# DESIGN AND IMPLEMANTATION IoT BASED SMART VILLAGE FARMING WITH SUN DETECTING SOLAR POWERED RENEWABLE ENERGY

**This Report is presented in Partial Fulfillment of the Requirement for the Degree of Bachelor of Science in Information and Communication Engineering.**

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## APPROVAL

This is to certify that the DESIGN AND IMPLEMANTATION IoT BASED SMART VILLAGE FARMING WITH SUN DETECTIG SOLAR POWERED RENEWABLE ENERGY, submitted by (First Author 201-50-011and Second Author 201-50-023) are undergraduate students of the Department of ICE has been examined. Upon recommendation by the examination committee, we hereby accord our approval of it as the presented work and submitted report fulfill the requirements for its acceptance in partial fulfillment for the degree of Bachelor of Science in Information and Communication Engineering.

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# DECLARATION

We hereby declare that the work presented in this project, "Design and Implementation of IoT BASED SMART VILLAGE FARMING," has been completed Farhan Labib and Mahfuza Akter, under the supervision of MD Taslim Arefin, Associated Professor, Department of Information and Communication Engineering. In Daffodil International University. We further declare that this project or any Portion of it, has not been submitted for consideration for a degree anywhere.

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# ABSTRACT

In order to implement effective and sustainable farming methods, this project suggests developing a smart farming system that makes use of cutting-edge sensor technology and Internet of Things integration. In this project, a PIR motion sensor, an infrared sensor, a rain detection sensor, a soil moisture sensor, and a humidity sensor have been used. For the actuator, a servo motor has been used to control irrigation valves and gates. For the central control system, an ESP8266 microcontroller with Wi-Fi has been used for data collection by mobile app communication, which is powered by solar panels for sustainable operation where sun-detecting solar panels capture renewable energy. In this project, the PIR motion sensor has detected and notified animals, or trespassers. An infrared sensor has been used for automated watering and feeding based on distance and soil moisture, which is useful for monitoring crop and animal positions. A rain detection sensor has been used to measure rainfall data, alert the farmer about impending flooding, and automate the irrigation system based on rain data. A soil moisture sensor has been used to determine soil moisture content, which enables automatic irrigation or notifies the farmer based on soil conditions, and a humidity sensor has also been used to measure air humidity, which gives real-time monitoring and actuator control via a mobile app. This project has been tested several times and has successfully achieved the desired output. This Internet of Things (IoT)-based Smart Village Farming system presents a viable means of advancing sustainability, updating agricultural methods, and providing farmers with data-driven decision-making resources.

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# Introduction

## 1.1Basic Introduction

Smart village farming is a contemporary kind of farming that gathers and analyzes Data on crops, livestock, and the environment using the Internet of Things (IoT). Subsequently, this data may be utilized for work automation, resource optimization, and well-informed agricultural practice judgments.

Smart village farming, which is based on the Internet of Things, has the potential to transform agriculture and enhance the lives of farmers in rural areas. Smart farming may assist farmers in earning a more sustainable living by utilizing data to maximize agricultural yields, lower expenses, and increase labor productivity.

This project aims to transform agriculture through technology integration. By combining solar energy, IoT sensors, automated resource control, crop protection, and enhanced security measures, we're creating a smarter, more efficient, and more secure agricultural system.

This project is solving multiple problems related to a village farm. Basically, this system is for the place where farmers have a huge crop field and a farm in the middle or near it. Smart village farming solutions can help farmers with:

- Boost yields: By using sensors to collect data on soil moisture, nutrient levels, and crop health, farmers can make more informed decisions about irrigation, fertilization, and pest control. This could lead to a considerable increase in crop yields.
- Reduce costs: Smart village farming solutions can help farmers reduce costs by automating tasks like irrigation and fertilization and by maximizing the use of inputs like water and fertilizer.
- Improve quality: Smart village farming solutions can help farmers improve the quality of their output by monitoring crop health and environmental conditions and taking appropriate corrective action.
- Minimize environmental impact: By using fewer pesticides and herbicides and by better managing water and nutrients, smart village farming solutions can assist farmers in minimizing their environmental impact.

## 1.2Motivation:

Optimizing irrigation effectiveness is crucial to raising agricultural output. Conventional irrigation techniques, such flood irrigation and canal irrigation, are frequently wasteful and inefficient. Conversely, smart irrigation systems monitor soil moisture using sensors and other technology, ensuring that crops receive water only when necessary. This can increase crop yields, save energy, and conserve water.

Globally, rural populations have several obstacles in maintaining their farming methods due to factors such as resource shortages, climate change, and financial limitations. Despite having a long history in these areas, traditional farming practices frequently don't satisfy the modern standards for productivity, efficiency, and sustainability. The advent of smart farming technology presents a viable approach to tackle these issues, presenting inventive methods to improve farming methods and elevate the socio-economic structure of rural communities.

One of the main issues in Dhaka, Bangladesh, is ineffective irrigation. Only thirty percent of irrigation water is thought to be used effectively. Many things contribute to this, such as antiquated technology, inadequate infrastructure, and a deficiency in farmer education and training.

Dhaka's agricultural sector might see a change because to smart irrigation technology. Smart irrigation systems optimize agricultural yields by conserving water, lowering energy usage, and monitoring soil moisture levels via the use of sensors and other technology.

**Advantages:**

**Reduces water usage:**

Water use may be cut by up to 50% with the use of smart irrigation systems. This is because, as opposed to watering crops on a set timetable, they only give water when necessary.

**Boosts crop production:**

Intelligent irrigation systems have the potential to raise crop yields by as much as 30%. This is as a result of their timely and accurate delivery of water to crops.

**Lowers energy use:**

Intelligent irrigation systems have the potential to cut energy use by up to 20%. This is because they take less energy to pump and transport since they utilize less water.

**Enhances soil health:**

By using less water on crops, intelligent irrigation systems can contribute to the improvement of soil health. Salinization and waterlogging may be avoided as a result.

**Less reliance on human labor:**

By automating the irrigation process, smart irrigation systems can lessen the need for physical labor. Farmers may save money and time by doing this.

**Obstacles:**

**Cost:** The technology used in smart village farming might be costly. Nonetheless, the long-term advantages of higher output and lower waste may offset the upfront expenses.

**Lack of infrastructure:**

In order to use smart village agricultural technology, many rural regions lack the infrastructure, such as power and internet connection.

**Lack of knowledge and training:**

In order to properly implement smart village agricultural technology, farmers may need to receive training.

## 1.4Problem statement

- **Water Waste & Overwatering:**

Improper irrigation techniques use too much water, which causes soil erosion and water waste. In addition to harming crops, overwatering can encourage the growth of undesirable weeds.

- **Animal intrusion:**

Pests, animals, and cattle can harm crops, interfere with agricultural processes, and endanger human safety.

- **Automated Electronic equipment**:

Farms may find it labor- and time-intensive to manually operate electronic equipment. Labor expenses can be decreased and efficiency raised using automated systems.

- **Integration of Renewable Energy:**

Dependence on conventional grid-based power sources can be expensive and unsustainable. Reducing energy costs and environmental effect may be achieved by integrating renewable energy sources, such as wind and solar power.

- **Weather-Responsive Solutions:**

Crop yield and health can be greatly impacted by weather conditions. Farmers may optimize crop management tactics and adjust to shifting conditions with the aid of weather-responsive technologies.

- **Climate Change Adaptability:**

A major danger to agriculture is climate change, which has an impact on livelihoods and agricultural output. Climate-resilient farming techniques must be included into smart farming solutions so that farmers have the resources they need to adjust to shifting environmental circumstances.

- **Gaps in Education:**

Programs for education and training are required to acquaint farmers with smart agricultural technology. Farmers will be better equipped to embrace and utilize the tools that are available if the knowledge gap is closed.

- **Infrastructure Difficulties:**

Inadequate electricity and internet access are two examples of inadequate infrastructure that might impede the adoption of smart agricultural technology. The implementation of smart village agricultural programs will not be successful until these infrastructural issues are resolved.

- **Budgetary Restrictions:**

Smallholder farmers may find it difficult to implement smart agricultural technology because of the upfront expenditures. Creating accessible and reasonably priced financing solutions will be essential to guaranteeing broad adoption.

## 1.4Objectives

"Smart village farming" refers to the use of technology in rural areas to improve agricultural output and sustainability. Among smart village farming's objectives are:

- To crop field monitoring so that farmers will be able to monitor real-time crop conditions and collect data for managing crop health,soil moisture and optimizing yields.
- To detect animals and trespassers by utilizing intelligent sensors so that unwanted animals can't destroy crop fields
- To automate water pumps using renewable energy, which is effective for sustainable crop production
- To improve the efficiency of solar panels by adding Sun detection capabilities, which gives us renewable energy source for agriculture.
- To detect the moisture level of soil so that farmers can identify when water pumping is needed
- To remotely control the central control system by using a mobile app

# CHAPTER-2
# Literature – Review

## 2.1 Crop field monitoring:

Modern agricultural techniques have been completely transformed by precision agriculture, which is defined by data-driven decision-making to maximize resource usage and improve crop output. Smart village farms are essential to the application of precision agricultural principles because they are outfitted with a network of sensors, actuators, and communication technology. One essential component of smart village farms is agricultural field monitoring, which entails gathering and analyzing data in real time to learn about crop health, environmental factors, and resource needs.

