parching, paper and material creation, and food handling. In farming, estimation of moistness is significant for estate security (green house), soil

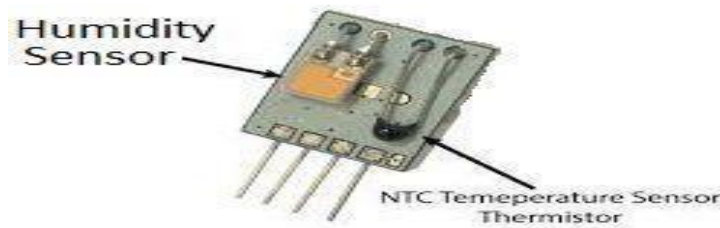


Fig 4.2.1 DHT11 Internal View

Dampness observing, and so forth Most moistness sensors utilize capacitive estimation to decide the measure of dampness noticeable all around. This sort of estimation depends on two electrical channels with a non-conductive polymer film laying between them to make an electrical field between them. Dampness from the air gathers on the film and causes changes in the voltage levels between the two plates. This change is then changed over into an advanced estimation of the air's relative dampness subsequent to considering the air temperature. The DHT11 computes relative mugginess by estimating the electrical opposition between two cathodes. The moistness detecting part of the DHT11 is a dampness holding 30 substrate with the terminals applied to the surface. At the point when water fume is consumed by the substrate, particles are delivered by the substrate which builds the conductivity between the terminals. The adjustment in obstruction between the two terminals is corresponding to the relative stickiness. Higher relative moistness diminishes the obstruction between the terminals while lower relative dampness builds the opposition between the anodes.

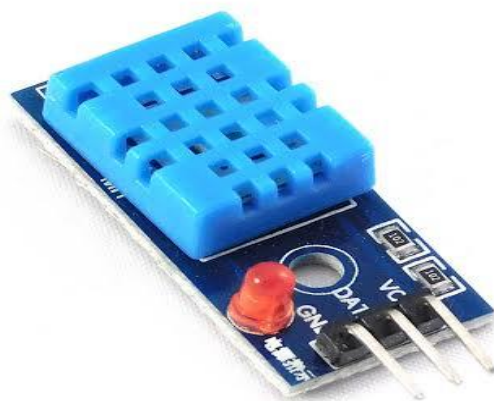


Fig 4.2.2 DHT11 TEMPERATURE AND HUMIDITY SENSOR

4.3 pH SENSOR

Defining pH

pH is the numeric portrayal of gram-comparable per liter of hydrogen particle fixation in any arrangement. It differs between 0 to 14. It is the logarithmic estimation of moles of hydrogen particles per liter of arrangement. The arrangements having pH esteem between 0 to 7 are acidic arrangements with huge convergence of hydrogen particles though arrangements having pH esteem between 8 to 14 are fundamental arrangements with little hydrogen fixation. The arrangements having

pH estimation of 7 are impartial arrangements. Estimating the pH gives the proportion of alkalinity or corrosiveness of an answer. For what reason is pH estimation fundamental? • To screen pH level of blood, which should be between to 7.35 and 7.45 • To screen pH level of soil for ideal development of harvests as indicated by the prerequisites. • To screen pH of downpour with the goal that we can identify the toxins in air, if the downpour water turns out to be more acidic. To screen pH of numerous other every day utilized items like milk, cleanser and so



Fig 4.3 pH Sensor

Three Ways to measure pH of a solution

- Using pointer strip which when put in an answer, changes its tone as needs be. The strip is then taken out and its tone is coordinated with a tone on the shading outline to choose the comparing pH esteem.
- Using a pH pointer liquid where the obscure arrangement is added to the liquid and the changed shade of the liquid is coordinated with a generally accessible tone on the shading wheel to choose the pH esteem.
- Using a pH sensor where a test can be essentially embedded inside the arrangement and pH perusing should be possible . Rule of pH Meter or pH Sensor pH meter fundamentally chips away at the way that interface of two fluids delivers an electric potential which can be estimated. At the end of the day when a fluid inside a nook made of glass is put inside an answer other than that fluid, there exists an electrochemical potential between the two fluids.

4.4 LCD Display

Simplicity of programming for characters and designs. LCD represents fluid gem; this is a yield gadget with a restricted survey point. The decision of LCD as a yield gadget was Because of its expense of

utilization and is better with letters in order when contrasted and a 7-portion LED show. We have such countless sorts of LCD today and our application requires a LCD with 2 lines and 16 characters for every line, this gets information from the microcontroller and showcases the equivalent. It has 8 information lines, 3 control line, a stock voltage Vcc (+5v and a GND. This makes the entire gadget easy to use by showing the equilibrium left in the card. This additionally shoes the card that is as of now being utilized. Lately the LCD is finding far reaching use supplanting LED's.

This is because of the accompanying reasons:

1. The declining costs of LCD's.
2. The capacity to show numbers, characters and illustrations. This is rather than LED's, which are restricted to numbers and few characters.
3. Consolidation of a reviving regulator into the LCD, there by mitigating the CPU of the assignment of invigorating the LCD .conversely, the Led should be revived by the CPU to continue to show the information.

