# ADVANCED AGRICULTURE

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***Abstract*— The increasing demands of many consumers and demand for agricultural products has stimulated an awareness among farmers that increasing their productivity by implementing advanced technologies is the best option for the long term in this sector. The most important aspect that is to be improved is the efficient use of natural resources. Traditional techniques are very inefficient and cannot keep pace with the increasing demands. Therefore our paper outlines techniques that can be implemented in order to achieve higher yields by using soil moisture sensor for determining the soil moisture level, pH level sensors to maintain proper soil pH using fertilizers and others which are connected to a GSM module which is used to send updates periodically to the farmer's mobile phone.**

**Advances in wireless communication technologies have led to the emergence of numerous engineering projects to meet human needs. As we all know, agriculture plays a significant role in developing countries such as India and the implementation of mobile communication to facilitate farmers is the basic idea of our project.**

***Keywords*—Arduino, Soil moisture sensor, DHT 11 (Temperature and Humidity sensor), pH Sensor, Water pump, Relay, GSM Module.**

## I. INTRODUCTION

Agriculture is one of the most important and oldest activities that humans do. We as a species heavily rely on it to meet our food supply demands. In the present world, with the rapid growth of the world population, agriculture is still a necessity for the human race. Agriculture is the backbone of the Indian economy, as 60-70% of the economy depends on it. India is one of the largest producers of wheat and rice. In the present world, with the rapid growth of the world population, agriculture is still a necessity for the human race. As agriculture requires proper irrigation and specific weather conditions and with each year we have a higher water use than rain with varying weather conditions, it becomes essential for producers to look for ways to conserve water, minimize the energy, costs and work and at the same time achieve maximum performance. Traditional irrigation techniques require a lot of water, but almost half of the water is wasted as it does not reach the intended destination or simply just too much water is used.There is a need for a better system to manage these resources and make efficient use of them. Our project, **Advanced agriculture** aims to tackle this and provide a cost effective solution for farmers. With the use of modern sensors and controllers, we can monitor and control various important parameters which enables us to make better decisions.

The main objectives are:

- The system supports the decision to manage water and fertilizers, which determines the control times for the process and supervision of the entire system through the GSM module.
- The system constantly monitors the water and fertilizer level in the tank and provides the precise amount of water and fertilizers needed for the plant or tree (harvest).
- The system checks the temperature, pH value and soil moisture.
- Low cost and effectiveness with low energy consumption using sensors for monitoring and remote-control devices that are controlled by SMS via a GSM via an Android mobile device.

## II. LITERATURE SURVEY

The paper on 'IOT Based Smart Agriculture Monitoring System' proposes monitoring of the agricultural field with an alarm system which sends a detailed description of the values read by the various sensors like the temperature sensor LM35, moisture sensor and PIR sensor. The alarm is sent when the sensor reads values that exceeds a user defined threshold value. They have equipped both an automatic and a manual system which controls the switching ON and OFF of the PIC microcontroller 16F877A, automatically or by an android application respectively. Proteus 8 is used as a simulation software for various circuit designs of the microcontroller. It is also used to test programs and embedded designs which avoids the risk of damaging hardware due to any wrong design.

The next step involves the sending of the message by the **GSM module**, The SMS is sent through the terminal to the number using AT Commands. "AT-Attention" commands which are used by the controller to control the GSM to perform the desired functions. The **LM35 sensor** is used as a temperature sensor because its output is directly proportional to the temperature in celsius, and also has a wide range of measurement value from (-55) degrees to (+150) degrees. **PIR sensors** provide detection of any kind of movement in the field, it detects the infrared radiation emitted or reflected from an object. **Water level sensor** is used just to indicate the level of water inside any water source employed by the farmer. Other devices like the LCD screen, Buzzer, ADC are also employed by the authors.

