



## SMART FARMING USING SENSORS FOR AGRICULTURAL TASK AUTOMATION AND FENCING SYSTEM

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**Abstract:** Smart farming relies heavily on the Internet of Things (IoT). IoT sensors capable of supplying information on their agriculture areas have given rise to the concept of smart farming. The goal of the article is to use emerging technology, such as the Internet of Things (IoT) and smart agriculture with automation. The main component in increasing the production of efficient crops is to monitor environmental conditions. This paper's main feature is that it uses several sensors to monitor temperature, humidity, soil moisture, and rainfall in an agricultural area. The Pi Camera is connected to take photographs and videos, which are then sent to the appropriate email address using an SMTP server.

**Index Terms – Temperature, Humidity, Soil Moisture, Fencing System**

### I. INTRODUCTION

The Internet of Things (IoT) have an important role in present world specially, the internet of Things (IoT) is remodeling the agriculture business and enabling farmers to modify the big challenges they face. The business should overcome increasing water shortages, restricted handiness of lands, tough to manage prices, whereas meeting the increasing consumption desires of a worldwide population that's expected to grow by seventieth by 2050. New innovative IoT applications area unit addressing these problems and increasing the standard, quantity, property and price effectiveness of agricultural production. Sensors offer the primary purpose designed IoT platform designed to fulfill the distinctive desires of today's connected world. Because of the leading IoT platform. It delivers the protection and quantifiability to handle numerous daily transactions. With Sensors, you'll deliver powerful, new good agriculture IoT solutions in an exceeding fraction of the time of different approaches.

Water could be a restricted resource and is crucial for agriculture, business and for creature's existence on earth as well as individuals. Immeasurable individuals don't understand truth importance of drinking enough water daily. A lot of water is wasted by several uncontrolled manners. This drawback is quietly associated with poor water allocation, inefficient use, and lack of adequate and integrated water management. Therefore, economical use and water observation area unit potential constraint for home or workplace water management system.

Internet of Things (IoT) allows to create a system while not human interference. In different words IoT is an atmosphere that has the power to transfer knowledge over a network while not human to human or human to laptop interaction. The present machine-controlled methodology of level detection is delineated which is accustomed build a tool on/off. Moreover, the common methodology of level management for appliance is just to start out the feed pump at a coffee level and permit it to run till a better water level is reached within the cistern. The most purpose of a system to figure with four major halves. The primary half is sensible sensors, second the association mechanism, then the mechanisms that act on the crops and eventually the good board to supply detector and actuator management interface Internet of Things (IoT) refers to a platform wherever a wise area network with practical protocols kind physical and virtual identities for addressing them with ease over the net meant for social environmental communication. This involves a wise arrange of operations of a range of sensors and controller's area unit to be utilized in this proposal to browse these contents. IOT sensors area unit capable of providing data regarding agriculture fields. We've planned an IOT and good agriculture system victimization automation. This IOT based mostly Agriculture observation system makes use of wireless detector networks that collects knowledge from completely different sensors deployed at varied nodes and sends it through the wireless protocol. This good agriculture victimization IOT system is battery-powered by Node MCU, it consists of Temperature detector, wet detector, Rain detector.

The farmers will simply acknowledge the activity by sitting at one place and might operate the pump or motor to irrigate farm remotely within the convenience of a mobile. And thus, excess water will injury to the crops, with the assistance of wet detector the adequate quantity of water required for the land is set, there's an optimum utilization of water and power offer, remotely monitor environmental conditions frequently, and observation each moment of the farm.

## II. LITERATURE SURVEY

[1] Sraboni Bhuiyan has introduced Smart Board for exactitude Farming victimization Wireless sensing element Network. Operating consists of FFD sensing element chiefly used for hearth detection through WIMAX. The information collected through multiple gateways is updated to server in web, to accessed anyplace within the world. The information present in web, displayed in good board and projected a wise sensing element system supported by actuators to change farming and supply exactitude farming expertise. The system helps person with inferior information of technology to grasp and maintain the system with a replacement device specifically good Board. The board helps to watch standing of the farm and to send action command to farm machinery. This work additionally helps to observe of e-governance by setting an easy however effective knowledge exchange between government and farmers. Farmers can get benefitted because the good board can keep them up so far on government's agriculture connected announcements. It's a scientific mixture of the many technologies as well as a wise sensing element network system.