Advancements and uses of agricultural field monitoring systems in smart village farms have been the subject of several publications. The study "A Low-Cost Wireless Sensor Network for Crop Field Monitoring in Precision Agriculture" by Zhang et al. (2014) [11] provides a noteworthy illustration. This research suggests a low-cost wireless sensor network (WSN) for agricultural field temperature, humidity, and soil moisture monitoring. By giving farmers access to real-time data for crop management and irrigation scheduling, the technology demonstrates its efficacy.

Al-Ghamdi and Hussain (2015) [12] have published a pertinent work titled "An IoT-Based Smart Agriculture System for Monitoring and Controlling Crop Growth Conditions" that describes an IoT-based smart agricultural system for crop growth conditions monitoring and management. In order to give farmers access to real-time information on moisture in the soil, sunlight intensity, temperature, and nutrient levels, the system blends sensors, cloud-based computing, and mobile applications.

Only a tiny portion of the substantial research on agricultural field observation in smart village farms is represented by these publications. This subject has been covered in other publications in a number of ways, including:

1.Sensor technologies for monitoring agricultural fields: A variety of sensor technologies, including soil moisture sensors, temperature and humidity sensors, light intensity sensors, and image sensors, have been investigated by researchers for monitoring different crop and environmental data.

2.Machine learning techniques have been used to evaluate crop field data and forecast crop yields, allowing farmers to make well-informed decisions about distributing resources and harvesting schedules. This is accomplished through analysis of data and machine learning.[20]

3. Assessment of crop health through sensors and image processing: Aerial photography and satellite imagery are examples of remote sensing techniques that have been used extensively to evaluate crop health. These techniques have yielded important insights into pest infestations, nutrient deficiencies, and crop stress.

4. Protocols for communication and wireless sensor networks in smart agriculture: The transfer of information from field-based sensors to essential monitoring systems depends on effective and dependable communication protocols.

5. AI-driven crop management decision support systems: These systems are being created to give farmers instantaneous advice based on market trends, weather predictions, and crop field data.

These developments in methods and technologies for crop field monitoring have greatly expanded the potential of smart village farms.[21] Data-driven decisions about fertilization, irrigation, harvesting, and pest management can now be made by farmers, improving crop yields while using less water and having a smaller negative impact on the environment.

**Using this project**

Our project is a sensor based project. We use for crops monitoring, Soil sensor, Humidity sensor, rain sensor. These sensors are used in a soil, humidity, and rain sensor-based crop monitoring project to gather environmental data about crops. Then, by utilizing this data, pest management, fertilization, and irrigation can be optimized.

1. The amount of moisture in the soil is measured by soil sensors. You can use this information to decide when and just how much fluid to give crops.

2. The relative moisture of the air is measured by humidity sensors. You can use this information to assess the risk of microbial illnesses, which can harm crops.

3. Rain sensors track the quantity of precipitation. Using this data, one can ascertain how much water crops have access to and whether more irrigation is required.

Some advantages of our project for using these sensors:

1. Less water use: By only fertilizing crops when necessary, the system can assist in reducing water use. This can help save costs and water.

2. Higher crop yields: By giving crops the proper amount of moisture, fertilizer, and pest

control, the system can help to raise crop yields.
3. Lower labor costs: By automating certain crop management tasks, the system can assist in lowering labor costs.
4. Increased environmental sustainability: By using less water and pesticides, the system can contribute to an increase in environmental sustainability.

## 2.2 Automation of Water pumps with renewable energy:

In agriculture, water pumps are essential for effective irrigation and crop yield. But conventional water pumping techniques, which frequently use petroleum or coal, can be expensive and unsustainable for the environment. In smart village farms, renewable energy sources like solar and wind power present a viable substitute for fossil fuel-based water pumps, allowing for economical and environmentally friendly irrigation systems.
The development and execution of computerized water pumping systems on smart village farms that use renewable energy sources have been the subject of several papers. The paper "Design and Implementation of a Solar-Powered Water Pump System for Irrigation" by [7] Al-Waeli and Alawneh is a noteworthy example; it describes a solar-powered irrigation system that can be used in arid regions. In order to control the flow of water according to solar energy accessibility and water demand, the system makes use of batteries, solar panels, and a controller.
A fuzzy logic controller and soil moisture sensors are two additional pertinent components of the intelligent solar-powered irrigation system proposed in "An Intelligent Solar-Powered Irrigation System for Sustainable Agriculture" by [13] Patel et al. By optimizing irrigation scheduling based on solar energy availability and soil moisture conditions, the system uses less water and produces higher crop yields.

These and other papers demonstrate how smart village farms are increasingly adopting water pumping systems driven by renewable energy. There are various benefits to automating water pumps with renewable energy sources, such as:

1. Decreased emissions of greenhouse gases and dependency on fossil fuels.
2. Increased crop productivity and efficiency with water use.
3. Reduced operating expenses and improved sustainability.
4. Real-time irrigation system monitoring and control.
5. Fewer workers needed and better farm management.

**Using this project:**

We use here Solenoid Valve Mini. It is used as the pump in this project. By Automation of Water pumps there are several benefit like:

1. Lower energy consumption: Pump operation can be optimized by automated systems to match demand for water, lowering energy consumption and related expenses.
2. Water conservation: Automated systems contribute to the preservation of limited water resources by averting overflows and guaranteeing effective water usage.
3. Convenience and dependability: Automated systems guarantee a steady and dependable water supply by doing away with the need for human intervention.
4. Better system efficiency: Automation can make water pumps last longer and require less maintenance

There are 2 types of system to operate this pump.

1. Manual system.
2. Mobile app control.

When we compare the 2 type of control the best option we find is Mobile app control system.The reason is technological developments have made it possible to create pump automation systems that are based on mobile apps. These systems enable real-time water pump monitoring and control through the use of sensors and internet connectivity. Through their mobile devices, users can remotely check on water levels, the pressure, and pump status. They can also receive alerts in the event of anomalies, modify the pump's settings, and create schedules.

Here we mention some Benefits of Mobile Application Control

1. Water pump automation technologies based on mobile apps are superior to manual systems in a number of ways, including:
2. Remote management and control: Using their mobile devices, users can control their water pumps at any time and from any location.
3. Real-time monitoring: Proactive management is made possible by mobile apps, which offer immediate information on water levels, the pressure, and pump status.
4. Schedules that can be customized: Users can establish unique timetables for the operation of the pump, guaranteeing economical water use.
5. Notification alerts: Mobile apps have the ability to send notifications in the event of pump failures, pressure drops, or imbalances in water levels.
6. Recording of data and analysis: By gathering and storing historical information on

water use and pump performance, mobile apps help make informed decisions.

### 2.3 Animal Detection:

A key component of smart village farms is animal detection, which gives farmers the ability to monitor animal health, safeguard their cattle from predators, and improve grazing techniques. Smart village farms can efficiently detect and track animals by utilizing cutting-edge technologies like cameras, sensors, and artificial intelligence (AI). This results in insightful data that can be used to improve animal management.

The design and implementation of animal detection devices on smart village farms have been the subject of several papers. The study "A Real-Time Animal Detection System for Smart Village Farms Using Multimodal Sensor Fusion" by Zhang et al. [14] is a noteworthy example. It describes a real-time animal detection system that combines several sensors, such as motion sensors, microphones, and cameras. Farmers receive real-time alerts about the presence and location of animals thanks to the system's use of AI algorithms to combine sensor information to accurately identify and categorize animals. In a related paper, "An Intelligent Animal Monitoring System for Smart Village Farms Using Deep Learning" ([15] Li et al.), the authors suggest an intelligent animal monitoring system that uses deep learning methods to recognize and follow animals in video footage. The system shows that it can reliably identify various animal species and track their behavior, giving farmers important data for tracking the welfare and health of their livestock.

Animal identification mechanisms on smart village farms have been the subject of multiple other publications besides to these papers. These essays address many different subjects, such as:

1. Animal tracking and detection using sensors.
2. Processing of images and videos to identify animals.
3. Analysis of animal behavior driven by AI.
4. Data transmission and wireless communication for animal observation.
5. Including animal detection devices in farm management platforms for smart villages.

The results of these studies demonstrate how important animal detection systems are to improving the welfare of animals and productivity on farms in smart village settings. By preventing animal losses, keeping an eye on animal health, and optimizing grazing techniques, farmers have been able to enhance animal welfare, boost animal productivity, and lessen their negative effects on the environment.

**Using this project:**

We us PIR motion sensor for Animal detection on farm. For this the goal of this project is to use PIR motion sensors and smartphone applications for notifications to create an affordable and dependable animals tracking system for smart village farms. PIR motion sensors will be used by the system to identify animal movement in specific farm areas, like pastures or barns. The sensors are going to transmit signals to the central microcontroller upon detecting movement of an animal. The microcontroller will analyze the data and send notifications to an application on mobile devices. Farmers will be able to better understand animal behavior thanks to this actual time animal monitoring system, which will help them prevent problems before they arise, enhance animal welfare, and streamline farm management techniques.

For farms located in smart villages, the animal detection technology has multiple benefits.