## III. WORKING PRINCIPLE

ADVANCED AGRICULTURE is a simple, multipurpose and an affordable system which works on the various parameters to keep the agricultural field functional and tries to increase the overall yield of the crops. The field is monitored by 4 parameters, Soil moisture, pH value, temperature and humidity. For these parameters we will have sensors that will read the data from the field and then send it to our controller, Arduino. The controller will then compare the values to the user specified threshold value. In case the value read by the sensor does not satisfy the required values, then a signal will be sent to the relay board. To maintain the soil moisture level, we will have a 3 phase motor to start the flow of water in the field.

Similarly the system will have a fertilization system to satisfy the pH value of the soil and a fan or some kind of ventilation system to control the temperature and humidity. The system will monitor these values from the field continuously and would stop the signal to the relay board when we get the optimum values.

Further, for monitoring purposes we have integrated 2 systems, firstly, an LCD screen that can be attached anywhere in the vicinity of the field, like the gate or in the house of the farmer as well, the system is programmed in a way that we can decide what kind of information the farmer needs to check about his field, this includes the status of the pumps and the data from the sensors as well. We have also been able to introduce a telecommunication system with the GSM module. This module is used to send such information to the mobile device of the farmer, the biggest advantage of this system is that this module supports even the basic sim cards and mobile phones which are usually employed by the farmers.

## VI. BLOCK DIAGRAM

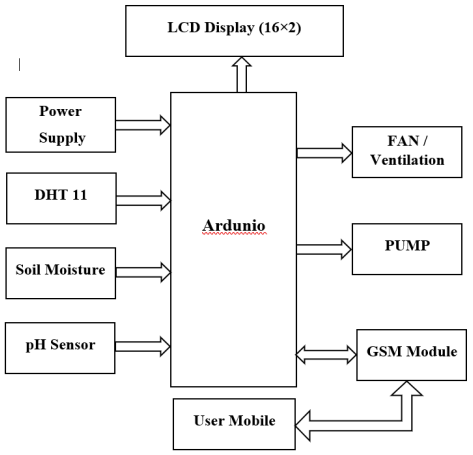


*Fig 1: -Block Diagram*

## IV. PROJECT MODULES/COMPONENTS

The project can be better described by dividing it into two categories, namely.

1. Hardware

2. Software

### HARDWARE:

### ARDUINO UNO

Arduino Uno is a controller unit, based on ATmega328P. It is fitted with fourteen optical I / O pins, six analog inputs, a 16 Megahertz quartz crystal, a USB interface, a power connector, an ICSP header and a RESET key.

- It has an operating voltage of 5 Volts
- It can have an input voltage between 7-12 Volts
- It has a limiting range of input voltage : 6-20 Volts
- It is provided with digital I/O Pins =14 ( 6 = Pulse Width Modulation o/p)
- It can have a DC Current for each I/O Pin as 40 mA
- The DC Current for 3.3 Voltage Pin is 50 mA
- It is equipped with a flash Memory of 32 KB of which a half KB is acquired by the bootloader.
- SRAM: 2 KB (ATmega328)
- EEPROM: 1 KB (ATmega328)

**Sensors Used:**

**1. Soil moisture Sensor**

The soil moisture sensor consists of two probes used to measure the water content. The two probes allow the current to pass through the ground and thus obtain the resistance value to measure the humidity value. If water is plentiful, the soil contributes to more energy, meaning the resistance is lower. When the water level decreases the soil consumes less energy, indicating that the resistance rises. The sensor inserted into the ground and the status of the water content in the soil can be reported as a percentage.

The designed circuit uses a 5 V power supply, a fixed 1kΩ resistor, a 10Ω resistor, two copper wires as sensor probes, and a BC548 transistor. Provides a voltage output corresponding to the earth conductivity. The output voltage is conducted on the transmitter connected to a 10kohm resistor. The two copper wires inserted into the soil act as sensor probes.

Principle:

The soil moisture sensor uses the capacity to measure the dielectric permittivity of the surrounding environment. In soil, dielectric permittivity is a function of the water content. The sensor creates a voltage proportional to the dielectric permittivity and, therefore, to the water content of the soil. The sensor calculates the average of the water content over the parameter of the sensor.