[2] Dr. D. Saraswathi projected the technique known as farming. Farming refers to the art of growing plants in water (either saline) while not soil (land). Nutrients for the plants' area unit equipped to the roots within the style of answer that may be either within the style of static or flowing. Farming is cultivated each in inexperienced house and glass house setting. The limitation in inexperienced house setting is to take care of the temperature, pressure, timidness price at a specific level. additionally, thereto, observation on hydrogen ion concentration price and electrical physical phenomenon in farming is another challenge that must be monitored and maintained. Manual observation is in apply that could be a terribly trivial task else the plants might die out. This project, focuses on 2 tasks, the primary one is to automatize the inexperienced house setting observation. The next is automation of hydrogen ion concentration level and electrical physical phenomenon maintenance. IOT is employed to transfer the retrieved knowledge to web the net (mass storage) and mobile app is employed to speak this standing to the employment through the use of internet to their mobile phones, in order that observation & maintenance are going to be easier.

[3] Amandeep have introduced novel wireless detector network technique in smart Farming victimization IOT to extend the productivity. The wireless detector network uses totally different detectors like temperature sensor that defects the temperature by the warmth created. Humidness detector detects the timidness according the cooling fan and wetness detector that senses the soil wetness. Extremist sonic obstacle detector for thievery detection, these data area unit sends to the most server. additionally, AVR Microcontroller At mega 16/32 want to monitor to regulate the system. Deployed ZigBee Module, that controls the pilotless vehicle and warehouse. Totally different blocks area unit utilized in this work, in block one GPS module is employed for spraying pesticides, scaring away the birds and animals and in block a pair of the AVR microcontroller is employed within which the detector detects and looking on the warmth and therefore the cooling method the motor switch ON and OFF method is allotted. Star PV panels area unit want to generate electricity which is able to offer inexperienced and pollution free power.

[4] Elhassan Mohammed projected the automated irrigation system designed and implementation. The system improved is beneficial and works in a very efficient apply. It decreases the water loss to a larger vary. It desires minimum maintenance the ability waste has been reduced greatly by victimization star cells. The system is applied in greenhouses. The System is incredibly helpful in fields wherever water deficiency could be a major downside. The crop's productivity improved and therefore the wastage of crops area unit greatly cut victimization this irrigation system. The automatic system is simpler and offers additional accomplishable results. The extension work is that the prediction of crop water desires victimization data processing algorithms within which we tend to area unit presently progressing. The prediction helps to provide the correct amount of irrigation to the crops.

[5] Sudhir Rao Rupanagudi delineate tomato maturity grading system victimization image process technique, classification of the matures of fruit, supported its color and texture, forms a really necessary method to be allotted by agriculturists and therefore the food process trade. As we've got ascertained that farmer is usually finite regarding these crops that however the expansion of the plant are going to be because it can't be picturized. Parts utilized in this system area unit soil wetness detector, photographic camera and chiefly MATLAB program is employed for Simulink. Primarily, photographic camera that is placed higher than the crop to capture the image through image process the image gets filtered according to its color. At next stage it'll separate the red tomatoes because its growth is complete and divide it. The analysis been in deep trouble that remaining tomato per its maturity grading, color, texture and image is shipped to the website or application, and additionally it'll send the small print of standing.

[6] Savath Saypadith introduced novel good crop cultivation observation system to grasp the expansion and cultivation of crops. Soil temperature humidness detector, water level detector, relay management and Wi-Fi wireless local area units network{WLAN|wireless fidelity|Wi-Fi|local area network LAN} module are wont to develop observation system. Wireless fidelity module has been connected to sensors specified soil and temperature and water level is been management led by relay control and magnet valve is been introduced to electromechanical operated valve.

[7] Florin Pop have developed cloud primarily based field server system, that senses the extent of water and soil the info collected through actuators been pointed and keep in native field server system. The projected answer accomplished all the goals that it's set and managed to implement a visual image service for giant scale statistic knowledge, that responds to numerous user needs, is flexible and efficient and interacts well with the opposite services from the system that abstracts a wise setting. To form a symbol of thought, we tend to selected good farms that we've got delineate the design of the system, and additionally necessary parts for the event of the visual image service. Once the design has been established, we tend to delineate the workflow of the service, that represents the start line within the implementation stage. Additionally, for any access from anywhere the cloud primarily based field service management has been enforced in order that is accessed from any places.

8] Sinung Suakanto have developed abstract model and system style that encompass network device, server, application and additionally communication protocol for sensible farming. The abstract model includes six components to blame for observation, management, planning, info distribution, call support, and management action. This model considers not solely aspects in device networks and management however additionally knowledge analysis for call support. The model considerations concerning knowledge analysis, as a result of device networks alone cannot facilitate the farmers. Authors have developed an entire system style for sensible farming therefore farming business stakeholders will implement the system in simple approach. The planning focuses concerning device implementation in farm swathes, communication and transmission protocol, and server infrastructure. Clearly, the system style has weakness in kind of constraints. The constraints mentioned square measure traffic management and knowledge nature. Authors offer the stakeholders with some methods to beat the 2 constraints. More analysis is required to implement the system style in a many thanks to certify that the constraint methods are going to be dispensed consequently.