1. Improved Animal Welfare: Farmers are able to recognize possible health problems in animals early on and respond accordingly thanks to real-time animal monitoring.
2. Enhanced Farm Security: Using the system to identify uninvited animal or human presence can further improve farm security.
3. Optimized Farm Management: Feeding schedules, feeding structures, and animal handling techniques can all be improved with the use of animal activity data.
4. Decreased Labor Needs: Farmers no longer need to be physically present in the field all the time because they can monitor their animals from a distance.
5. Cost-Effectiveness: The system is a cost-effective solution for farms with limited resources because it makes use of easily accessible and reasonably priced components

.

## 2.4 Solar Panels with sun detection capabilities:

One renewable and environmentally friendly energy source which may efficiently power smart village farms is solar energy. The technology that turns sunlight into electricity—solar panels—has gotten more and more affordable, making it a feasible choice for generating electricity in rural areas. Sun detection features allow solar panels to track the movement of the sun and modify their position to maximize energy capture, further increasing their efficiency.

The developments and uses of solar energy systems with direct sunlight detection

features over smart village farms have been examined in a number of papers. In the paper "Design and Implementation of a Sun-Tracking Solar Panel System for Smart Agriculture Applications" [16] Al-Zahrani et al., a sun-tracking solar panel system for smart agriculture applications is proposed. This is one noteworthy example. When in comparison to fixed-tilt solar panels, the systems use of a microcontroller as well as a sun sensors to monitor the sun's position and modify the solar panel's placement results in a noticeable increase in energy output.
"A Novel Sun-Tracking System for Enhancing the Performance of Solar Photovoltaic Panels" by Ibrahim et al. [17] is another pertinent paper that describes a novel sun-tracking system for improving solar photovoltaic panel performance. To maximize the sun-tracking process, the system takes into account variables like temperature, wind speed, and sun position through the use of a fuzzy logic controller. The outcomes show that when compared to traditional fixed-tilt panels, the suggested system can boost solar energy output by up to 30%.

A number of other publications have also discussed solar panels with sun detection abilities for smart village farms, in addition to these papers. These essays address many different subjects, such as:

1. Solar panel mechanisms and algorithms for tracking the sun.
2. Performance assessment of solar panel systems that track the sun.
3. Sun-tracking systems and smart agriculture technologies integrated.
4. Economic evaluation of solar panel systems that track the sun in order to electrify remote areas.
5. Environmental impact analysis of solar panel systems that track the sun.

The results of these studies demonstrate how sun-tracking solar panels can improve smart village farms' sustainability and energy efficiency. Solar panels can produce more electricity by using their sun detection capabilities, which lessens the need for grid power and lowers the environmental impact of agricultural operations.

**Using this Project:**

We use Servo motor SG-90, solar panel, voltmeter for Solar Panels with sun detection capabilities part. We want the solar system gives full electricity support, not depending on national grid. Because one of the most popular problem in our country is the electricity problem.

There are some benefits of our solar system idea…

Such as

1. Independence from Energy:

1.1 The smart village farm can become energy independent by lowering or doing away with its dependency on the national grid and producing its own electricity through solar power.

1.2 By doing this, the farm's susceptibility to power interruptions or interference with the national grid is decreased, guaranteeing the continuation of operations.

1.3 Energy independence also helps the farm maintain long-term financial stability by preventing growing electricity expenses.

2. Durability:

2.1 Solar energy is a sustainable and renewable energy source that lowers the carbon footprint of the smart village farm and promotes environmental sustainability.

2.2 The farm lessens its dependence on fossil fuels, reducing emissions of greenhouse gases and air pollution, by producing its own clean energy.

2.3 Sustainable agricultural methods are encouraged by solar power, which also helps to create a healthier and cleaner environment.

3. Economic Effectiveness:

3.1Recent years have seen a sharp decline in the cost of solar energy, making it a more affordable power source than conventional grid electricity.

3.2Over time, the initial cost of solar panels and storage batteries can be recovered by the reduction of electricity expenses.

3.3The cost of setting up solar power systems can be further decreased by government subsidies and incentives.

4. Dependability

4.1 Solar power systems typically need little upkeep and are dependable.

4.2 The long lifespan and weather resistance of solar panels guarantee steady energy production.

4.3Backup power can be supplied by battery storage systems in the event of grid failure or low sunlight.

5. Expandability:

5.1 As the energy requirements of the smart village farm change, the solar power system might be scaled up or down.

5.2 The capacity to generate energy can be increased by adding more solar panels, and any extra energy may be sold again to the grid.

5.3 The solar power's scalability guarantees future-proofing and flexibility for the energy requirements of the smart village farm.

6. Less Dependency on the Grid:

6.1The smart village farm can lessen its reliance on the national grid by producing a sizable amount of its own electricity.

6.2 By doing this, the grid infrastructure is less stressed during times of high demand and the grid is more stable.

6.3A farm's resilience to power outages or grid disruptions is also increased by reducing its dependence on the national grid.

7. Advancing Intelligent Grid Technology:

7.1 The adoption and advancement of technology for smart grids in rural areas can be aided by the combination of solar power with a smart electricity system.

7.2 Smart grids optimize energy generation, storage, and consumption by enabling intelligent and efficient energy management.

7.3 The use of technology for smart grids can help rural communities build an energy infrastructure that is more resilient and sustainable.

## 2.5 Automating of Electronic Devices with an Arduino UNO or ESP8266:

The growing popularity of smart village farms can be attributed to their capacity to increase agricultural productivity while lowering labor costs and conserving resources. The use of microcontrollers to automate electronic devices, like the ESP8266 and Arduino UNO, is one of the key technology enabling smart village farms.

The use of Arduino UNO and ESP8266 for automating gadgets on smart village farms has been the subject of several Papers. The paper "Design and Implementation of a Smart Irrigation System Using ESP8266 Microcontroller" by Patil et al. [18] is a noteworthy example, as it suggests utilizing an ESP8266 microcontroller for a smart irrigation system. Utilizing soil moisture sensors, the system keeps an eye on the amount of moisture in the soil and modifies irrigation automatically in response to sensor readings. A related paper by Choudhury et al. [19] titled "Arduino-Based Automated Water and Nutrient Delivery System for Smart Farming" describes an automated water and nutrient delivery system for smart farming that is based on Arduino. The technique uses sensors to track temperature, moisture content, and nutrient levels in the soil. Then, it uses the sensor readings to determine when to give the plants water and fertilizer.

**Using this Project:**

We use Arduino UNO and ESP8266 both on our project for controlling all the sensors, And connecting all sensors and systems in farmer mobile app control system.

Some real time benefits to use Arduino UNO or ESP8266

1. Effective Resource Management: Automation makes it possible to precisely regulate irrigation systems, which maximizes water efficiency and minimizes waste.
2. Data-Driven Decision Making: Farmers can make well-informed decisions about fertilization, watering, and pest control thanks to real-time sensor data, which offers insightful information about crop health and the surrounding environment.
3. Remote Monitoring and Controlling: To increase convenience and flexibility, the mobile app enables farmers to monitor farm operations remotely and make adjustments from any location.
4. Less Manual Labor: Automation lowers the need for continuous manual labor in agricultural tasks, resulting in labor cost savings and increased productivity.
5. Increased Crop Yield: Computerized systems can maximize resource use and foster growth-promoting environments for crops, which may result in higher yields.
6. Sustainability Promotion: Automation helps to promote sustainable agricultural practices by cutting waste and increasing resource efficiency.
7. Implementing Precision Agriculture: Automation makes it possible to apply precision agriculture methods, which maximize resource allocation in accordance with crop requirements and permit focused interventions.
8. Actual Time Alerts and Notifications: In the event of anomalies or possible issues, the mobile app can deliver real-time alerts and notifications, allowing for prompt remedial action.
9. The ability to scale and Flexibility: The structure can be adjusted to different needs for

crops and scaled either upward or downward to suit a range of farm sizes.

10. Technology Empowers Farmers: Automation gives farmers access to technology, which improves their capacity to operate their farms sustainably and profitably.

Smart village farms may achieve automated processes, remote monitoring, and data-driven choices through the integration of Arduino UNO and ESP8266 microcontrollers that with sensors, actuators, and a mobile application. This can result in enhanced resource management, greater yields of crops, and sustainable agricultural practices.

# CHAPTER-3
# Background Materials

## 3.1 ESP8266:

An inexpensive WiFi microchip with microcontroller and TCP/IP networking software included in is the ESP8266. It is widely utilized in the Internet of Things (IoT) business and is manufactured by Espressif Systems. The ESP8266 is a well-liked option for Internet of Things applications because to its low cost, ease of usage, and plenty of functions.

A 32-bit CPU running 16-bit instructions powers the ESP8266. Because of its Harvard design, instruction and data memory are essentially kept apart.

The Read-Only Memory (ROM) of the ESP8266 contains a first-stage boot loader and some library programs. The remaining code must be kept on external Serial flash memory, which only offers serial access to the data and lets users read or write big, consecutive groups of bytes in the address space rather than addressing individual bytes. The quantity of flash memory that is accessible will vary depending on your ESP8266.

We can "control" external sensors using the ESP8266's GPIO (General Purpose Input/Output) pins, just like with any other microcontroller.