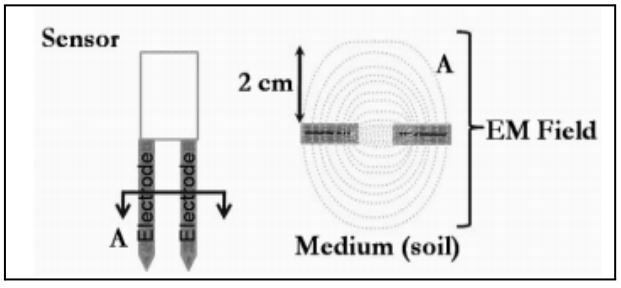


*Fig 4: - Soil Moisture Sensor Working*

Specifications:

- It provides a range of 0 – 45 percent of volumetric water content in soil. It can go to a 100% with a different calibration.
- It has an accuracy of ±4%
- It has a thirteen bit resolution (Sensor DAQ) 0.05%

- Twelve-bit resolution (LabPro, LabQuest, Go! Link, or Easy Link) 0.1%
- Power 3 mA at 5 Volts DC
- A range of operating temperature of –40 to +60oC

Moisture requirements for different crops:
In general, it is recommended to keep the soil moisture in the upper 60 cm of the soil not less than 70% of the field capacity. For rain irrigation, the optimal soil moisture range is usually from the field capacity (soil moisture available 100%) to 50% of the soil moisture available, while for drip irrigation the optimal range is from the field capacity to 90% of the soil moisture available in the irrigation area.
Below are the humidity requirements for different crops:

Onion-55%, Rice-80%, Sugar cane-95%

**2. Temperature and humidity sensor (DHT11)**

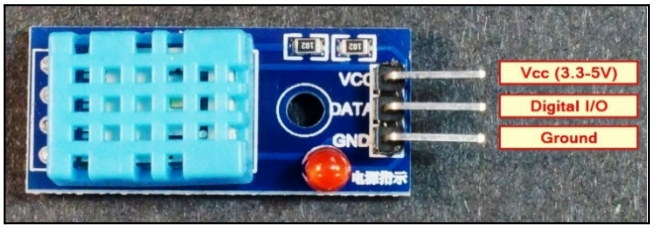


*Fig 5: - DHT11 Sensor*

Dht11 is a digital sensor which is used to detect Temperature and humidity of the surrounding area .It is cost effective and User Friendly. Sensor make use of capacitive humidity and a thermistor to measureThe surrounding area and generate data in digital form.

Operating principle of the DHT11 sensor:

To Detect Temperature of the surrounding area , a DHT11 sensor makes use of two components: a humidity sensor and a thermistor. Negative Temperature Coefficient thermistor is used by Sensor to calculate the temperature .This property helps Sensor to estimate increase in temperature When value of Resistance Decreases. To achieve a small change in Temperature From higher Resistance Value , Sensor is made up of ceramic Polymers or Semiconductors.

Temperature Range of Sensor Lies Between 0 and 50 degree Celsius with accuracy upto 2%..Range of Humidity of Sensor is between 20 to 80 % with 5% precision. Frequency of Sampling rate is 1Hz. The DHT11 Sensor is compact in size . The operating Voltage Ranges from 3 to 5 Volt. The Average Current used by DHT11 is 2.5mA.

**3. pH sensor**

pH is a $H_2$ ion scale in a solution and illustrates that somehow the behavior of the hydrogen ion (-log10 aH+) is (aH+). The pH range 0-14 is a sum of 10,000,000,000 (1x 1014), i.e. the hydrogen ion concentration is pH (1x 1014), which is more than pH (1x 507*2) = 14. This means that the pH for hydroxyl ion is 14 times higher (1x 1014) than pH= 0.