### III. FUNCTIONAL REQUIREMENTS

#### HARDWARE & SOFTWARE COMPONENTS

##### 3.1 The ATmega328

Within Atmel's megaAVR family, the ATmega328 might be a single-chip microcontroller. Basic Arduino boards, such as the Arduino UNO, Arduino Professional Mini, and Arduino Nano, use the ATmega328 microprocessor. The ATmega328 is a twenty-eight-pin microcontroller with an eight-bit high-performance design. 1KB EEPROM, 2KB SRAM, 32KB ISP nonvolatile storage. There are 23 IO pins. There are 32 general-purpose operational registers in all. 6 channel 10-bit A/D converter with SPI interface in operation One voltage. 8-5.5V. The ATmega328 is commonly used in a variety of devices and autonomous systems where a simple, underpowered, low-cost microcontroller is required. NodeMCU

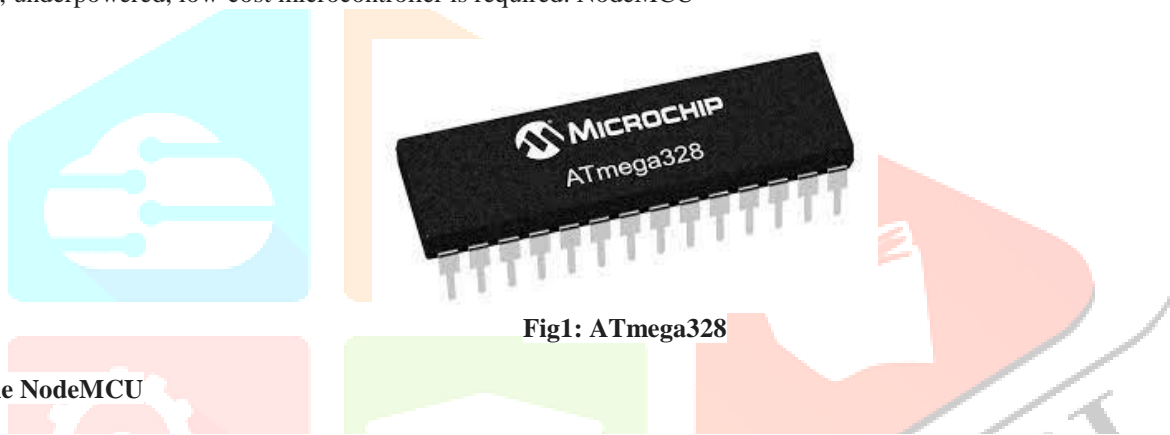


Fig1: ATmega328

##### 3.2 The NodeMCU

NodeMCU are at the core of system acting because the central communication unit Wi-fi AND microcontroller unit. The NodeMCU are accountable for the communication between the hardware elements to the robot app. The NodeMCU can hook up with the net through Wi-fi 802.11b.g for a stable affiliation, 2.4ghz speed. This affiliation is employed to handle communication between the NodeMCU and therefore the robot Mobile. The ESP8266 is capable of either hosting AN application or offloading all Wi-Fi networking functions from another application processor. This module comes with AT commands code that permits you to urge practicality like Arduino local area network protect, but you'll load completely different firmware's to form your own application on the modules' memory and processor. Its a awfully economic module and contains a vast and growing community support.

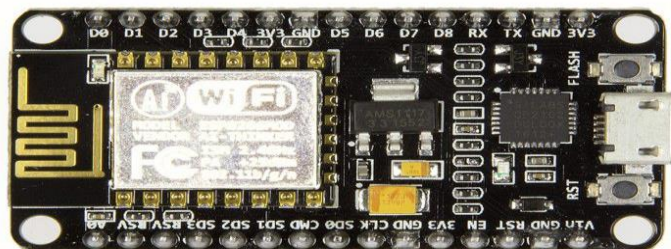


Fig 2: NodeMCU

### 3.3 DHT11

Temperature & wetness sensing element options a temperature & wetness sensing element complicated with a mark digital signal output. This sensing element includes a resistive-type wetness mensuration part associate degreed an NTC temperature mensuration part, and connects to a high performance 8-bit microcontroller, providing glorious quality, quick response, anti-interference ability and cost-effectiveness. When MCU sends a begin signal, DHT11 changes from the low-power- consumption mode to the running-mode, looking forward to MCU finishing the beginning signal. Once it's completed, DHT11 sends a response signal of 40-bit information that embody the ratio and temperature data to MCU. Users will opt to collect (read) some information. while not the beginning signal from MCU, DHT11 won't provide the response signal to MCU.