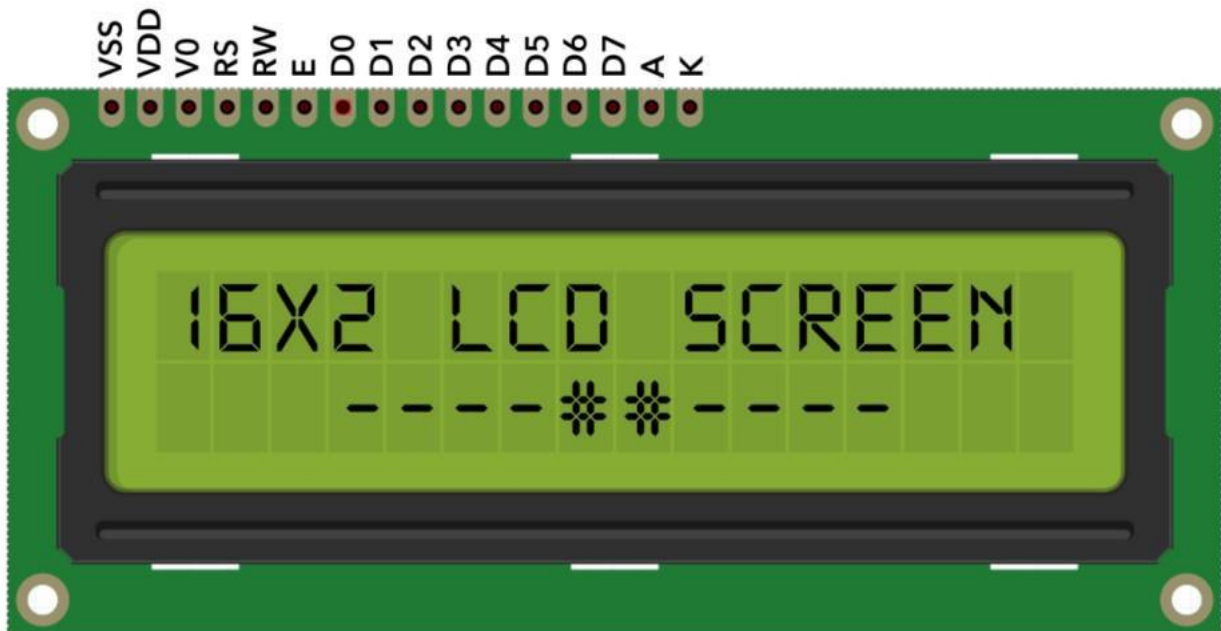


Fig 4.4 16*2 LCD SCREEN

4.4.1 LCD PROGRAMMING CHART

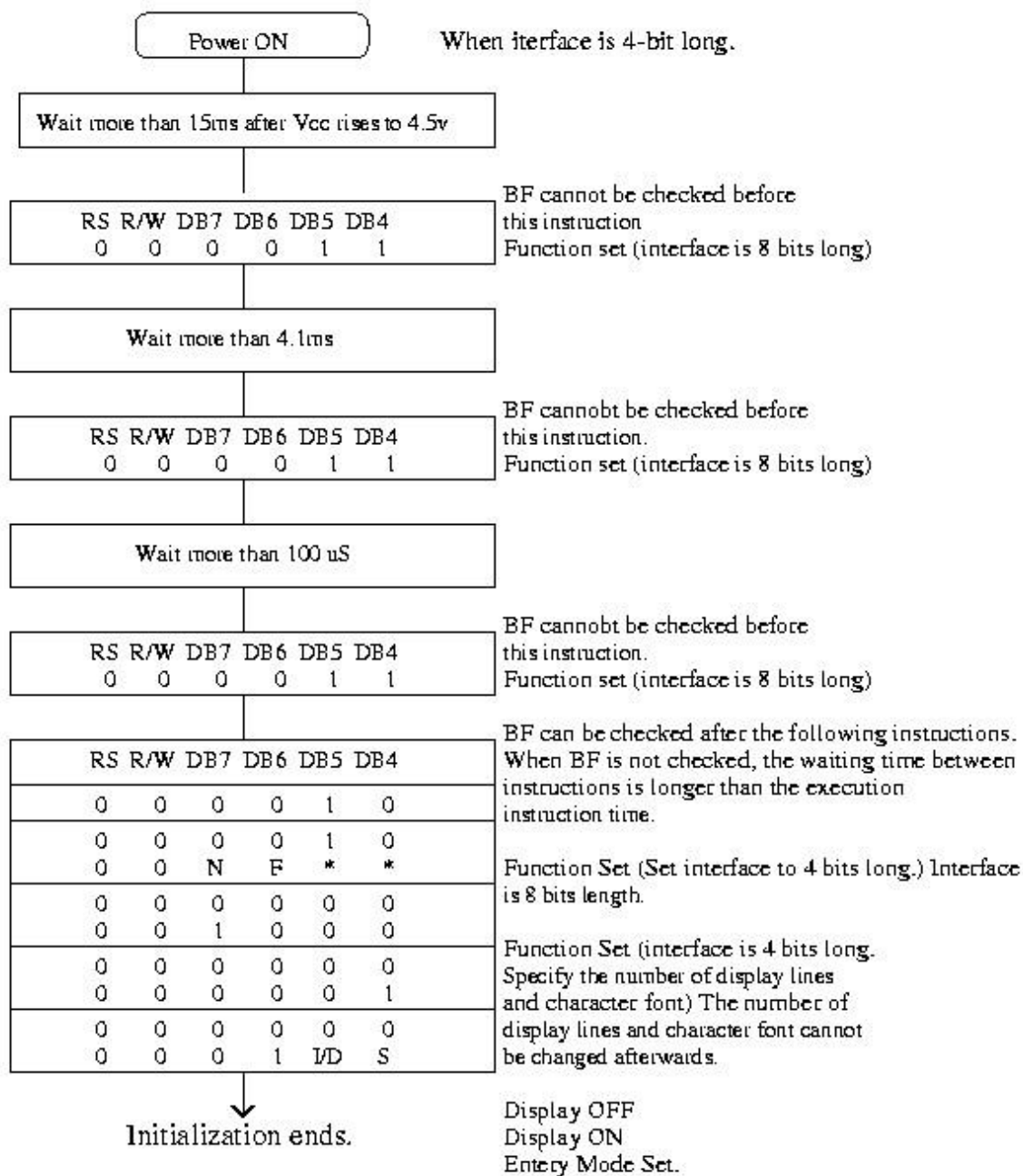


FIG 4.4.1 LCD PROGRAMMING CHART

4.5 RF 433 Mhz Transmitter and Receiver Module

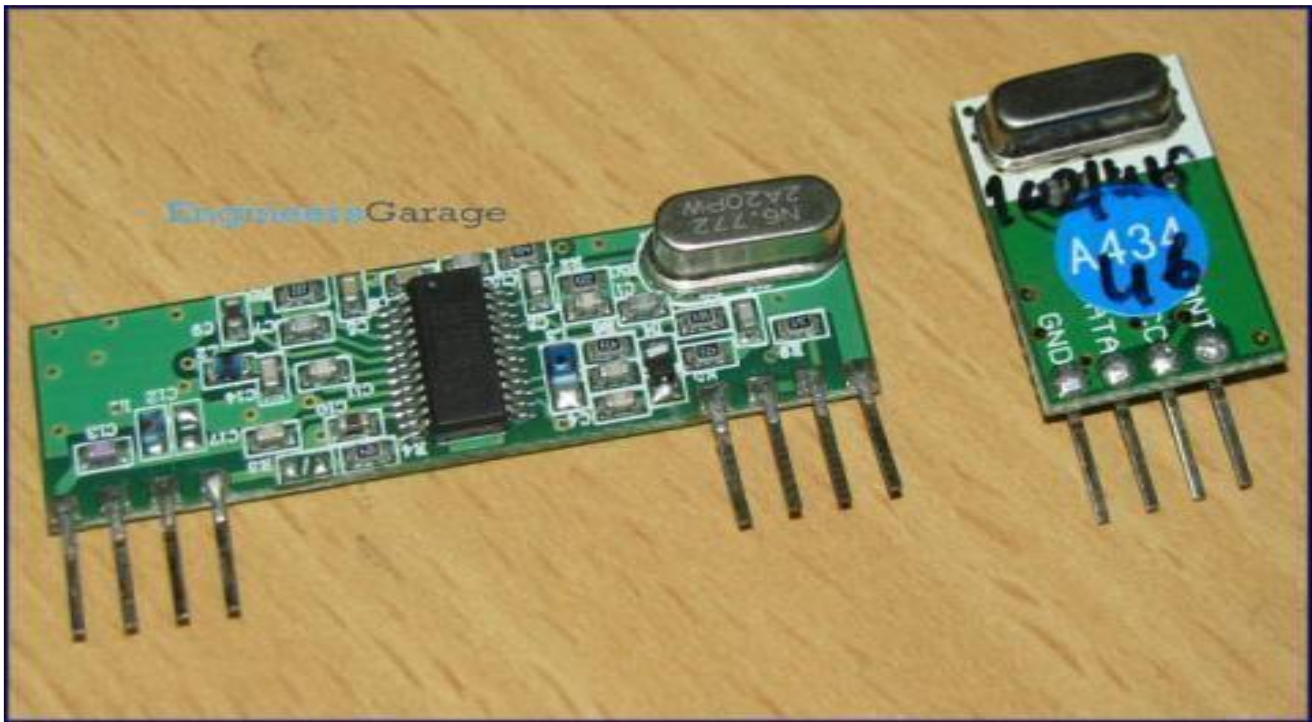


Fig:4.5 RF MODULE

The RF module, as the name proposes, works at Radio Frequency. The comparing recurrence range shifts between 30 kHz and 300 GHz. In this RF framework, the computerized information is addressed as varieties in the sufficiency of transporter wave. This sort of adjustment is known as Amplitude Shift Keying (ASK). Transmission through RF is superior to IR (infrared) due to numerous reasons. First and foremost, signals through RF can go through bigger distances making it reasonable for long reach applications. Additionally, while IR generally works in view mode, RF signs can travel in any event, when there is an obstacle between transmitter and recipient. Then, RF transmission is more solid and dependable than IR transmission. RF correspondence utilizes a particular recurrence dissimilar to IR signals which are influenced by other IR producing sources. This RF module includes a RF Transmitter and a RF Receiver.