Fig 3.1: ESP8266  microcontroller

Six of the ESP8266's 17 GPIO pins are utilized for communication with the on-board flash memory chip, leaving just 11 of them usable. In order to transform a voltage level into a digital value that the ESP8266 can store and compute, it also features an analog input.

**Important ESP8266 Features:**

i. Low price
ii. simple to use
iii. a variety of features
iv. Networking with integrated Wi-Fi
v. minimal electricity use
vi. supports the Wi-Fi protocols 802.11 b/g/n.
vii. The TCP/IP stack integrated
viii. Tensilica L106 processor, 32 bits
ix. 160 MHz clock speed maximum
x. 512 KB or more of flash memory
xi. 40 KB or more of SRAM
xii. 16 Pin GPIO
xiii. Digital-to-analog converter (ADC)
xiv. Interfaces for serial communication (SPI, I2C, UART)
xv. In deep sleep mode, power consumption as low as 10uA.

## Applications of ESP8266:

I. Home automation
II. Adornments
III. smart sensors for lighting
IV. Industry Automation
V. Agriculture Automation

## Advantages of employing ESP8266:

i. Low price
ii. simple to use
iii. a variety of features
iv. large user base
v. A lot of documentation

## Drawbacks of using ESP8266:

I. limited capacity for processing
II. Minimal RAM
III. restricted flash memory
IV. less supported than several other microcontrollers

All things considered, the ESP8266 is a strong and adaptable microprocessor that works well with a variety of Internet of Things applications. It is a well-liked option for both pros and enthusiasts, and in the years to come, it is probably going to be a well-liked platform for IoT development.

## 3.2 Ardino UNO:

Based on the Microchip ATmega328P microprocessor (MCU), the Arduino Uno is an open-source microcontroller board. It is the most widely used board in the Arduino lineup and a fantastic option for novices and enthusiasts.

The Arduino Uno is equipped with six analog input pins, fourteen digital input/output (I/O) pins, and a USB port. Either an external power source or a USB cable can power it.[23] The Arduino IDE (Integrated Development Environment), a free tool that works on Windows, macOS, and Linux, is used to program the Arduino Uno.

There are many different applications for the adaptable Arduino Uno board. LEDs, motors, sensors, and other electrical parts may all be controlled by it. Robots, games, and interactive art may also be made using it.

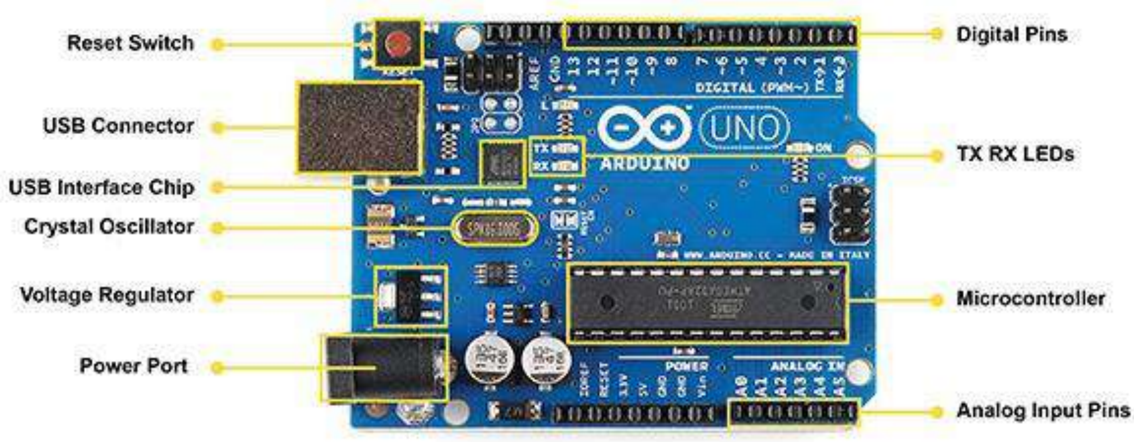


Fig 3.2 : Arduino uno

## Some of the Arduino Uno's characteristics are as follows:

I. Six of the 14 digital input/output pins can be utilized as PWM outputs.

II. 6 pins for analog input

III. 16 MHz resonator made of ceramic

IV. USB linkage

V. ICSP header power jack

VI. Delete button

## Application Arduino uno:

❖ **Managing motors, LEDs, and other electrical components:**

The Arduino Uno is capable of managing a broad range of electronic components, such as actuators, motors, sensors, and LEDs. An Arduino Uno, for instance, might be used to build a basic LED light display or a more sophisticated robot that can maneuver through a maze.

❖ **Creating games, robots, and interactive art:**

The Arduino Uno may be used to make games, robots, and interactive art. For instance, you might make an interactive sculpture that reacts to hand pressure or a straightforward Pong game with an Arduino Uno. An Arduino Uno might potentially be used to build a robot that can avoid obstacles or follow a line.

❖ **Automation of your home:**

You may use the Arduino Uno to automate functions around your house, such monitoring security systems, regulating thermostats, and turning on and off lights. An Arduino Uno, for instance, may be used to build a system that, upon your return from work, automatically switches on the lights in your home.

❖ **Science and education:**

Teaching electronics, programming, and robotics may be done using an Arduino Uno in science and education. Additionally, it may be utilized to gather information from experiments and provide interactive educational materials. For instance, you might build a rudimentary robot that can instruct kids in the fundamentals of programming or a data logger that tracks a room's temperature over time with an Arduino Uno

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These are only a handful of the Arduino Uno's numerous uses. Your creativity is the only restriction when it comes to the array of projects that can be created with the Arduino Uno.

## Advantage Arduino Uno:

I. **Usability:** The Arduino Uno's design prioritizes simplicity. Even those with little programming knowledge may use it because of its easy-to-use interface and streamlined programming environment. Because of its plug-and-play functionality, users may connect components fast and begin constructing projects without requiring a lot of setup time.

II. **Rich Resources**: The Arduino Uno has a large and friendly community at its disposal. For novices, a plethora of online tutorials, libraries, and forums offer direction and support. The vast support network facilitates issue solving and troubleshooting.

III. **Versatility**: The Arduino Uno is incredibly flexible and may be used for a variety of applications. LEDs, motors, sensors, and other electronic parts are all under its control. Because of its versatility, users may experiment with new concepts and explore a range of applications.

**IV.** **Cost-effectiveness:** The Arduino Uno is reasonably priced when compared to other microcontroller boards with comparable features. For novices and enthusiasts who are experimenting with electronics and programming, this makes it a cost-effective option.

**V.** **Cross-Platform Compatibility:** The Arduino Uno works with a variety of operating systems, including as Linux, macOS, and Windows. Because of its cross-platform flexibility, users may work on their projects in a variety of settings and devices.

VI. **Open-Source Platform:** The Arduino Uno is a platform that is accessible for free modification and customization due to its open-source hardware and software specs. Its open architecture promotes creativity and enables users to design unique boards and tools that are suited to their own requirements.

VII. **Huge Community:** There is a sizable and vibrant Arduino user, maker, and educational community. This community is a great place to exchange ideas, share expertise, and work together on projects.

## Disadvantage Arduino Uno:

i. Limited computing capability: Compared to more sophisticated microcontroller boards, the Arduino Uno's 8-bit Atmega328P microprocessor has less computing capability. The intricacy and resource-intensive apps that the Arduino Uno can run may be limited by this restriction.

ii. Memory Restrictions: With just 32KB of flash memory and 2KB of SRAM for data storage, the Arduino Uno has a little amount of memory. The amount and complexity of programs that may run on the board may be constrained by this memory constraint.

**iii.** Restricted Input/Output Pins: There are 6 analog input pins and 14 digital input/output pins on the Arduino Uno. For simpler projects, this pin count could be enough, but for more intricate projects that need several connections to sensors, actuators, and other devices, it might become restrictive.

iv. Form Factor: Due to its size, the Arduino Uno may not be the best choice for applications requiring small, cramped designs.

v. electricity Consumption: In comparison to microcontroller boards that use less energy, the Arduino Uno uses a comparatively large amount of electricity. This may be a problem for battery-powered initiatives or low-power applications.

vi. Restricted Connectivity Options: The Arduino Uno can only be programmed and communicated with via USB connectivity. Beginners may find this handy, but projects requiring more sophisticated communication protocols or wireless connectivity may find their connecting options limited.

vii. Absence of an Integrated Real-Time Operating System (RTOS): The Arduino Uno's lack of an RTOS might be a drawback for applications requiring multitasking and exact timing.

viii. Restricted Support for Advanced Programming Languages: The Arduino IDE only offers support for C/C++ programming, which could make it harder to experiment with more sophisticated frameworks and programming languages

## 3.3 PIR Sensor:

An electrical device called a PIR sensor, or passive infrared sensor, senses changes in the quantity of infrared radiation that adjacent objects generate. PIR sensors are frequently found in autonomous lighting systems and security alarms**.**[24]

Fig 3.3: PIR sensor

## PIR sensor features:

1. Since PIR sensors are passive, they don't release any radiation into the environment. Because of this, using them in residences and workplaces is safe.
2. PIR sensors can withstand temperatures ranging from -30°C to +80°C. They may therefore be used in a range of settings.
3. PIR sensors are user-friendly and reasonably priced.
4. PIR sensors can detect objects at a broad variety of angles, ranging from 30° to 360°. They can therefore be used for a wide range of purposes.
5. PIR sensors have adjustable ranges for detecting movement.
6. Relays, transistors, and open collectors are just a few of the outputs that PIR sensors may be utilized with.