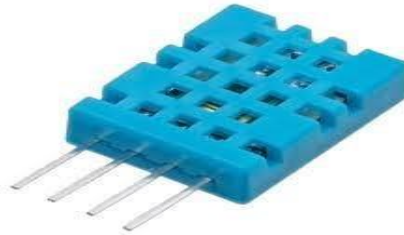


Fig 3: DHT 11

### 3.4 Soil Moisture Sensor

This sensor is used to determine the moisture of soil; when there is a water scarcity in the soil, the module output is high; otherwise, the output is low. By mistreatment this detector one will mechanically water the flower plant, or the other plants requiring automatic watering technique. Module triple output mode, digital output is easy, analog output a lot of correct, serial output with precise readings. the utilization of soil wetness sensors helps growers with irrigation planning by providing info concerning once and the way abundant to water. This provides for economical use of water; enough to fulfill crop desires while not applying excess or deficient water. Excessive irrigation will increase the price of production from extra pumping prices and fertilizer lost to runoff and natural action. It can even decrease yields from water work and natural action of soil nutrients. Excessive runoff will generally be harmful to the surroundings if fertilizers and pesticides emotional to sensitive environments. Under- watering leads to plant stress which might cut back yield and crop quality.

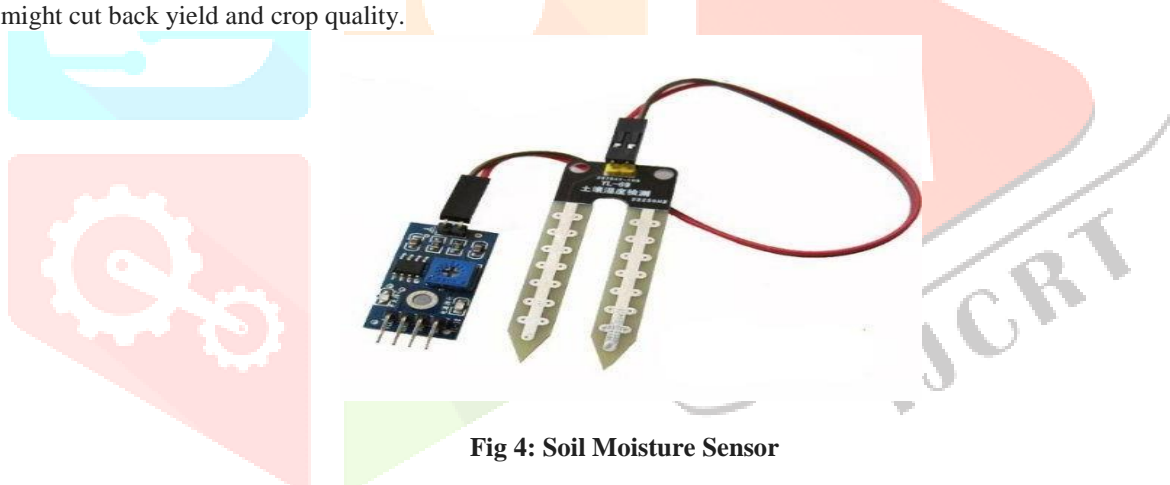


Fig 4: Soil Moisture Sensor

### 3.5 Rain Sensor

The rain device module is a simple tool for rain detection. It is used as a switch once driblet falls through the descending board and additionally for mensuration the intensity. The module options, a rain board and therefore the panel that's separate for additional convenience, power indicator diode associate degreed an adjustable sensitivity although a potentiometer. The analog output is employed in detection of drops within the quantity of precipitation. Connected to 5V power offer, the diode can activate once induction board has no rain drop, and DO output is high. once dropping a bit quantity water, DO output is low, the switch indicator can activate. ignore the water droplets, and once rehabilitated to the initial state, outputs high level.