The transmitter/recipient (Tx/Rx) pair works at a recurrence of 434 MHz. A RF transmitter gets sequential information and sends it remotely through RF through its radio wire associated at pin4. The transmission happens at the pace of 1Kbps - 10Kbps. The sent information is gotten by a RF beneficiary working at the very recurrence as that of the transmitter. The RF module is frequently utilized along with a couple of encoder/decoder. The encoder is utilized for encoding equal information for transmission feed while gathering is decoded by a decoder. HT12EHT12D, HT640-HT648, and so on are some ordinarily utilized encoder/decoder pair ICs.

4.5.1 Pin Diagram:

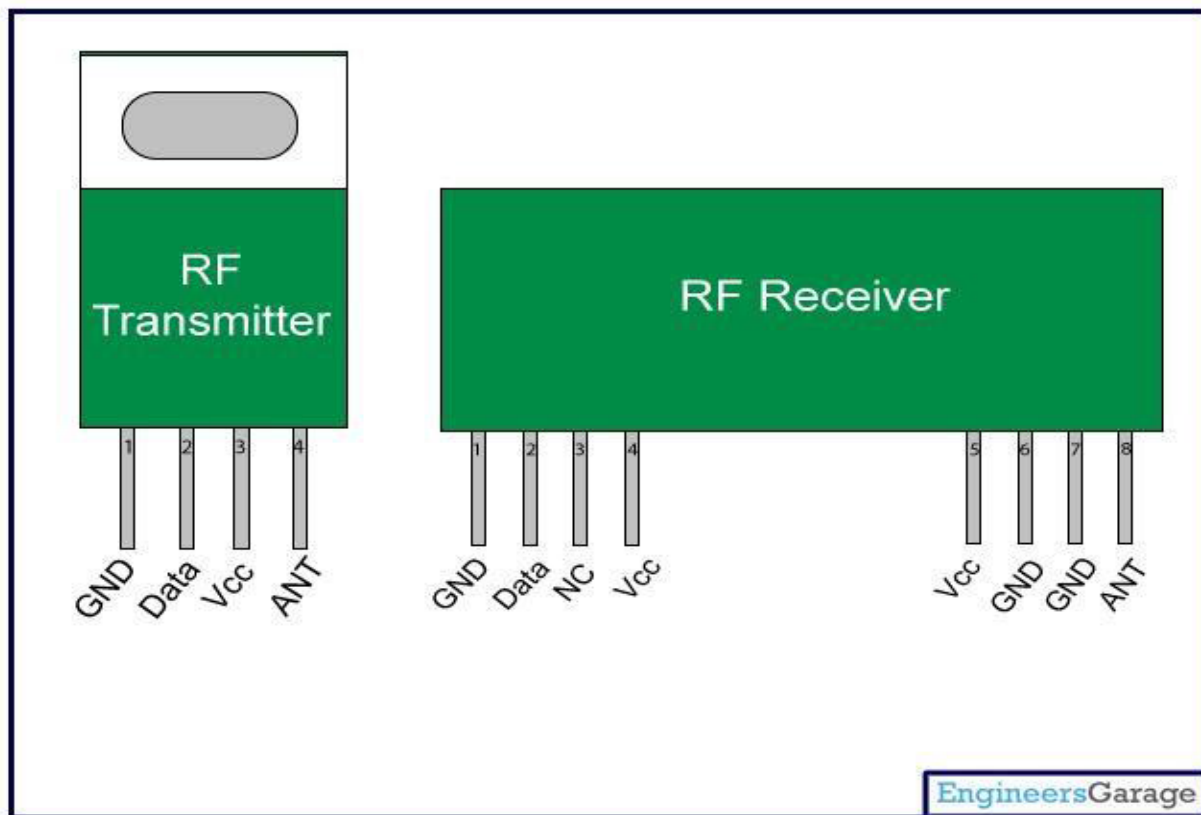


Fig:4.5.1 PIN DESCRIPTION

4.5.2 RF Transmitter

Table 4.5.2 RF Transmitter

Pin No	Function	Name
1	Ground (0V)	Ground
2	Serial data input pin	Data
3	Supply voltage; 5V	Vcc
4	Antenna output pin	ANT

4.5.3 RF Receiver

Table 4.5.3 RF Receiver

Pin No	Function	Name
1	Ground (0V)	Ground
2	Serial data output pin	Data
3	Linear output pin; not connected	NC
4	Supply voltage; 5V	Vcc
5	Supply voltage; 5V	Vcc
6	Ground (0V)	Ground
7	Ground (0V)	Ground
8	Antenna input pin	ANT

4.6 ZIGBEE TRANSRECEIVER

With a plenty of high information rate correspondence norms not appropriate for speaking with sensors and actuators, a framework planner essentially searches for a norm to work viably with low-power prerequisites and low-idleness. Despite the fact that it was at first worked as an option to Bluetooth in light of its inefficacy to work in specific applications, ZigBee is most appropriate for IoT gadgets including mechanical mechanization, installed frameworks, home computerization, and so f



Fig 4.6 ARCHITECTURE OF ZIGBEE NETWORK

4.6.1 What is ZigBee

ZigBee depends on IEEE (Institute of Electrical and Electronics Engineers) 802.15.4 Standard which sets down determinations for the low rate remote individual territory organization. ZigBee is fundamentally utilized for two-route correspondence between a sensor and a control framework. Like Bluetooth and Wi-Fi, it is a short-range correspondence and offers availability up to 100 meters. On the opposite end, Wi-Fi and Bluetooth are high information rate guidelines which support the exchange of media documents, programming, and so on ZigBee innovation upholds the exchange of information coming from the sensors at a pace of around 250 kbps. It works at different frequencies like 868 MHz, 902 – 968 MHz, and 2.4 GHz. Since it requires low force from the gadget, the battery



life is fundamentally improved.

Fig 4.6.1 ZIGBEE MODULE

4.7 DC motor

In any electric engine, activity depends on basic electromagnetism. A current-conveying conductor produces an attractive field; when this is then positioned in an outer attractive field, it will encounter a power relative to the current in the conductor, and to the strength of the outside attractive field. As you are very much aware of from playing with magnets as a child, inverse (North and South) polarities pull in, while like polarities (North and North, South and South) repulse. The inside setup of a DC engine is intended to outfit the attractive cooperation between a current-conveying conductor and an outside attractive field to create rotational movement. How about we start by taking a gander at a basic 2-pole DC electric engine (here red addresses a magnet or twisting with a "North" polarization, while green addresses a magnet or twisting with a "South" polarization).