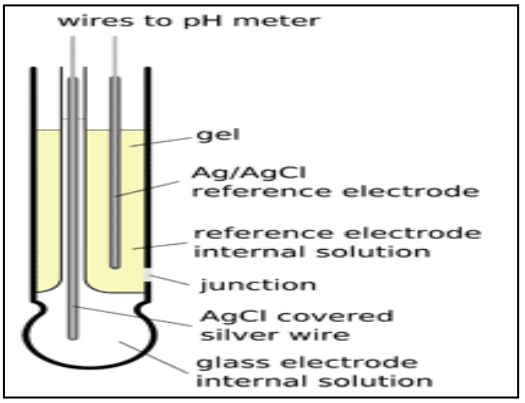


*Fig 7: -Internal Structure of pH Sensor*

Unless there are equal numbers with hydrogen and hydroxyl ions, pH is 7. Acids are labeled pH amounts from 0 to 7 and bases from 7 to 14. The improvement in a single entity pH (e.g. pH 6 to pH 7) is a change in the factor 10 of the hydrogen ion concentration.

By producing electrical potential in the glass / liquid interface, a pH electrode's glass membrane reacts to the behavior of the hydrogen ion. This potential varies with both the pH of the measured solution at a constant temperature.

**pH Table**

| pH Range | | |
|---|---|---|
| **5.0-5.5** | **5.5-6.5** | **6.5-7.0** |
| Blueberries | Wheat | Some Clovers |
| Irish Potatoes | Corn | Alfalfa |
| Sweet Potatoes | Cotton | Sugar Beets |
| Peanuts | | |
| | Rice | |
| Soya beans | | |

*Fig 8: - pH Range for different crops*

**4.GSM MODULE**

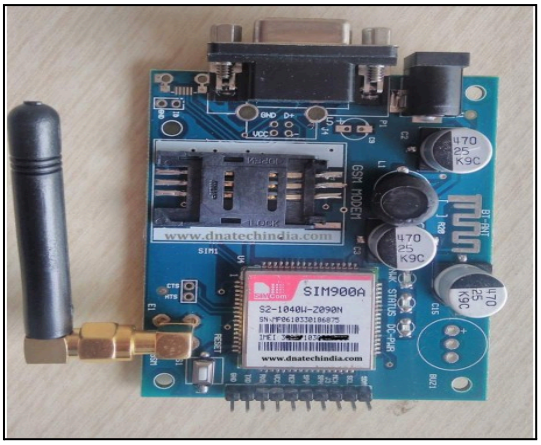


*Fig 9: - GSM Module*

Introduction:

The TTL modem is a SIM9004-band GSM / GPRS, running at frequencies of 850 MHZ, 900 MHZ, 1800 MHZ and 1900 MHZ. It is tiny to use as a GSM modem and comfortable. The

modem is aligned with the 3V DC system. At the AT commands (caution), a rate between 9600-115200 bps can be set. The modem comes with a 3v3/5VDC interface cable, allowing the user to directly communicate with the 5 V Microcontrollers (PIC, AVR, 8051 etc.) AND the 3V3 (ARM, ARM Cortex XX, etc.) This GSM / GPRS TTL modem has an internal TCP / IP stack that allows users to connect to the Internet via the GPRS feature. It is suitable for the application of the transfer of SMS and DATA in the interface from mobile to mobile. The modem can be connected to a microcontroller using the Universal Synchronous Asynchronous Receiver and the modem comes with a 3v3/5VDC interface cable, allowing the user to directly communicate with the 5 V Microcontrollers (PIC, AVR, 8051 etc.) AND the 3V3 (ARM, ARM Cortex XX, etc.) Transmitter (USART) function (serial communication).

Features:

- RS232 to TTL logic converter or vice versa (MAX232).
- Configurable transmission speed.
- Support for the Subscriber Identity Module (SIM) card.
- Integrated network status LED.
- Powerful integrated TCP / IP (Transfer Control Protocol / Internet Protocol) stack for data transfer via GPRS (General Packet Radio Service).
- Audio interface connectors (audio input and output).
- Most status and control pins are available
- Normal operating temperature: from -20 ° C to +55 ° C
- Input voltage: 5 V to 12 V DC
- Connector LDB9 connector (serial port) provided for a simple interface.

**Hardware Description**

SIMCOM SIM900A GSM Module: This is the true SIM900 GSM module manufactured by SIMCom. The SIM900 is a globally configured four-band GSM/GPRS system running at GSM 850 MHz, EGSM 900 MHz, DCS 1800 MHz, and PCS 1900 MegaHertz frequencies.