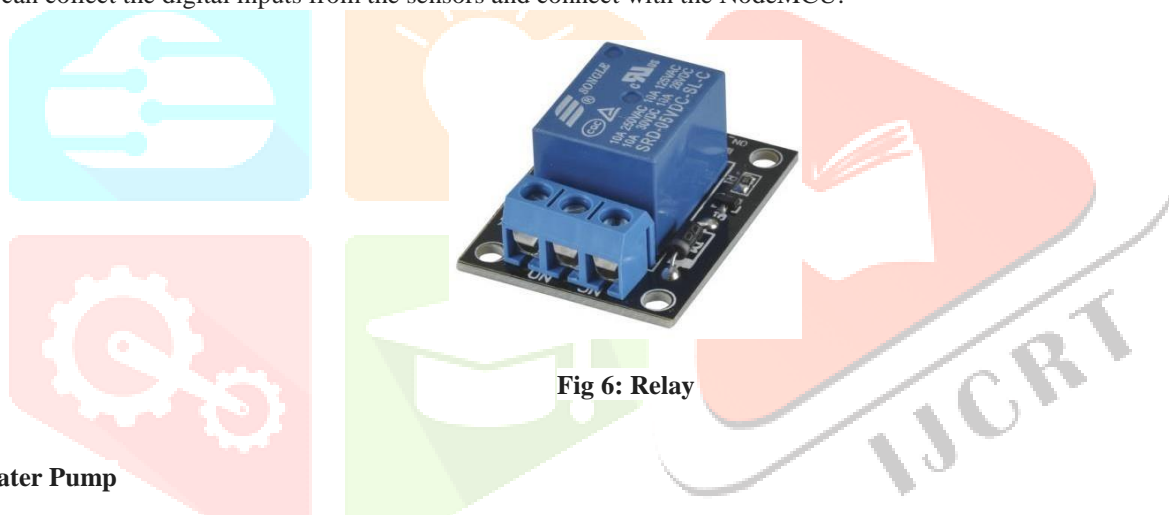




**Fig 5: Rain Sensor**

### 3.6 Relay

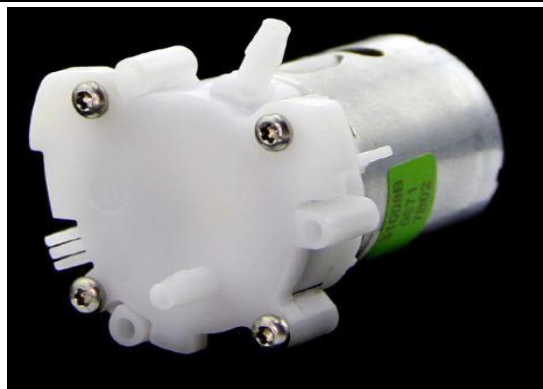
Relay is one in every of the foremost vital mechanical device devices extremely employed in industrial applications specifically in automation. Relay switches area unit electrical switches controlled by alternative switches by permitting atiny low current flow circuit to manage a better current circuit. A relay is employed for electronic to electrical interfacing i.e. it's accustomed put on or off electrical circuits operational at high AC voltage employing a low DC management voltage. A relay typically has 2 elements, a coil that operates at the rated DC voltage and a automatically movable switch. The electronic and electrical circuits area unit electrically isolated however magnetically connected to every other; thus any fault on either aspect doesn't have an effect on the opposite aspect. The Relay switch modules can interface directly with the NodeMCU to receive management command. they're going to even be hardwired to the irrigation valves to show them on and off. The relay can physically interface to the NodeMCU. which can collect the digital inputs from the sensors and connect with the NodeMCU.



**Fig 6: Relay**

### 3.7 Water Pump

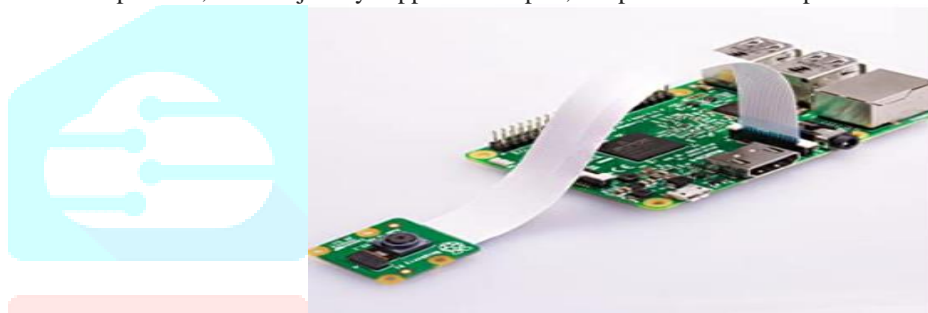
DC 12V 1A Powerful small Brushless Magnetic Amphibious Appliance pump Pump motor DC brushless motor, no spark of labor. Pump beginning current, high potency, stable and reliable operation, low power. Consumption, energy saving, environmental protection. Pump motor shaft with high degree of wear-resistant ceramic shaft, continuous service lifetime of twenty,000 hours or a lot of. Pumps will be amphibious. Specification: Rated voltage: DC12V. Current : one.05A. Flow : 550L / h. Noise : 35dB (0.5 meters). Fluid temperature vary of zero to 65°C. Size : 8cm x 5cm Diameter of Outlet : one0mm Package Includes : 1 x DC 12V Powerful pump. A pump may be a device that moves fluids (liquids or gases), or typically slurries, by mechanical action. Pumps will be classified into 3 major teams in line with the strategy they use to maneuver the fluid: direct raise, displacement, and gravity pumps. Mechanical pumps serve in a very wide selection of applications like pumping water from wells, fish tank filtering, pool filtering and aeration, within the automobile trade for water-cooling and fuel injection system, within the energy trade for pumping oil and fossil fuel or for in operation cooling towers. Solenoid Valve Solenoid Valve are electrical valves controlled by electronic signal by allowing a small current flow , to actuate an electromagnet For irrigation the Solenoid Valves will be used to control the irrigation valves that need to be turned on and off through a physical switch. Using 3.3V from the NodeMCU I/O pins, the solenoid will control the water tap to well , with electrical power operating up to 250V. Solenoid valve to control tap flow into water well. The Relay switch modules will interface directly with the NodeMCU to receive control command. They will also be hardwired to the irrigation valves to turn them on and off. The solenoid will physically interface to the NodeMCU. which will collect the digital inputs from the sensors and connect to the NodeMCU, digital GPIO pin D4.