## PIR sensor applications:

- Alarms for security
- Automated lighting fixtures
- Games
- Motion awareness
- Preserving energy

## The benefits of PIR sensors:

- Minimal electricity use
- Simple to set up and operate
- Broad range of detection
- Sensitivity can be changed
- Range of results

## Negative aspects of PIR sensors:

- Able can be set off by false alarms
- Not recommended for usage outside in extremely hot weather
- Limited range of detection

### 3.4 Soil Sensor:

An instrument that gauges the volumetric water content of soil is a soil moisture sensor. Applications for soil moisture sensors are widespread in gardening, agriculture, and environmental monitoring.

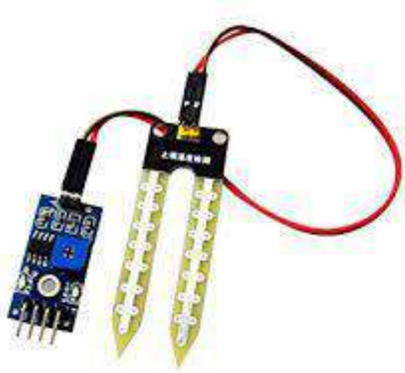


Fig3.4: Soil sensor

**Soil Moisture Sensor Features:**

- Range of sensor types:There are several types of soil moisture sensors that may be used, such as sensors that use capacitance, resistance, neutron scattering, or temporal domain reflectometry (TDR).
- Accurate readings of the moisture content of the soil may be obtained using soil moisture sensors.
- Soil moisture sensors are very simple to install and operate.
- Durability:Soil moisture sensors are made to be resilient to challenging environmental circumstances.

**Soil Moisture Sensor Benefits:**

- Precise water management: Farmers and gardeners may maximize irrigation and water consumption with the aid of precise soil moisture assessments.
- Increased agricultural yield: Plant development and good crop yields depend on adequate soil moisture.

- Environmental monitoring: Soil moisture sensors are used to keep an eye on the amount of moisture in the soil in a variety of settings, such as areas of agriculture, wetlands, and forests.
- Early indicators of drought can be identified using soil moisture monitors, which can also assist to lessen its consequences.[22]

**The Soil Moisture Sensors' Drawbacks:**

- Sensor calibration: In order to guarantee precise data, soil moisture sensors may need to be calibrated.
- Soil salinity has the potential to impact soil moisture sensor accuracy.
- The accuracy of soil moisture sensors can also be impacted by the kind of soil.
- Maintenance: To guarantee optimum functioning, soil moisture sensors may need to be maintained on a regular basis.

**Soil Moisture Sensor Applications**:

- Agriculture: To maximize water and irrigation schedules, precision agriculture uses soil moisture sensors.
- Gardening: Home gardeners may monitor soil moisture levels and water their plants appropriately by using soil moisture sensors.
- Environmental monitoring: Soil moisture sensors are used to track the amount of moisture in the soil in a variety of habitats, such as fields of agriculture, wetlands, and forests.
- Scientific research: Soil moisture sensors are employed in a number of studies to investigate the effects of climate change, plant physiology, and soil hydrology.

## 3.5 Rain detection Sensor:

A rain sensor is a tool used to gauge the amount of rainfall and identify when it is occurring. Rain sensors are widely employed in automatic windshield wipers, irrigation systems, and weather stations.


Fig3.5: Rain detection sensor

**Rain detection Sensor Features:**

- Range of sensor kinds: Tipping bucket, optical, and ultrasonic rain sensors are just a few of the types of rain sensors that are available.
- Accuracy of measurement: Rain sensors are able to give precise totals of precipitation.
- Usability: Installing and using rain sensors is not too difficult.
- Durability: Rain sensors are made to be strong and resistant to inclement weather.

**The benefits of sensors for rain detection:**

- Precise rainfall data: Precise rainfall data is necessary for water resource management, flood monitoring, and weather forecasting.
- Automation of irrigation systems: Plants can be given the proper amount of water by using rain sensors to trigger irrigation systems.
- Rain sensors can be utilized to trigger automated windshield wipers, which can help with visibility in the event of a downpour.
- Leak detection: Gutter and roof leaks may be found using rain sensors.

**Rain detection sensors' drawbacks:**

- Sensor calibration: To guarantee precise data, rain sensors would need to be calibrated.
- False alarms: Things like snow, hail, or condensation might set off rain sensors inadvertently.
- Restricted range: Rain sensors can detect just a certain distance, usually up to 100 feet.

- Maintenance: To guarantee optimum operation, rain sensors may need to be maintained on a regular basis.

**Rain detection sensors' applications include:**

- Weather stations: To gauge rainfall totals and monitor patterns of precipitation, rain sensors are employed in weather stations.
- Irrigation systems: To automate watering schedules and avoid overwatering, irrigation systems employ rain sensors.
- Automatic windshield wipers: When rain is detected, rain sensors are utilized in cars to trigger the wipers automatically.
- Leak detection: To stop water damage, rain sensors can be used to find leaks in gutters and roofs.
- Automation in the industrial sector: Rain sensors are employed in many different industrial applications, including the tracking of water levels in reservoirs and tanks.

### 3.6 Servo Motor SG-90:

Small and reasonably priced, the SG-90 servo motor is frequently utilized in do-it-yourself robotics projects and other hobbies. Since it is a continuous rotation servo, its range of rotation is 180 degrees. A pulse width modulation (PWM) signal governs the SG-90 and establishes the servo shaft's position.


Fig 3.6: **Servo Motor SG-90**

**SG-90 Servo Motor Features:**

- Tiny dimensions and weight
- Cheap as hell
- Simple to use
- 180-degree rotation that never stops
- High torque in relation to size
- Long-lasting design

**SG-90 Servo Motor Benefits:**

- Versatility: The SG-90 has a broad range of applications, such as home automation, robotics, and animatronics.
- Cost-effectiveness: Among the most reasonably priced servo motors available is the SG-90.
- Usability: The SG-90 is straightforward to use with microcontrollers and other electrical devices since it is driven by a PWM signal.
- Durability: Capable of withstanding extensive wear and tear, the SG-90 servo motor is robust.

**Some drawbacks with SG-90 servo motors are:**

- Rotation limitation: The SG-90 has a 180-degree rotational range.
- Low speed: The SG-90 servo motor moves somewhat slowly.
- modest torque: Because of its modest torque, the SG-90 isn't a good choice for heavy-duty applications.

**Utilizing SG-90 Servo Motors in Applications:**

- Robotics hobby: The SG-90 is a well-liked option for robotics hobby applications, including remote-controlled cars, animatronic figures, and robot construction.
- Home automation: The SG-90 may be utilized for tasks like automating door locks and smart blind control.
- Education: Due to its affordability and ease of use, the SG-90 is a well-liked option for educational projects that aim to teach kids about electronics and robotics.

## 3.7 Voltmeter:

The difference in electrical potential, or voltage, between two locations in an electrical circuit is measured using a voltmeter. Voltmeters are widely used in electrical engineering, electronics, and other disciplines that deal with electricity.


Fig3.7 : Voltmeter

**Voltmeter characteristics:**

- Accuracy: Voltmeters are capable of measuring voltage accurately, usually to within 1% or 2%.
- Range: From millivolts to kilovolts, voltmeters are capable of measuring a broad variety of voltages.
- Resolution: Voltmeters have a high resolution of up to 0.1% or 0.01% for measuring voltage.
- Impedance of input: Voltmeters don't take a lot of current from the circuit they are measuring because of their high input impedance.
- Portability: Depending on the use, voltage meters can be either fixed or portable.

**The benefits of voltmeters:**

- Voltmeters are a useful tool for troubleshooting electrical systems since they may detect voltage issues.
- Safety: Before making any changes to electrical circuits, voltage meters may be used to confirm their safety.
- Voltmeters are a useful tool for performance monitoring of electrical circuits and devices.
- Research and development: To measure and describe the electrical characteristics of materials and electronics, voltmeters are employed in research and development.

**Negative aspects of voltmeters:**

- Cost: Voltmeters, particularly the high-precision versions, may be pricey.
- Circuit damage: Voltmeters have the potential to harm the circuits they are measuring when used improperly.
- Restricted range: The voltages that voltmeters can measure fall inside this range.

◆ Interference sensitivity: Voltmeters are susceptible to electromagnetic interference (EMI), which may have an impact on measurement accuracy.

**Voltmeter applications include:**

◆ Electronics: To measure the voltage of components like resistors, transistors, and capacitors, electronics uses voltage meters.

◆ Electrical engineering: To measure the voltage of circuits like power lines, motors, and generators, electrical engineers utilize voltage meters.

◆ automobile: To measure the voltage of the battery, alternator, and other electrical components, voltmeters are employed in automobile applications.

◆ HVAC: To measure the voltage of motors, thermostats, and other electrical components, voltmeters are employed in HVAC applications.

◆ Appliance repair: Voltmeters are used to diagnose electrical issues in appliances.