The power switch "Allow / Oust" is a push-on type of DPDT that only allows the power generated via the Dc / Ac socket, shown by the "Power LED." GSM on Switch is a type of DPST Push on the control-button used for the creation of the "On" GSM module labeled with "On / Off LEDs" from which the module begins with the LED lit Network warning network. Card Slot: SIM

The status of the indicator LEDs is shown: there are three LEDs showing the on/off status of the node, the network status, and the off/on status. Once this card has been disabled via the push and off feature, the control LED stays active. The network status LED is displayed when the inserted SIM card is correctly linked to the provider with a poor signal power. The on / off panel LED demonstrates the on / off state of the GSM machine.

RXD, TXD and GND pins (JP2):

These pins connect devices to the GSM module through USART communication (universal synchronous receivers and senders). Those are also used to attach devices. Devices can be such as desktop computers or tablets, etc. RXD (Receive Data) has to be attached to another device's TXD (Data Transmission) and GND (Earth) must be connected to another device's GND pin to provide both systems with such a common base to use.

**5. 16x2 LCD**

LCD modules are very commonly used in most integrated projects, due to their cheap price, availability and ease of programming. Most of us would have found these screens in our daily lives, both in PCO and in calculators.

The LCD is named 16 x 2 because of 16 numbers of columns and 2 rows. There are various other combinations available, such as 8 x 1, 8 x 2, 10 x 2, 16 x 1, etc., but the most commonly utilized is the 16 x 2 LCD screen. Therefore, it will have 16 x 2 = 32 characters and each character will consist of 5 x 8 pixel dots.

**Pin Diagram:**

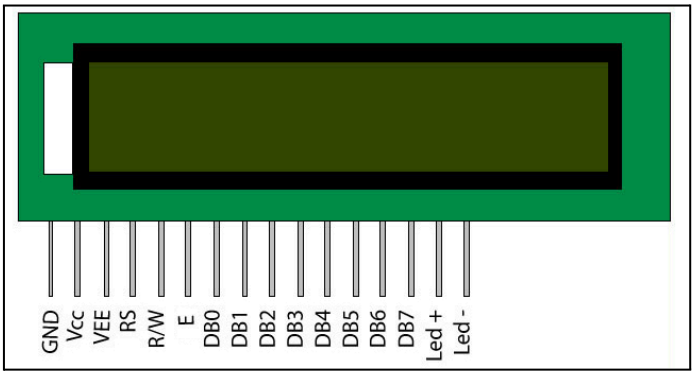


*Fig 14: - Pin diagram of 16x2 LCD*

A register must pick the pin (RS) for the memory of the LCD. You may pick the data log, which shows what is on the screen or an order log where the LCD display is searching for the next move.
Chooses a read-or write-mode pin (R or W).
A pin (E) activation to enable records to be registered.
Eight pins (D0-D7). 8 holes. The states (higher or lower) of these pins are the parts you type in a register while writing or read.

**6. RELAY**

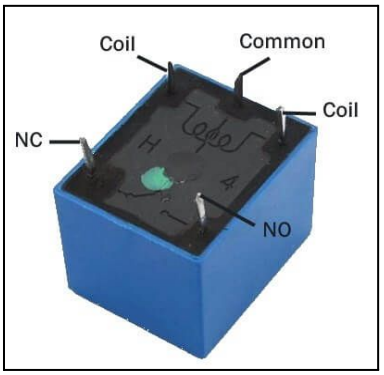


*Fig 15: - Relay Terminal*

A relay is used to connect the pump with the controller. The relay prevents the motor from drawing its power through the controller. A Relay is actually a switch which is electrically operated by an electromagnet. The electromagnet is activated

with a low voltage, for example 5 volts from a microcontroller and it pulls a contact to make or break a high voltage circuit. The main operation of this device is to make or break contact with the help of a signal without any human involvement in order to switch it ON or OFF. It is mainly used to control a high-powered circuit using a low power signal.