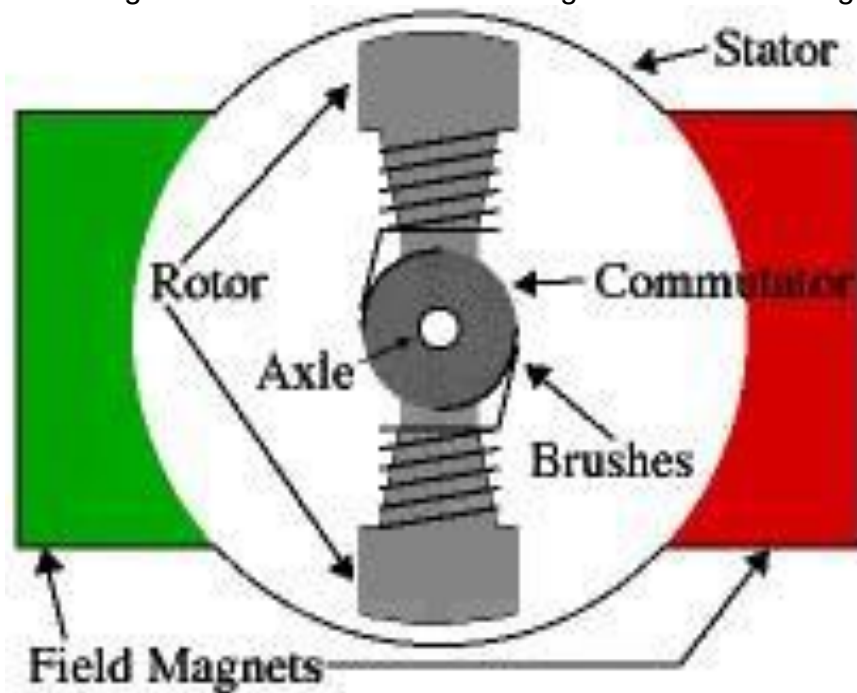


Fig:4.7 INTERNAL VIEW

4.8 SD Card Interfacing with Arduino

A SD card is a strong state gadget. This implies it has no moving parts to work. This is a major improvement over more seasoned versatile stockpiling gadgets. Floppy plates, for instance, had shaky circles inside which turned at high paces and were dependent upon information misfortune when set close to attractive fields. Discs and DVDs are bigger and less tough, and their stockpiling ability corrupts rapidly with loads of changes. A SD card's segments are important for its hardware, and its bundling is little and strong contrasted with these archetypes. Inside the SD card is hardware that incorporates streak memory. ven however every SD card consents to norms for the structure factor, limit, speed and regular information/yield interface, distinctive SD card producers adopt various strategies in planning the blaze memory and supporting segments inside. In consistence with principles, every SD card comes designed with a File Allocation Table (FAT) record framework, which is viable with pretty much every working framework that should get to the documents in that framework. Once in a while, you may have to reformat a SD card, either to "zero out" the information

for an intensive wipe of all information, or to recuperate the document framework after a debasement, which could happen while eliminating the card during basic read-compose tasks.

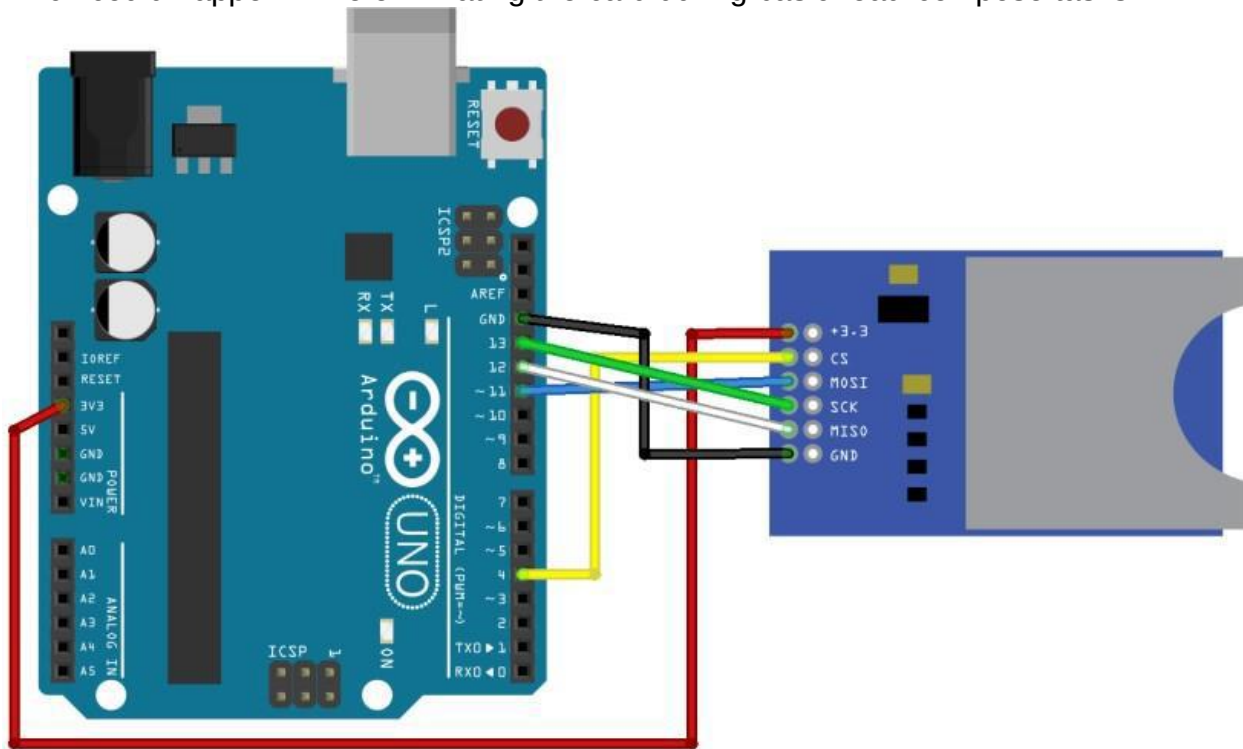


Fig 4.8 SD card Arduino Interfacing

4.9 Nutrition Sensor (Nitrogen)

In this framework we exhibit a programmed electrochemical sensor framework for consistent supplement assurance. The move through electrochemical sensor framework with two terminal framework work dependent on stream infusion investigation (FIA) procedure for identifying the supplements. The essential point of this framework to build up a delicate and solid electrochemical

sensor framework for checking the supplements in soil test for long haul applications.



Fig:4.9 ELECTRO CHEMICAL SENSOR

The electrochemical sensor comprises of two anodes which reacts to focused particle and changes the responses to perceptible electrical signs. Particle Selective Electrode (ISE) and Ion Selective Field Effect Transistor (ISFET) are the two sorts of ordinarily utilized potentiometric electrochemical sensor for soil supplement location. Here ISEs isn't reasonable for ongoing detecting applications on account of their time delay (a few minutes). An electrochemical sensor comprises of a dispersion obstruction, a detecting terminal and a counter cathode. In a climate liberated from synthetically receptive gases, oxygen diffuses into the phone and adsorbs on both terminal. The outcome is a steady potential between the two wherein the little current streams. The cell synthetic cycle now Oxygen enters through the sensor through the fine where it interacts with the cathode and it quickly decreased to hydroxyl particles. This sort of electrochemical sensor depends on ISFET innovation. The electrochemical sensor can possibly be delivered in bunches to tiny size by utilizing MEMS-based miniature creation innovation at low expenses. Plus, little measured sensors require little volume of reagent and tests, which can likewise decrease the expense in soil testing.