**Fig 7: Water Pump**

### 3.8 Raspberry Pi Camera

The Raspberry Pi Camera v2 could be a top quality eight megapixel Sony IMX219 image device customized add-on board for Raspberry Pi, that includes a set focus lens. It's capable of 3280 x 2464 component static pictures, and conjointly supports 1080p30, 720p60 and 640x480p60/90 video. The board itself is little, at around 25mm x 23mm x 9mm. It conjointly weighs simply over 3g, creating it excellent for mobile or alternative applications wherever size and weight square measure vital. It connects to Raspberry Pi by manner of a brief ribbon cable. The top quality Sony IMX219 image device itself encompasses a native resolution of eight megapixel, and encompasses a fastened focus lens on-board. In terms of still pictures, the camera is capable of 3280 x 2464 component static pictures, and conjointly supports 1080p30, 720p60 and 640x480p90 video.



**Fig 8: Raspberry Pie 3**

### 3.9 LCD DISPLAY

Liquid Crystal show that is usually called {alphanumeric show|digital display|display} will display Alphabets, Numbers in addition as special symbols so alphabets. Graphic show has embedded controller for dominant completely different modes.



**Fig 9: LCD Display**

### 3.10 Arduino IDE

A microcomputer item uses on the on-electricity supply, a USB connection for connecting to a computer, and an Atmel microcontroller processor. It facilitates the creation of any management system by supplying a standardized board that can then be configured and installed without the need for complicated PCB concept and implementation.



Fig 10: Arduino IDE

### 3.11 Thing Speak

Thing Speak is degree IoT analytics platform service that allows you to mixture, visualize and analyses live data streams among the cloud. Thing Speak provides instant visualizations of knowledge denote by your devices to Thing Speak. With the ability to execute MATLAB® code in Thing Speak you will be ready to perform on-line analysis and method of the knowledge as a result of it comes in. Thing Speak is used for prototyping and proof of concept IoT systems that require analytics.