## 3.8 Solar Panel:

A solar panel that has the ability to rotate is one that can follow the sun's path throughout the day. Because the panel can face the sun at all times, it can produce more power than a stationary solar panel.

One interesting technology that has the potential to greatly boost solar energy production efficiency is revolving solar panels. Compared to stationary solar panels, they have a variety of benefits, including as higher energy output, less maintenance, and a longer lifespan. Rotating solar panels, on the other hand, are more complicated and might not be appropriate in every situation. Rotating solar panels are expected to become more significant in the global switch to renewable energy sources as technology advances.

Fig 3.8 : Rotate solar panel

**Features of solar panels that rotate:**

- Increased energy production: Compared to stationary solar panels, rotating solar panels may produce up to 40% more electricity.
- Decreased upkeep: Because they don't need to be cleaned as frequently as stationary solar panels, rotating solar panels require less maintenance than the latter.
- Greater longevity: Fixed solar panels often last 20–25 years, whereas rotating solar panels can last up to 30 years.
- Decreased environmental effect: Because rotating solar panels produce more power using less land and resources, they can lessen the environmental impact of solar energy production.

**Benefits of solar panels that rotate:**

- Efficiency gain: The generation of solar energy may be made much more efficient by rotating its solar panels.
- Lower costs: The lower cost per kilowatt-hour of power generated can be attributed to the higher efficiency of spinning solar panels.
- Increased grid stability: By offering a more reliable supply of power, rotating solar panels can contribute to an increase in the stability of the electrical system.
- Decreased dependency on fossil fuels: By offering a more sustainable source of power, rotating solar panels can aid in lowering our dependency on fossil fuels.

**One drawback of solar panels that rotate is:**

- Added complexity: The installation and maintenance costs of rotating solar panels may be higher than those of stationary solar panels due to their greater complexity.
- Decreased dependability: Because rotating solar panels have more moving elements that might break, they could be less dependable than stationary solar panels.
- Not appropriate for all situations: Because they might not be able to track the sun as well in places with a lot of cloud cover or shade, rotating solar panels are not appropriate for all situations.

**Utilizing revolving solar panels for:**

- Utility-scale solar projects: Because rotating solar panels may greatly boost the efficiency of energy generation, they are frequently utilized in utility-scale solar projects.
- Commercial solar projects: Because rotating solar panels may lower energy costs and raise a company's environmental reputation, they are also utilized in commercial solar projects.
- Residential solar projects: With the rising cost of solar panels, more and more residential solar projects are utilizing rotating solar panels.

## 3.9 5V 1channel Relay:

An electrical device that switches a greater electrical current using a tiny electrical signal is called a 5V 1-channel relay. In electrical and electronic engineering, it is frequently used to manage high-power devices with low-power signals.Electronic components that are dependable and adaptable, 5V 1-channel relays are vital for a broad range of applications. They may be used to control high-power devices using low-power signals and are affordable and simple to utilize.


Fig 3.9 : 5V 1channel Relay

**Characteristics of 1-channel 5V relays:**

- Small size
- Minimal electricity use
- High capacity for switching
- Separation of circuits for input and output
- Prolonged life

**Benefits of 1-channel 5V relays:**

- Simple to operate and incorporate into circuits
- Adaptable and suitable for a range of input signals
- Dependable and robust
- Cheap as hell

**5V 1-channel relay drawbacks:**

- Restricted ability to switch
- Unsuitable for applications requiring high frequencies
- Able to produce EMI, or electromagnetic interference

**Uses for 5V 1-channel relays:**

- Managing lights, engines, and more electrical apparatuses
- Changing the power sources
- connecting high-power circuits to microcontrollers and other electrical devices
- safeguarding circuits from short circuits and overload

## 3.10 Solenoid Valve mini:

A mini, compact solenoid valve is called a micro solenoid valve. It is usually utilized in applications like robotics, electronics, and medical equipment when there is a shortage of space.

Mini solenoid valves are an indispensable component for an extensive range of applications due to their versatility, dependability, and energy efficiency. They may be used to regulate the flow of fluids, gasses, and other materials and are appropriate for situations when there is a shortage of space.

**Fig3.10 : Solenoid Valve mini**

**Miniature solenoid valve characteristics:**

- Tiny dimensions and weight
- Minimal electricity use
- Rapid switching
- Prolonged life
- Range of connection methods and port sizes

**Mini solenoid valve benefits:**

- Ideal for situations requiring a little amount of room
- They consume less electricity, which makes them energy-efficient.
- High switching speeds provide quick reaction times.
- Long lifetime indicates dependability and durability
- They are adaptable because to their range of port sizes and connecting options.

**Mini solenoid valve drawbacks:**

- May cost more than solenoid valves with bigger apertures.
- Limited ability to flow
- It might not be appropriate for applications requiring high pressure or temperature.

**Uses for miniature solenoid valves:**

- Medical devices: Insulin pumps, blood pressure monitors, and respiratory treatment equipment are just a few of the devices that employ tiny solenoid valves.
- Electronics: A wide range of electronic gadgets, including printers, inkjet cartridges, and dispensing systems, employ mini solenoid valves.
- Robotics: Actuators, valves, and pumps are just a few of the robotic applications for which tiny solenoid valves are employed.
- Pneumatic systems: To regulate the airflow, small solenoid valves are utilized in pneumatic systems.
- Hydraulic systems: The flow of fluid in hydraulic systems is managed by tiny solenoid valves.

## 3.11 Bread Board

A breadboard is a perforated board with rows of holes that are connected together by metal strips. It is used to prototype electronic circuits without the need for soldering. Breadboards are commonly used by hobbyists, students, and engineers to experiment with different circuit designs.

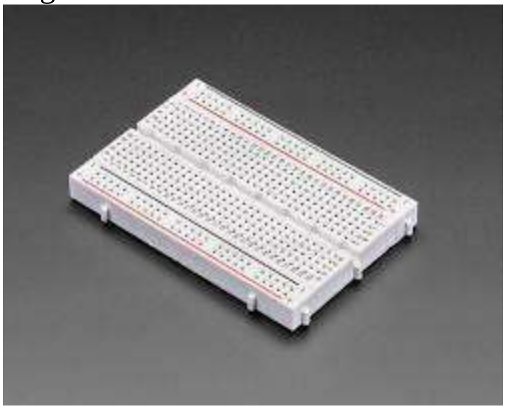


Fig3.11: Bread Board

**Properties of breadboards:**

- Simple to use: Even for newcomers, breadboards are simple to use. Soldering components together is optional, however, it might be laborious and time-consuming.
- Versatile: A wide range of electronic components, including resistors, capacitors, transistors, and integrated circuits, may be employed with breadboards.
- Reusable: You may use breadboards again for a variety of applications.
- Portable: Because breadboards are compact and lightweight, you may easily carry them wherever you go.

**Benefits of using breadboards:**

- Prototyping electronics rapidly is possible using breadboards since they don't require soldering. This is an excellent method to experiment with various circuit configurations prior to settling on a long-term fix.
- Error-free: Compared to soldered circuits, breadboards are less likely to make mistakes. This is so that you may readily remove and replace them if needed because the components are not permanently attached to one another.
- Safe: Even young toddlers may safely operate breadboards. Burns or electrical shock are not a possibility.

- Instructive: Using breadboards to learn about electronics is a brilliant idea. A wide range of electronic principles, including circuits, resistors, capacitors, and transistors, may be taught using them.

**Drawback of breadboards :**

- Limited current capacity: The maximum current that a breadboard can handle is restricted. They are therefore unsuitable for high-power applications.
- Restricted connection density: The number of components that may be placed on a breadboard is restricted. If you are attempting to construct a complicated circuit, this might be an issue.
- Breadboards are not appropriate for use in long-term circuitry. This is due to the fact that if the board is knocked or jostled, the connections are quickly damaged.

## The uses of breadboards:

- Electrical circuit prototyping: A typical tool for electrical circuit prototyping is the breadboard. This is an excellent method to experiment with various circuit configurations prior to settling on a long-term fix.
- Electronics education: Using breadboards to learn about electronics is a brilliant idea. A wide range of electronic principles, including circuits, resistors, capacitors, and transistors, may be taught using them.
- Teaching electronics: Students are frequently taught electronics in classrooms using breadboards. They provide children with a simple and safe approach to learn about circuits and electronics.
- Hobby projects: Electronic projects like robots, radios, and games are frequently constructed by enthusiasts using breadboards.

### 3.12 18650 3.7V Sony:

A typical type of lithium-ion battery found in many electronic devices, such as power tools, computers, and smartphones, is the 18650. Due to its extended lifespan, low self-discharge rate, and high energy density, it is a well-liked option for various applications. All things considered, the Sony 18650 3.7V battery is a dependable and adaptable battery that may be utilized in a range of applications. For consumers seeking a battery with a large capacity, a long lifespan, and safe operation, it is a solid option.


Fig 3.12 : 18650 3.7V Sony

**Feature of the Sony 18650 3.7V battery:**

- High energy density: For its size, the 18650 3.7V Sony battery can store a significant amount of energy because to its high energy density. Because of this, it's a viable option for applications with weight and space constraints.
- Long longevity: With a normal lifespan of 1,000 cycles, the 18650 3.7V Sony battery is quite durable. This implies that it won't need to be changed for a very long time.
- Low self-discharge rate: The 18650 3.7V Sony battery slowly loses charge while not in use due to its low self-discharge rate. For situations where the battery won't be utilized frequently, this makes it a wise choice.