4.10 FLOW CHART

4.10.1 FLOW CHART FOR TRANSMITTER SECTION

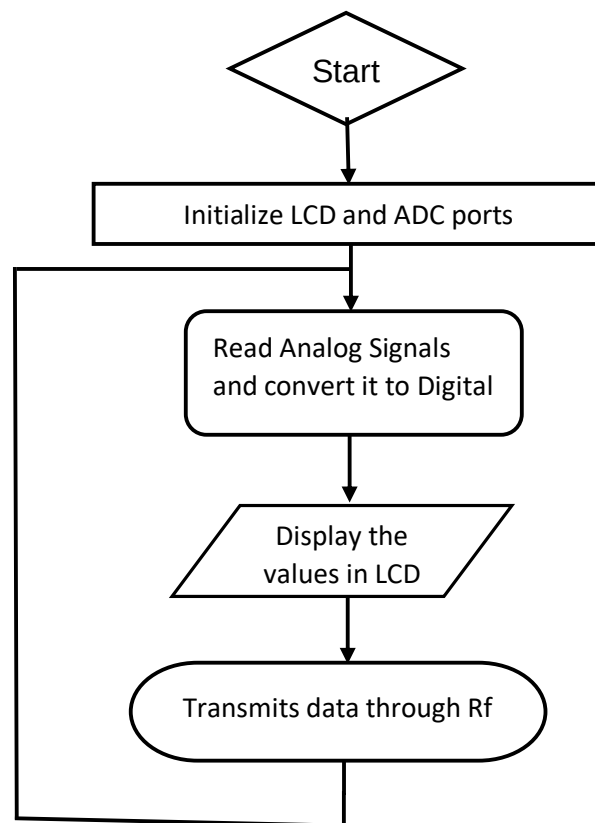


Fig:4.10.1 Flow Chart for Transmitter Section

In this firstly we have to initialize the LCD (Liquid Crystal Display) and ADC (Analog to Digital Converter) Ports. Because only the Digital Signals alone take in as a input So it reads the analog signal and convert it into digital signal. The values of pH, Temperature, Nutrition and Humidity sensors are measured and display on the LCD Screen. After that the measured values are transmits through RF module.

4.10.2 FLOWCHART FOR RECEIVER SECTION

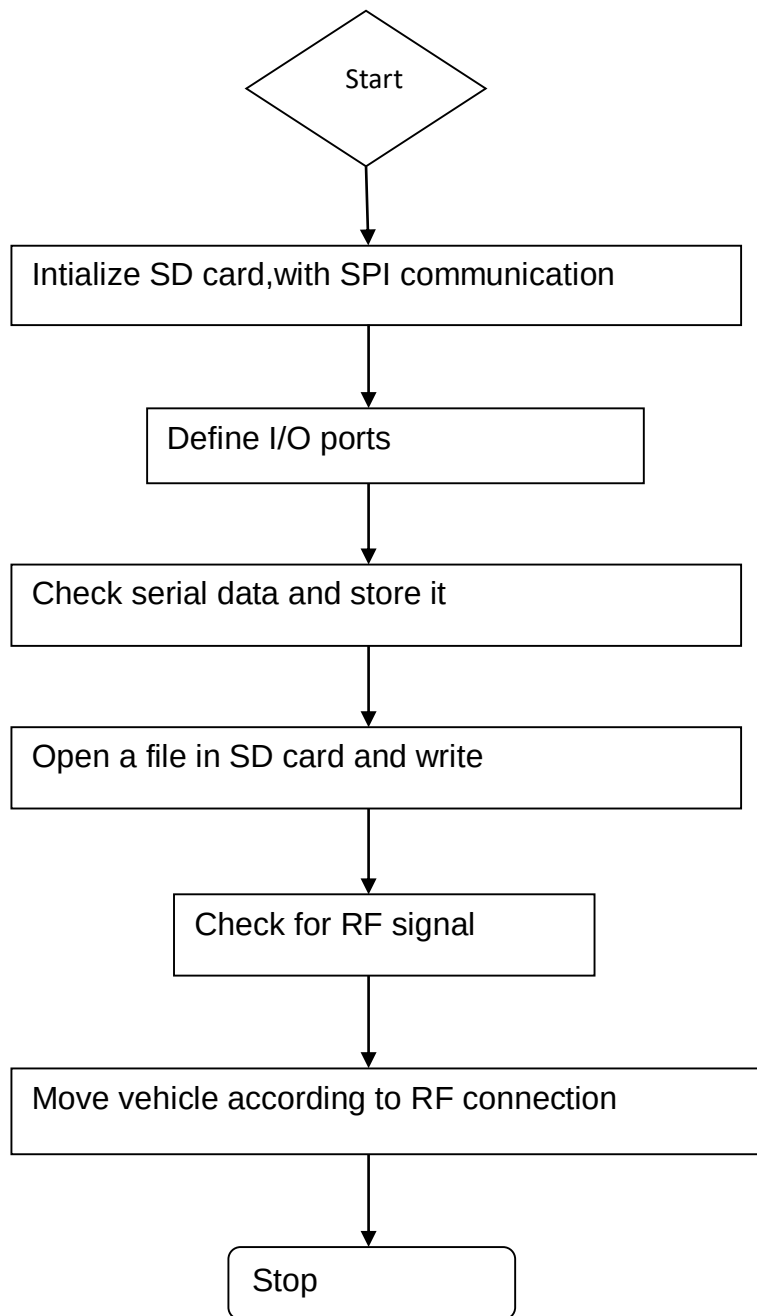


Fig:4.10.2 Flow Chart for Receiver Section

In Receiver setion firstly we have to initialize the SD card with Serial Peripheral Interface. After that the data's which is transmits from transmitter section are collected and store in SD card. In SD card one file was open and write automatically the collected data while the vechicle move towards by the RF signal.

4.11 CIRCUIT DIAGRAM

The below showing Diagrams are corresponds to the Transmitter Section and Receiver Section. While using these we know how the Arduino pins are connected to the sensors.