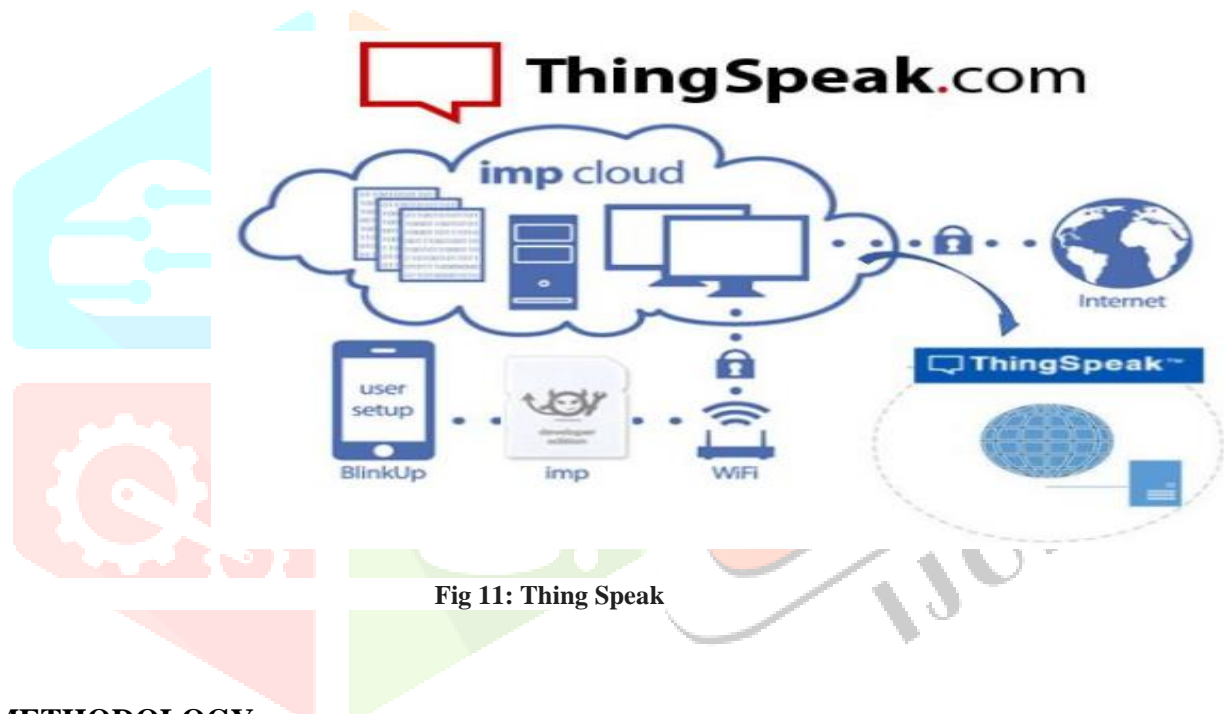
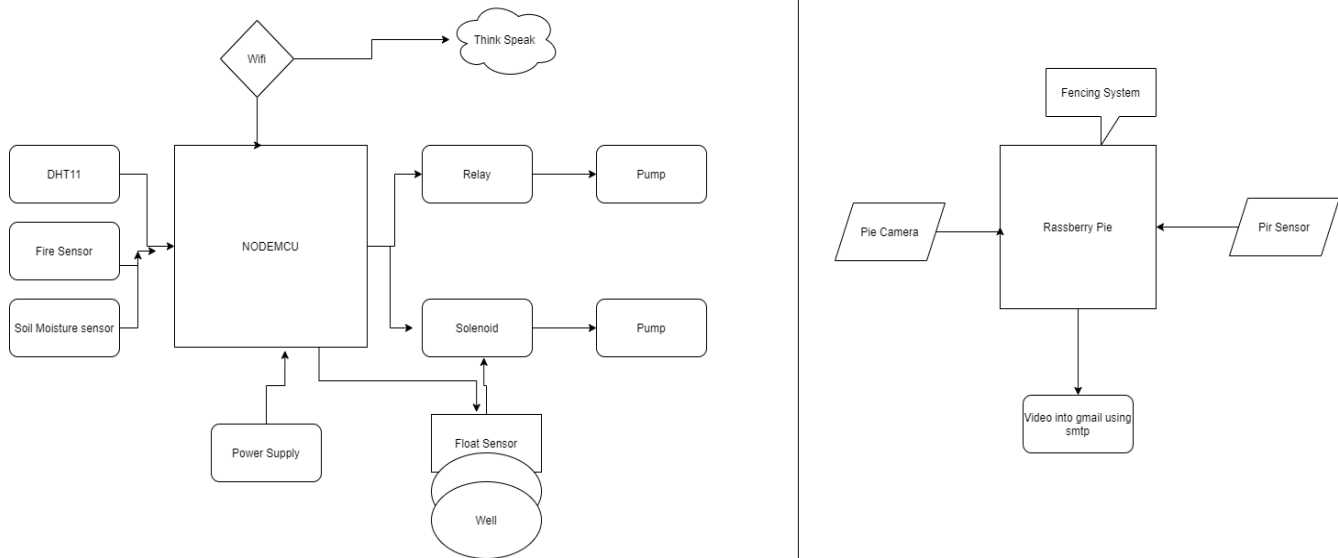


Fig 11: Thing Speak

## IV. METHODOLOGY

Voltage is detected using a voltage detecting device and the values are sent to the interface. if there is a three-phase power supply then water level in the tank is sensed using level sensor. The automated motor is turned on to store water in tank. The top-level sensor indicates tank the motor is turned off automatic, using values from the float sensor and soil moisture sensor. The soil moisture sensor [SEN-13322] measure the volumetric water content indirectly by using some other property of the soil, such as electrical resistance, dielectric constant, as a proxy for the moisture content. The pump is connected to the interface.

The user can turn on the pump based on the amount of moisture in the soil. He can set the duration for which the pump should work. This pump will pump water from well and water is sent to the farmland. Using the soil moisture sensor he can check the water level in soil, based on this condition the motor will be automatically on/off, that too from a remote place through mobile connected to internet.