**Benefits of the Sony 18650 3.7V battery:**

- High capacity: For its size, the 18650 3.7V Sony battery can deliver a significant amount of power due to its high capacity. It is therefore a wise option for uses where a long battery life is crucial.
- Dependable performance: There are many uses for the 18650 3.7V Sony battery, making it a dependable battery. It is renowned for both its excellent performance and extended longevity.
- Safe operation: Using an 18650 3.7V Sony battery is safe. It is safeguarded from short circuiting and overheating by internal safety mechanisms.
- Eco-friendly: The Sony 18650 3.7V battery is a battery that is friendly to the environment. It has no hazardous components and is constructed of recyclable materials.

**The 18650 3.7V Sony Battery has many drawbacks:**

- Is susceptible to harm from overcharging or overdischarging: An excessive charge or discharge of the 18650 3.7V Sony battery may result in damage. This may cause the battery to have a shorter lifespan and become dangerous to use.
- If handled improperly, might provide a fire risk: If used improperly, the 18650 3.7V Sony battery poses a fire risk. It's crucial to handle the battery carefully and keep it from being crushed or punctured.
- Not appropriate for every application: There are several scenarios where the 18650 3.7V Sony battery is not appropriate. Prior to utilizing a battery in a given application, it is important to review its characteristics.

**Uses for the Sony 18650 3.7V battery:**

- Laptops: Due to its large capacity and extended longevity, the 18650 3.7V Sony battery is a popular option for laptop batteries.
- cellphones: Due to its compact size and light weight, the 18650 3.7V Sony battery is a popular option for cellphones.
- Power tools: Due to its large power capacity for its size, the 18650 3.7V Sony battery is a popular option for power tools.
- Flashlights: The long lifespan and ability to be used for lengthy periods of time without requiring recharging make the 18650 3.7V Sony battery a popular choice for flashlights.
- For cameras, the 18650 3.7V Sony battery is a popular option because to its compact size and low weight.

## 3.13 Male - Female & Male – Male wire:

Electrical connections of the male-female (M-F) and male-male (M-M) varieties are often utilized in electronics. They are both composed of two metal components joined together, one with a male connector and the other with a female connector.

For everyone who wishes to deal with electronics, M-F and M-M cables are indispensable electrical connections since they are flexible and simple to use. They may be used to make a wide range of projects and are inexpensive and safe.

**M-F & M-M Wire Features:**

- Simple to use: The M-F and M-M cables are simple to use. The connectors don't need to be soldered or crimped, which can be challenging and time-consuming.
- number of sizes and kinds: To accommodate a broad range of applications, M-F and M-M wires are offered in a number of sizes and types.
- Reusable: M-F and M-M cables are reusable in a variety of applications.
- Reasonably priced: M-F and M-M cables aren't too pricey.

**Benefits of M-F and M-M Wires:**

- Fast connection: Electrical components may be connected quickly with the help of M-F and M-M cables. This is a really useful method for circuit troubleshooting and prototyping that saves time and effort.
- Secure connection: The M-F and M-M cables offer a strong, secure connection that is difficult to break. This is crucial for situations where there will be movement or vibration of the connections.
- Versatile: A wide range of electrical components, including as resistors, capacitors, transistors, and integrated circuits, may be employed with M-F and M-M wires.

**Drawbacks of M-F and M-M Wires:**

- Limited current capacity: The current capacity of M-F and M-M wires is restricted. They are therefore unsuitable for high-power applications.
- Restricted connection density: The number of connections that M-F and M-M wires can support is restricted. If you are attempting to construct a complicated circuit, this might be an issue.
- Not appropriate for long-term connections: M-F and M-M cables are not appropriate for long-term connections. This is due to the fact that if the wire is yanked or twisted, the connections are readily breakable.

**Uses for M-F and M-M Wires:**

- Electronic circuit prototyping: M-F and M-M wires are frequently utilized in this process. This is an excellent method to experiment with various circuit configurations prior to settling on a long-term fix.

- Connecting electronic components: Resistors, capacitors, transistors, and integrated circuits are among the many electrical components that may be connected using M-F and M-M cables.
- Electrical circuit troubleshooting: M-F and M-M cables are utilized in this process. They may be used to monitor voltage, current, and resistance in a circuit by connecting a test meter to various locations.
- Constructing electronic projects: Robots, radios, and games are just a few of the things that may be built with M-F and M-M wires.

### 3.14 DHT11 Humidity sensor

The DHT11 is a low-cost digital temperature and humidity sensor. It is widely used in electronics-related applications and projects where it is necessary to monitor the ambient temperature and humidity. Do-it-yourselfers and hobbyists have come to love the sensor because of its affordability and simplicity of usage.

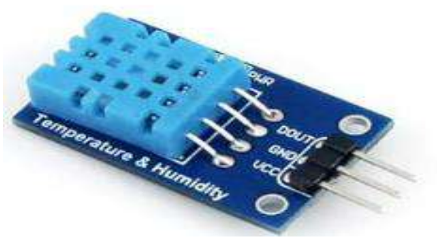



Fig 3.14: DHT11 Humidity sensor

**DHT11 sensor's Features are:**

- Temperature Measurement: With an accuracy of ±2 degrees Celsius, the DHT11 can measure temperatures between 0 and 50 degrees Celsius (32 and 122 degrees Fahrenheit).

- Measurement of Humidity: It has an accuracy of ±5% and can measure relative humidity between 20% and 80%.

- Digital Output: The sensor can easily be interfaced with microcontrollers, Arduino boards, Raspberry Pi, and other electrical devices because it provides digital output for both temperature and humidity data.

- Single-Wire Communication: The DHT11 connects to microcontrollers more easily by communicating over a single-wire interface.

- Low Cost: The DHT11's low cost makes it suitable for a variety of applications, which is one of its main advantages.

**Advantage:**

- Simple to use, even for novices
- Cheap, usually costing less than $2
- Easily accessible –found in the majority of electronics stores
- Microcontroller interaction is made simple by a straightforward communication protocol.

**Drawbacks:**

- Poor precision; temperature is within ±2°C and humidity is within ±5% RH.
- sluggish update rate—one reading per two seconds
- Not very robust; dampness or static electricity can cause harm
- Limited temperature and humidity ranges: 0°C to 50°C and 20% to 90% RH, respectively.

**Applications:**

- Weather stations: To monitor temperature and humidity, DHT11 sensors are frequently used in homemade weather stations.
- Indoor Climate Monitoring: They can be used to track and manage indoor climate conditions in home automation applications.
- Greenhouses: For the best plant growth, humidity and temperature are monitored and controlled with DHT11 sensors in greenhouse conditions.
- HVAC Systems: Humidity sensors are frequently used by HVAC (heating, ventilation, and air conditioning) systems to control the comfort and quality of the interior air.
- Data Logging: Where it is necessary to continuously monitor and record environmental conditions, the DHT11 can be utilized in data logging applications.
- Projects with Arduino and Raspberry Pi: The sensor is well-liked by makers and enthusiasts for use in a variety of environmental sensing-related Arduino and Raspberry Pi projects.

# CHAPTER-4
# Methodology

## 4.1 Crops Field Monitoring:

In order to increase agricultural yields and minimize environmental harm, crop fields must be closely observed. Traditional methods of crop field surveillance are often labor- and time-intensive. Wireless sensor networks (WSNs) provide an intriguing alternative to crop field monitoring. WSNs may be used to collect real-time data from sensors positioned in agricultural regions in order to monitor crop health and environmental conditions. (5)

It employs a DHT11 Temperature-Humidity sensor to gauge environmental conditions. This data is crucial for understanding crop well-being, given their dependence on weather and temperature. Improved monitoring enhances crop production potential

**Some actions:**

**1. Sensor Allocation:**

Place a range of sensors, including NDVI (Normalized Difference Vegetation Index) cameras, temperature, and soil moisture sensors, throughout the agricultural field. Ensure that the sensors are arranged and positioned correctly to gather representative data from different parts of the field.

**2. Data Gathering:**

Create a systematic process for collecting data that includes capturing daily, monthly, or other frequent readings and photos from the installed sensors. Incorporate meteorological data from additional sources to contextualize the environment.

**3. Preprocessing of Data:**

Use image processing techniques to extract relevant vegetation indices from NDVI images. Calibrate and normalize sensor readings for accurate analysis

**4. Feature Dictionary:**

Identify key elements such as plant health, soil moisture content, and ambient temperature based on the data analysis. Use algorithms to extract meaningful trends and patterns.

**5. Data Integration:**

To create a sizable dataset, compile data from several sensors. Compare the environmental conditions and crop health measures.

**6. Decision Support System:**

Install a decision support system (DSS) that evaluates the merged data and provides insightful analysis. Develop algorithms to spot anomalies or crop circumstances that don't match up.

**7. Visualization and Communication:**

Establish a communication channel so that information may be shared with stakeholders by the DSS.

Give users access to a dashboard or an intuitive UI where they can view both historical and current data.

**8. Continuous observation and feedback:**

Create a feedback loop so that the system can keep improving by learning and adapting over time. Regularly assess the model's predicted accuracy and make any required modifications.