4.11.1 CIRCUIT DIAGRAM OF TRANSMITTER SECTION

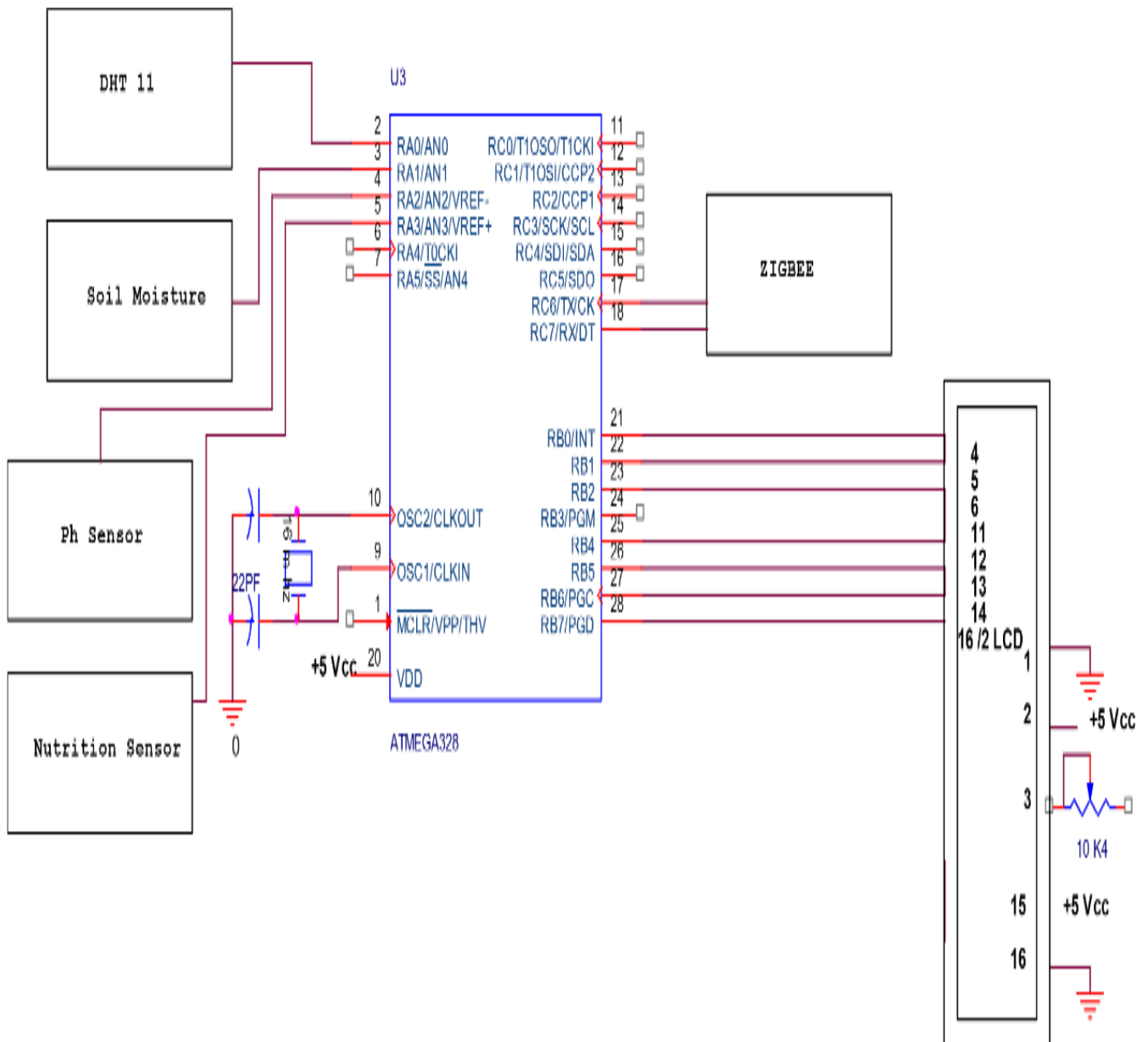
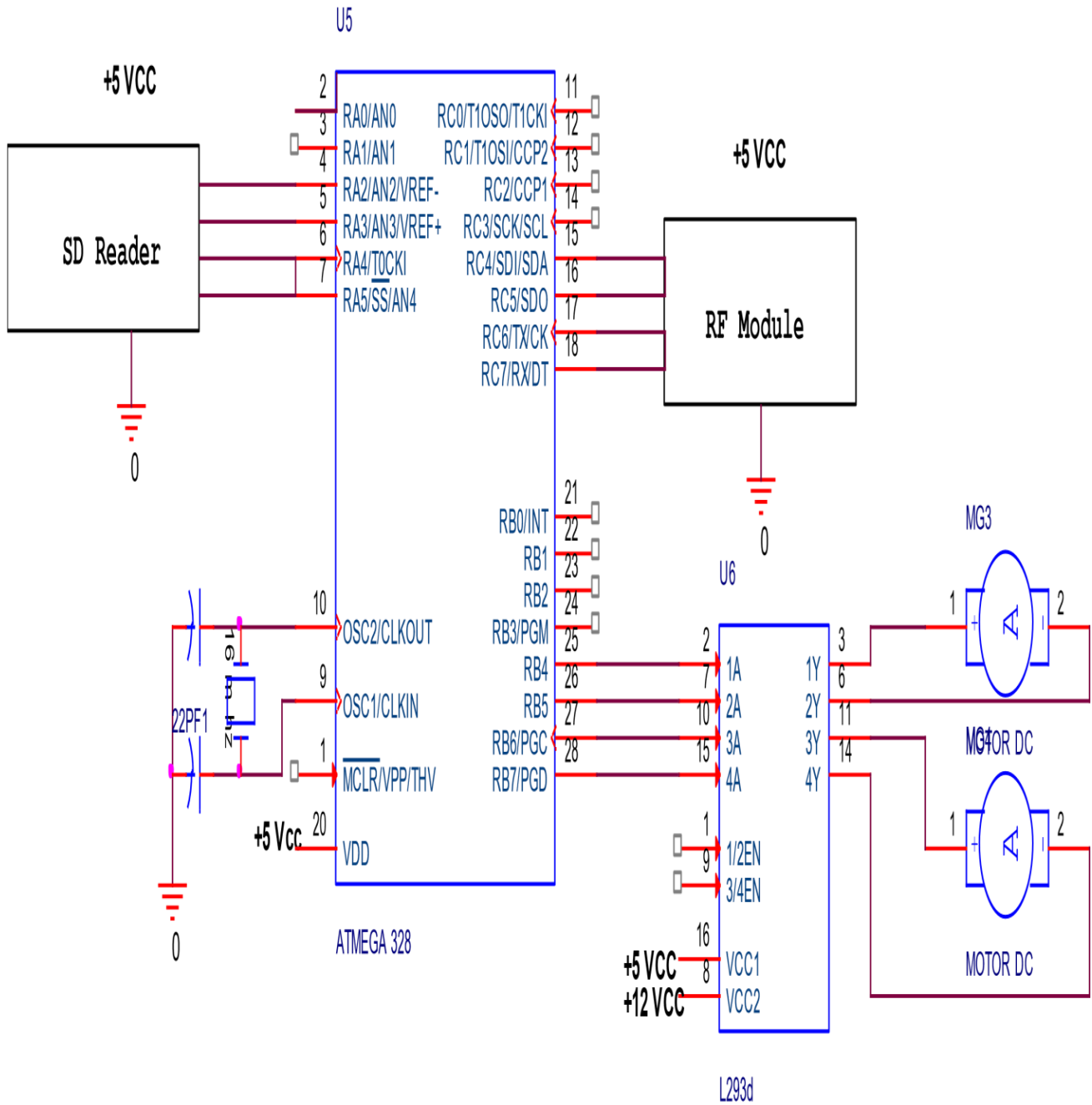


Fig:4.11.1 Circuit Diagram of Transmitter Section

4.11.2 CIRCUIT DIAGRAM OF RECEIVER SECTION



4.11.2 Circuit Diagram of Receiver Section

CHAPTER 5

5. RESULT:

5.1 Software Result

H:29	T:37	pH:15	N:42#
H:29	T:37	pH:15	N:42#
H:29	T:37	pH:15	N:42#
H:30	T:37	pH:14	N:42#
H:30	T:38	pH:14	N:43#
H:29	T:38	pH:15	N:43#
H:28	T:38	pH:15	N:42#
H:28	T:37	pH:15	N:42#
H:27	T:38	pH:13	N:42#
H:27	T:37	pH:15	N:40#
H:25	T:38	pH:11	N:41#
H:24	T:39	pH:11	N:41#