**Fig 12: Methodology**

The farmer easily monitors the temperature and humidity values of the farm and can operate the motor to store water and also with help of float sensor values. Excess of water can cause damage to the crops with the help of soil moisture sensor the adequate amount of water needed for the land can be set. When MCU sends a start signal, DHT11 changes from the low-power-consumption mode to the running-mode, waiting for MCU completing the start signal. DHT11 provides a response signal to MCU with 40-bit data that includes relative humidity and temperature information after it's finished. DHT11 will go into low-power mode once data has been collected until it receives a start signal from MCU again. The rain module is a simple technique for finding rain. When a raindrop falls through the rainy board, it can be used as a switch, as well as for gauging rainfall intensity. A rain board and a separate control board are included on the module for ultimate flexibility. The output value in temperature is Celsius and humidity level in the environment is percentage and the value is displayed in the LCD display. With the help of NodeMCU, the Pie-Camera will capture the images and video that is send to the Thing Speak platform where we can get the graph. The graph will give you the clear view like Date, Timings and Variations in temperature, humidity, soil moisture and rain.

In the second phase, fencing system here mainly we use raspberry pie camera, PIR sensor. The human being or object enter the form he or she will automatically be sensed by PIR sensor and will send the recoded video to Gmail through SMTP server. Mainly we use push button to start the recording and will set the time if possible.

## V. SYSTEM TESTING

Testing is an important phase in the development life cycle of the product. This is the phase where all the error remaining in all phases will be detected. As a result, testing is crucial for quality management and verifying the software's stability. During the test, the program to be tested is executed with a set of test cases and the output of the program for the test cases is evaluated to determine whether the program is performing as expected. Testing of software or hardware is conducted on complete system to evaluate its compliance with specified requirement. System testing is performed on entire system in the context of functional requirements specification and/or system requirement specification. Testing is an investigatory phase, where focus is to have almost a destructive attitude and test not only the design, but also the behavior and even the believed expectation of the customer.

### 5.1 TESTING OBJECTIVES

The testing objectives are as follows:

- Testing is the process of executing the program with the intent of finding an error.
- A successful test is the one with a high chance of detecting an error.
- Testing can't prove that there aren't any flaws.

### 5.2 TEST TYPES

**Unit Testing:** It mainly focuses on verification effort on the unit of software design. The interface of each of the module are tested to ensure proper flow of the information in and out of the modules under consideration. Boundary conditions are checked. **Integration Testing:** This is the systematic technique for construction of the program structured while at the same time condition test to uncover errors associated with the interfacing. Data can be lost across an interface. One service module subsidiary function may have an unfavorable effect on another's; when combined, they may not generate the desired principal function; and worldwide data models might cause issues. The main difficulty that arises in integration testing is localizing errors that are discovered. **System testing:** After the integration testing, the software is completely assembled as package, interfacing errors has been uncovered and corrected. System testing involves putting all the modules together and checking the entire software. It is useful in checking whether for the given input desired output is achieved as a result or not. This allows to check whether all independent path within a module have been exercised at least once. **Acceptance testing:** User acceptance testing is a critical phase of any project and requires significant participation by end user.



### 5.3 TEST PERFORMED

The following table explain the various test performed on the system

Testing	Validating	Remarks
I2C LCD	Used to display the sensor Values.	Successfully tested
Fire Sensor	Used to detect fire.	Alert sent to the Thing Speak
DHT11 Temperature and Humidity Sensor	Used to detect the temperature and humidity of the field.	Successfully tested
Soil Moisture Sensor	Used to test the moisture of Soil.	Successfully tested
Buzzer	Beeps when fire is detected.	Successfully tested
Thing speak	All sensor data is sent to Thing speak.	Successfully tested
Water Pump	If fire has been confirmed by the system	Powered immediately when the fire is sensed
Rain Sensor	Used for rain detection	Successfully tested
Solenoid Valve	Used to control the irrigation valves.	Control tap flow into water well.
Raspberry Pie 3(Pie Camera)	Used to capture the image	Successfully capture the image

**Table 1: Test performed using the system**

## VI. CONCLUSION

The purpose of this smart agricultural monitoring system was to track the current state in the agriculture field in real time. The concept and execution of our IoT-based monitoring system are discussed in this study. Smart agriculture will benefit from the Internet of Things. The soil moisture level and humidity can be predicted using IoT. IoT technology allows for irrigation system monitoring and control. IoT improves time efficiency, water management, crop monitoring, and soil management in various aspects of farming. This system is comprised of a device with sensors, nodes, and a server, as well as a smartphone application. The field data monitoring device in this project is made up of a Raspberry Pi, an electrical solenoid valve, a DHT11 temperature and humidity sensor, a float sensor, a node MCU, and a variety of sensors that collect data from an agriculture field and send it to a server through Wi-Fi. In addition, a smartphone application has been created to see all of the data in a graphical format, complete with dates and times. In addition, this system is low-cost and simple to use. It also reduces human work, simplifies farming procedures, and aids in smart farming. With these capabilities, smart farming can assist farmers in expanding their market with a single click and no work.

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