**7. MOTOR**

For the implementation of a project on an actual large field a High-power motor is needed for proper irrigation, this would require a proper circuit and high voltage relay for interfacing motor with controller.

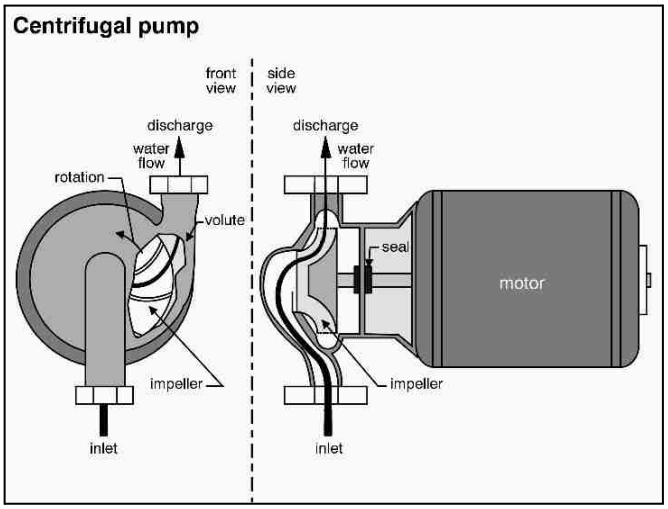


*Fig 16: - Centrifugal Pump*

An Electric motor is an electrical Device which converts Electrical energy into Mechanical energy. This process is Carried Using Motor's magnetic Field and Electric current in a wire winding to Generate Force in the form of Torque applied on Motor's Shaft. These Motors are powered by Direct current or Alternating current. The Most commercially Used Motors are powered by AC. The Widely used Types of Ac Motors are Single Phase and Three Phase Motor's. The commonly used Motor for Small Load Works or Household Purposes is Single Phase Ac motor. The Advantage of using Single Phase Ac Motors are they are highly Reliable, Construction of Single-Phase Motor is Simple, Cost -effective and Easily Affordable, repairing of these Motor's is easy.

**SOFTWARE:**

**Arduino Software (IDE):**

You may use Arduino Uno (Arduino Program (IDE)) to program it. ATmega3328 is configured by boot loading the Atmega / Genuine One board. In the Tools > Board list, pick the boot loader to allow the ATmega328 on the Arduino Uno to load new code without using external hardware programmers, interacting with the initial Arduino Uno STK500 Protocol (reference, header file C).

## V. FUTURE SCOPE

- In order to increase the Security of the Field , We can set up a field monitoring System. which will help to track various activities on the field.
- Data Science can be implemented to perform analysis . Data gathered from various Sensors can be used for analysis . This analysis will provide insights of where improvement is needed.
- The temperature monitoring and control action can be used at home or in different rooms, such as a conference room, seminar room to control the room temperature.
- We are able to measure multiple parameters such as humidity, light, CO2, water level, pressure, etc. and at the same time check them all.
- A voice alarm can be used instead of the normal bell.
- We can measure more parameters like Humidity, Light, CO2, Water level, Pressure etc. and at the same time control them all.
- By using large systems in different areas, we can easily reduce the greenhouse effect.
- A multi-controller system can be developed that allows a master controller together with its slave controllers to automate multiple greenhouses simultaneously.
- Using cloud computing we can get all the harvest data on our smartphone.
- Using the pest detection sensor, we can detect the presence of pests on a farm.

## VI. CONCLUSION

A gradual approach in the design of the Arduino-based system for the control and measurement of the important attributes for plant growth, i.e. temperature, pH value and soil moisture content, has proved a very reliable and precision filled performance of this system. This reduces the time required for the manual watering of the plants/field. This reduces the number of farmers/laborers that work on a traditional agriculture method.

Sensors like the temperature sensor, the pH sensor and the soil moisture measuring device are utilized here to manipulate and keep monitor on the temperature and irrigation of water and fertilizers in the greenhouse/gardening/ live agriculture field.

By reducing energy usage, maintenance and complexity, at a reduced cost and at the same time offering a robust and reliable way of preserving the environment, the device successfully overcomes many shortcomings of existing systems.

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