Fig 5.1 Software Result

5.2 HARDWARE RESULT

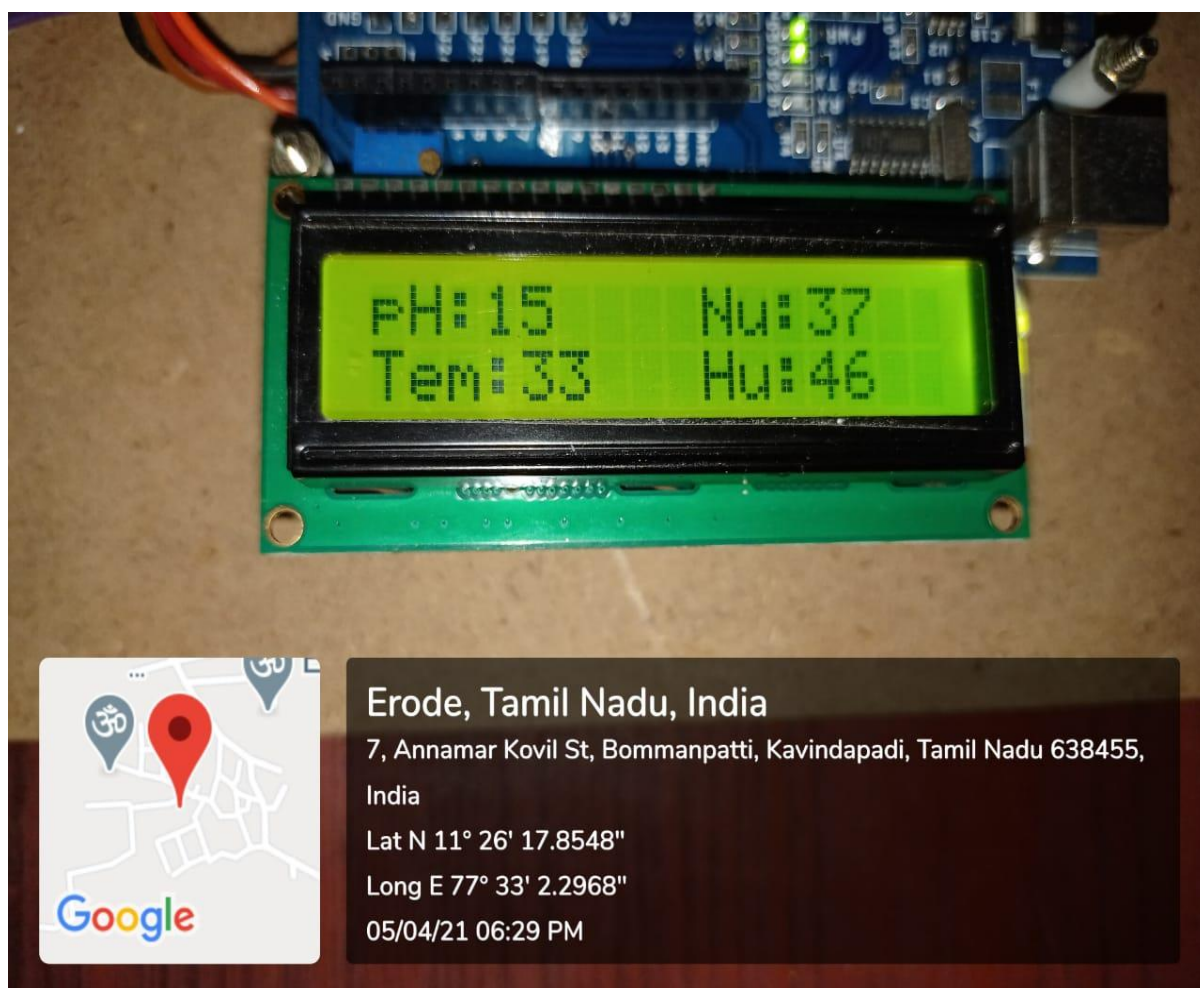


Fig 5.2 Hardware Result

5.3 TABLE OF SENSOR RESULTS:

Table 5.3 Table of Sensor Results

S. No.	SENSORS VALUES				DURATION
	pH	Nu	Tem	Hu	
1	15	42	37	29	Between 30 mins (Afternoon)
	12	32	38	25	
2	15	41	39	24	After 1 hr 30 mins
3	15	29	37	37	After 2 hrs
4	15	37	34	31	After 1 hr 30 mins
	15	37	34	34	
5	13	42	38	25	Between 5 to 10 mins (Afternoon) Different types of soil
	15	36	40	18	
	8	16	39	24	
	11	11	39	23	
6	15	40	24	79	Between 5.40 am to 9.40 am (Each results are taken in the gap of 2 hrs in morning time)
	15	31	26	74	
	15	39	29	65	

5.4 KIT SNAPSHOT

5.4.1 TRANSMITTER SECTION

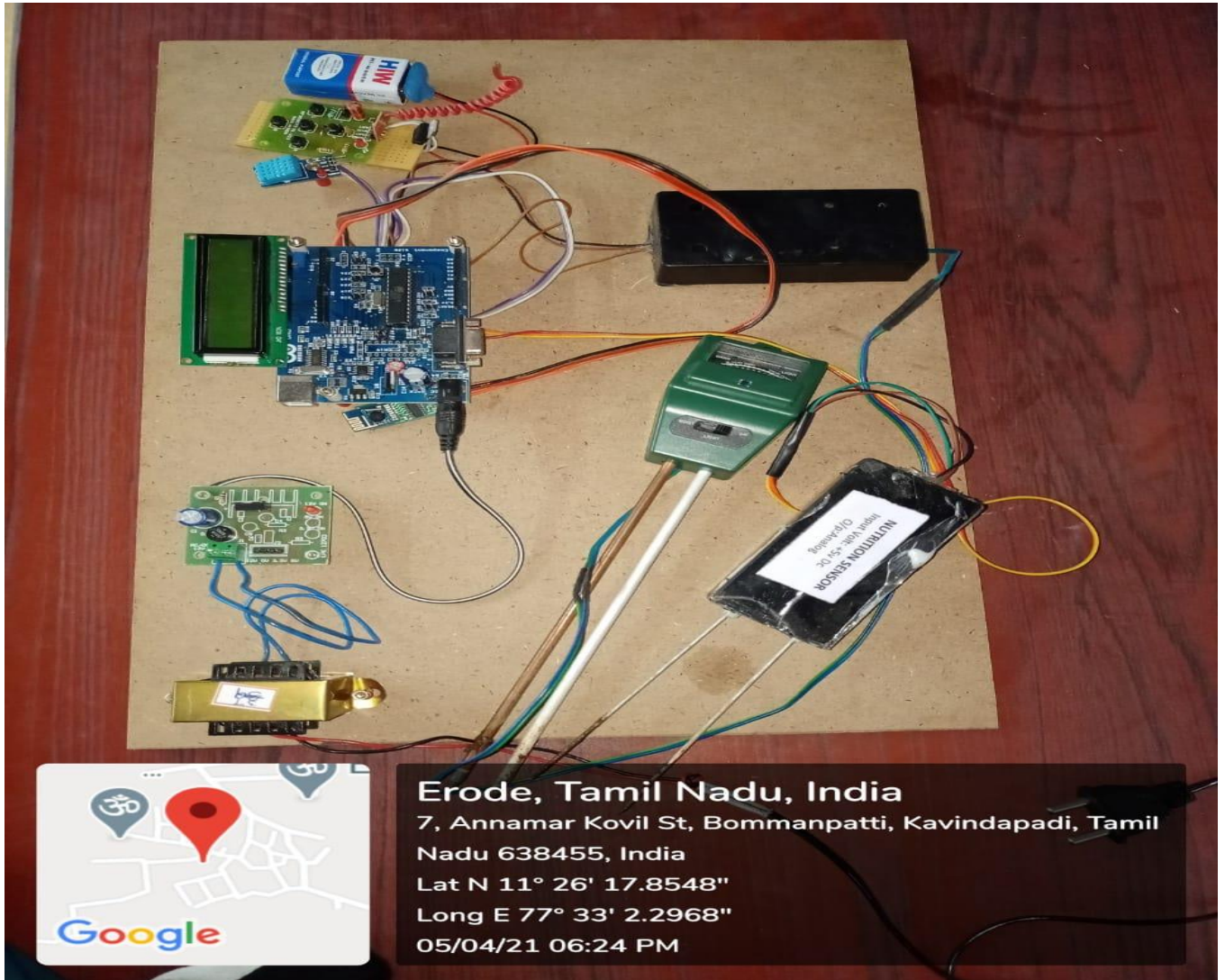


Fig 5.4.1 Transmitter section

5.4.2 RECEIVER KIT

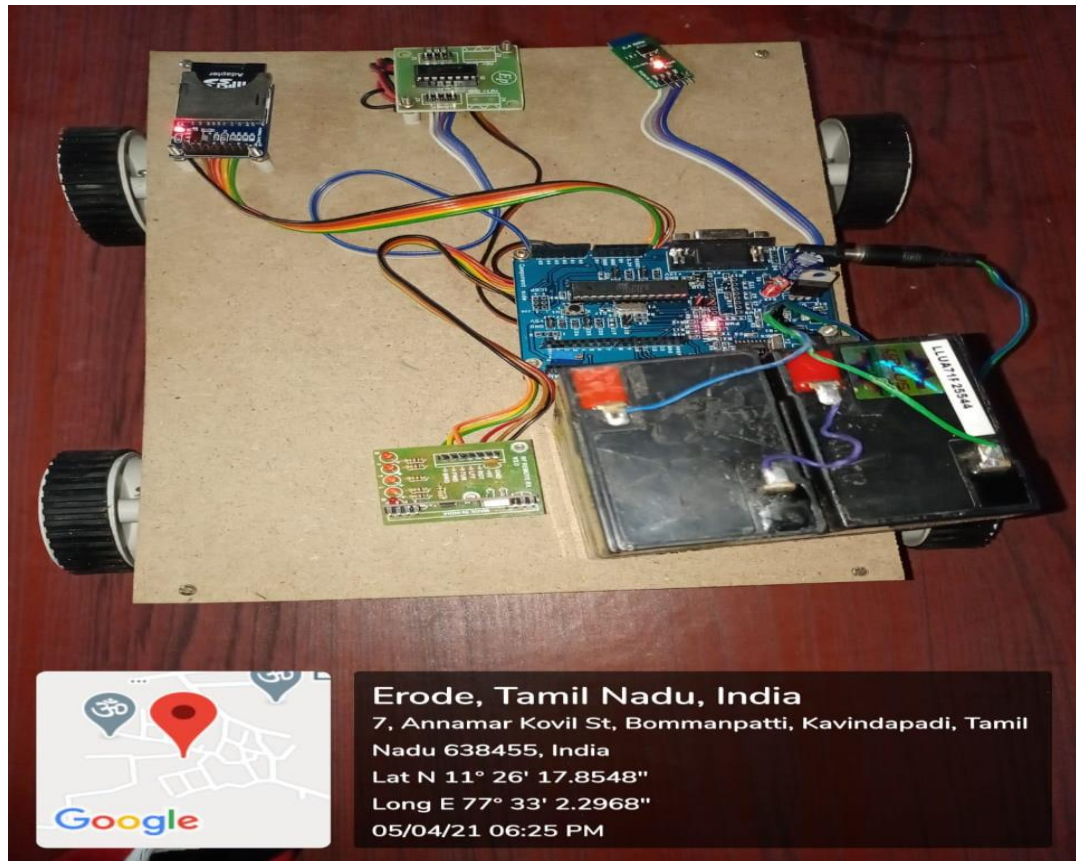


Fig 5.4.2 Receiver Section

5.4.3 RF REMOTE CONTROLLER



Fig 5.4.3 RF Remote Controller

CHAPTER 6

6 CONCLUSION

The hardware proposed here is easy to install, low power consumption (150mA), highly consistent, simple and handy. A novel method request-send-acknowledge is successfully used to communicate between a data collection and Soil parameter monitoring device. The system is expandable and utterly adaptable to the requirements of the end user. The trial events validate that the proposed model, with suitable sensors and controls, provides adequate results. A practical approach is applied to design the soil monitoring system for measure and control of the plant growth parameter. By use of the technology like IoT, agriculture can be executed more efficiently and more accurately. Water is the common primary thing which is very important for agriculture. The offered practice automates the complete process of irrigation, which is a time-consuming process. Consequently conserving, time money and water and fertilizers too. From the present system, it can be concluded that there can be extensive development in agriculture with the help of this platform. This system is a possible solution to the difficulties suffered by the farmers in the manual process and thus utilising the resources to optimum.

6.1 FUTURE WORK

Future agriculture will use advanced technologies such that robots, temperature and moisture sensors, aerial images, and GPS technology also. These advanced devices and precision agriculture and robotic systems will allow farms to be more profit, efficiency, safe, and environmentally friendly.

REFERENCE

1. A. Gulati, S. Thakur, Smart Irrigation Using Internet of Things, in: 2018 8th Int. Conf. Cloud Comput. Data Sci. Eng., IEEE, 2018: pp.819–823
2. A.D. Deshmukh, U.B. Shinde, A Low Cost Environment Monitoring System Using Raspberry Pi and Arduino with Zigbee, in:n.d.
3. AlexandrosZervopoulos,AthanasiosTsipis,Aikaterini Georgia Alvanou,KonstantinosBezas,GeorgiosTsoumanis,VasileiosKomianos,GeorgeKoufoudakis, Wireless Sensor Network Synchronization for Precision Agriculture Applications, 2020.
4. Ashish Lalwani, MrunmaiBhide, S. K. Shah, Autonomous Agribot for Smart Farming, 2017.
5. BalakrishnaKempegowda , Real-Time Soil Monitoring System for the Application of Agriculture, 2016.
6. Beecham Research Ltd., Towards Smart Farming Agriculture Embracing The IoT Vision,2014.
7. Dasari Naga Vinod, Autonomous Farming and Surveillance Agribot in Adjacent Boundary, 2018.
8. DivyanshThakur,YugalKumar,ArvindKumar,Pradeep Kumar Singh,Applicability of Wireless Sensor Networks in Precision Agriculture, 2019.
9. H.V. Bhatnagar, P. Kumar, S. Rawat, T. Choudhury,Implementation model of Wi-Fi based Smart Home System, in: 2018 Int. Conf. Adv. Comput. Commun. Eng., IEEE, 2018: pp.23–28.
10. Helmy, Marsha GresiaMahaidayu, ArifNursyahid, Thomas AgungSetyawan, Abu Hasan, Nutrient Film Technique (NFT) Hydroponic Monitoring System Based on Wireless Sensor Network, 2017.
11. MaherinMizanMaha,MdMasuduzzaman,Smart Board for Precision Farming Using Wireless Sensor Network, 2019.
12. Mr.KunalGoel,Dr.Amit Kumar Bindal, Wireless Sensor Network in Precision Agriculture
13. P.B. Jarande, S.P. Murakar, N.S. Vast, Ubale N P, S.S. S, Robotic Vacuum Cleaner Using Arduino with wifi, 2018 Second Int. Conf.Inven. Commun. Comput. Technol. (2018) 1513–1517.
14. P.P. FathimaDheena, G.S. Raj, G. Dutt, V.J. S, IOT Based Smart Street Light Management System, in: 2017 IEEE Int. Conf. Circuits Syst. IOT, 2017: pp.368–371.
15. PavankumarNaik,ArunKumbi,KirthishreeKatti,NagarajTelkar,Automation of Irrigation system using IoT, 2018.
16. R. Deekshath, P. Dharanya, K.R.D. Kabadia, G.D. Dinakaran, S. Shanthini, IoT Based Environmental Monitoring System using Arduino UNO and Thingspeak, Int. J. Sci. Technol. Eng. 4 (2018)68–75
17. Roopa G K,Radhika Shetty,IOT&Wireless Sensor Networks in Precision Agriculture, 2019.
18. S. Athani, C. Tejeshwar, M.M. Patil, P. Patil, R. Kulkarni, Soil moisture monitoring using IoT enabled arduino sensors with neural networks for improving soil management for farmers and predict seasonal rainfall for planning future harvest in North Karnataka -India, in: Int. Conf. I-SMAC (IoT Soc. Mobile, Anal. Cloud), 2017: pp.43–48
19. S. Chaudhury, D. Paul, Internet of Thing Based HealthCare Monitoring System, (2017)346–349.
20. W. Hlaing, S. Thepphaeng, V. Nontaboot, Implementation of WiFi-Based Single PhaseSmart Meter for Internet of Things (IoT), in: 5th Int. Electr. Eng. Congr. Pattaya, Thailand, 8-10 March 2017 Implement., 2017: pp. 8–10.