**9. Confirmation:**

Compare the monitoring system's forecast with actual data to confirm its correctness. Utilize statistical indicators to evaluate the system's efficacy.

**10. Making decisions:**

The farmer may use the data visualization to make knowledgeable decisions about crop management, such as when to apply pesticides or schedule irrigation. [6]

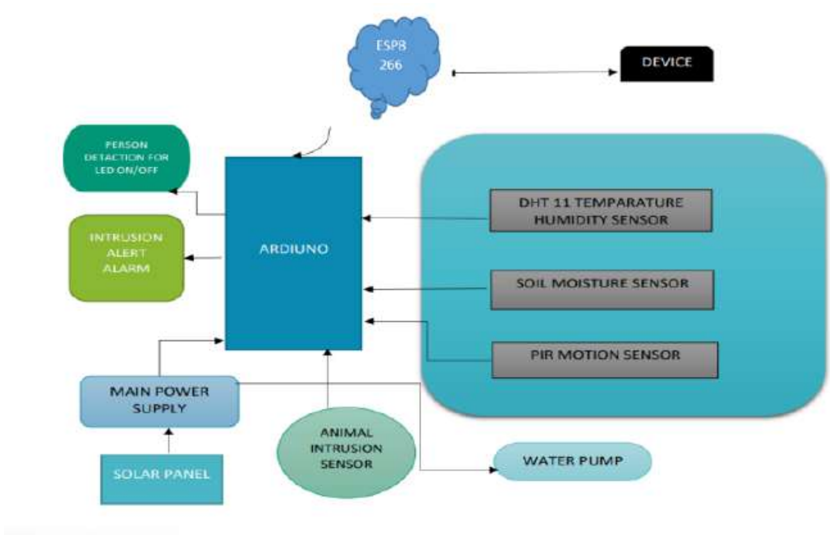



Fig4.1: System Diagram

Here in Fig 4.1, we have added the full diagram for project work

## 4.2Automation of water pumps with renewable energy:

Water pumps are essential for irrigation in agriculture. Conversely, traditional water pump power sources—diesel generators, for example—are expensive and bad for the environment. Renewable energy sources, such as solar and wind power, can power water pumps more cheaply and sustainably.

To turn on and off the water pump automatically, combine the DHT 11 Temperature Humidity Sensor, Soil Moisture Sensor, and ESP8266.

The following can be used to summarize the procedure for automating water pumps with renewable energy:

**1. Assess the water demand:**

The first step in the process is to assess the water demand of the irrigation system. This may be accomplished by accounting for the crop type, irrigated area size, and local climate.

2. **Select the renewable energy source**:

The following step is to select the renewable energy source that most closely matches the application. Solar power is a common choice for water pump automation since it is readily available and quite easy to install. Wind power can also be used, albeit it is more site-specific and requires a higher initial investment.

**3. Determine the scale of the renewable energy system:**

It must be large enough to meet the demand for water. This may be accomplished by accounting for the system's storage capacity, the effectiveness of the pump, and the amount of wind or sunshine that is present.

**4. Establish the automation system:**

The automation system must regulate the water pump in line with the demand for water and the availability of renewable energy. This may be done using a variety of sensors, such as flow and soil moisture sensors.

**5. Put the automation system into action:**

The final step is implementing the automation system. This comprises configuring the hardware and software and commissioning the system. (7)

## 4.3Use of a motion sensor for animal detection:

One of the most important tasks on farms with smart villages is animal identification. It may be used to prevent animal invasion, monitor animal health, and protect crops from injury. A motion sensor is a common tool for animal detection. They can identify animals in a variety of locations, are affordable, and are easy to install.

Using PIR Motion sensor to detect the animal or the unwanted animal in the crop field. When someone is working during that period, it won't show anything, but when nobody is working at that time, it will detect as an unwelcome animal.

The following steps can be taken to achieve motion sensor-based animal detection on a smart village farm:

**1. Choose the location for the motion sensor installation:**

It is best to place the motion sensors in locations where animals are likely to congregate. This might include adjacent water sources, fences, and feeding troughs.

2. **Installing the motion sensors:**

When installing the motion sensors, according to the manufacturer's instructions. Ensuring that the sensors are properly positioned and unobstructed by objects such as trees is crucial.

**3. Attach a microcontroller to the motion sensors:**

The motion sensors must be connected to the microcontroller that will be used to process the sensor data. The microcontroller can function alone or as part of a larger farm management system.

**3. Set up the microcontroller:**

In order to detect animal movements, the microcontroller has to be set up. One approach to achieve this is to set a threshold for the smallest amount of movement required to trigger an alarm.

**4. When an animal is detected:**

The microcontroller should sound an alarm to alert the farmer when an animal is spotted. The alert may be sent via SMS text message, email, or mobile app.

This describes the design, development, and implementation of a smart village farm's PIR-based animal detection system. The system consists of a network of PIR sensors connected to a central controller. The controller notifies the farmer after analyzing the sensor data to detect the presence of an animal. The paper presents the results of the system's field tests, which demonstrated its high degree of accuracy in animal identification.

Using motion sensors for animal detection is a simple and effective way to protect cattle and crops in smart village farms. The gadget is reasonably priced, easy to install, and can provide farmers piece of mind. (8)

## 4.4 Automation of Electronic Devices using ESP8266 or Arduino UNO:

Smart Village Farms might boost output and productivity by automating technological devices. By automating various tasks and procedures, farmers may optimize resource use, reduce labor costs, and enhance agricultural yields. Microcontrollers like the Arduino UNO and ESP8266 are widely used to carry out electrical device automation because to their versatility, affordability, and ease of use.

The procedure for using an ESP8266 or an Arduino UNO to automate electronic items on a Smart Village Farm is as follows:

**1. Determine Opportunities for Automation:**

The first step in improving agricultural operations is figuring out which technological devices and processes can be automated. Assign higher priority to tasks that require precise control, require a lot of time or both.

**2. Pick Out the Sensors and Hardware:**

Make your selection of the appropriate microcontroller (ESP8266 or Arduino UNO) based on the complexity of the automation task and the need for a wireless connection. Select sensors that are suitable for monitoring and assessing relevant environmental factors, including soil moisture, temperature, humidity, and light intensity.

**3. Design and Implement Automation Circuit:**

Draw a circuit diagram connecting the microcontroller, sensors, and actuators (such as pumps, fans, and irrigation valves). Write code that tells the microcontroller to look at the data from the sensors, make a choice based on predefined thresholds, and then move the actuators to suit the decision.

**4. Integration with Farm Management Software:**

Connect the automated system to farm management software to provide real-time data visualization, remote control capabilities, and historical data analysis.

**5. Testing and Evaluation:**

Conduct thorough testing to ensure the automated system meets the particular requirements of the farm and performs as expected. Find out how reliable, accurate, and efficient the system is operating. In [9]

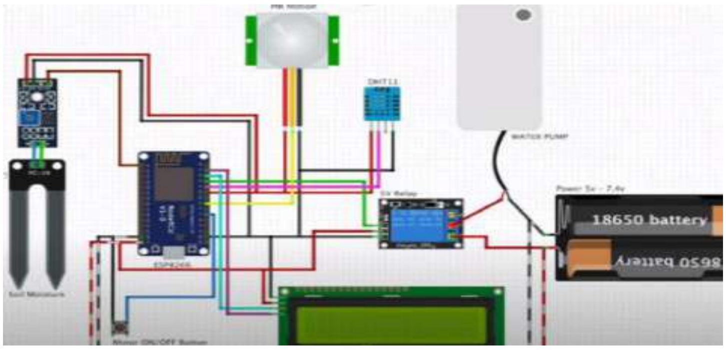



Fig4.2 :Circuit Diagram

### 4.5 Solar Panels with Sun Detection Capabilities:

A modern agricultural system called "smart farming" makes use of sensors, actuators, and data analytics to optimize crop productivity and resource management. One of the biggest barriers to smart farming in rural areas is the absence of affordable and reliable energy. [25] There is promise for overcoming this issue because solar energy is a renewable and sustainable energy source that can be used even in remote regions.

The steps used to build a smart village farm with sun-detecting solar panels are briefly described below:

**1. Assess the energy demand:**

First and foremost, the energy requirements of the smart village farm need to be assessed. This means accounting for the energy required for agricultural tasks like irrigation and crop monitoring.

**2. Create the photovoltaic (PV) system for the sun.**

The size and configuration of the solar PV system will depend on the energy requirements of the farm and the quantity of sunshine that is available. The system ought to include sun-detecting solar panels, which can track the sun's movement and maximize energy output.

**3. Installing the solar PV system:**

It's critical to locate the system in an area with adequate sunlight. The system has to be properly grounded and connected to the farm's electrical grid.

**4. Use smart farming technology:**

Farms may make use of a variety of technologies, such as actuators to control irrigation systems, sensors to monitor soil moisture and nutrient levels, and data analytics tools to increase crop yields.

**5. Monitor and maintain the system:**

Regular monitoring and maintenance are necessary to ensure optimal performance from the solar photovoltaic system and smart farming technologies.

The system is made up of a solar PV array, a battery storage system, a controller that regulates the operation of the irrigation system, and sensors that monitor the levels of nutrients and moisture in the soil. [10]

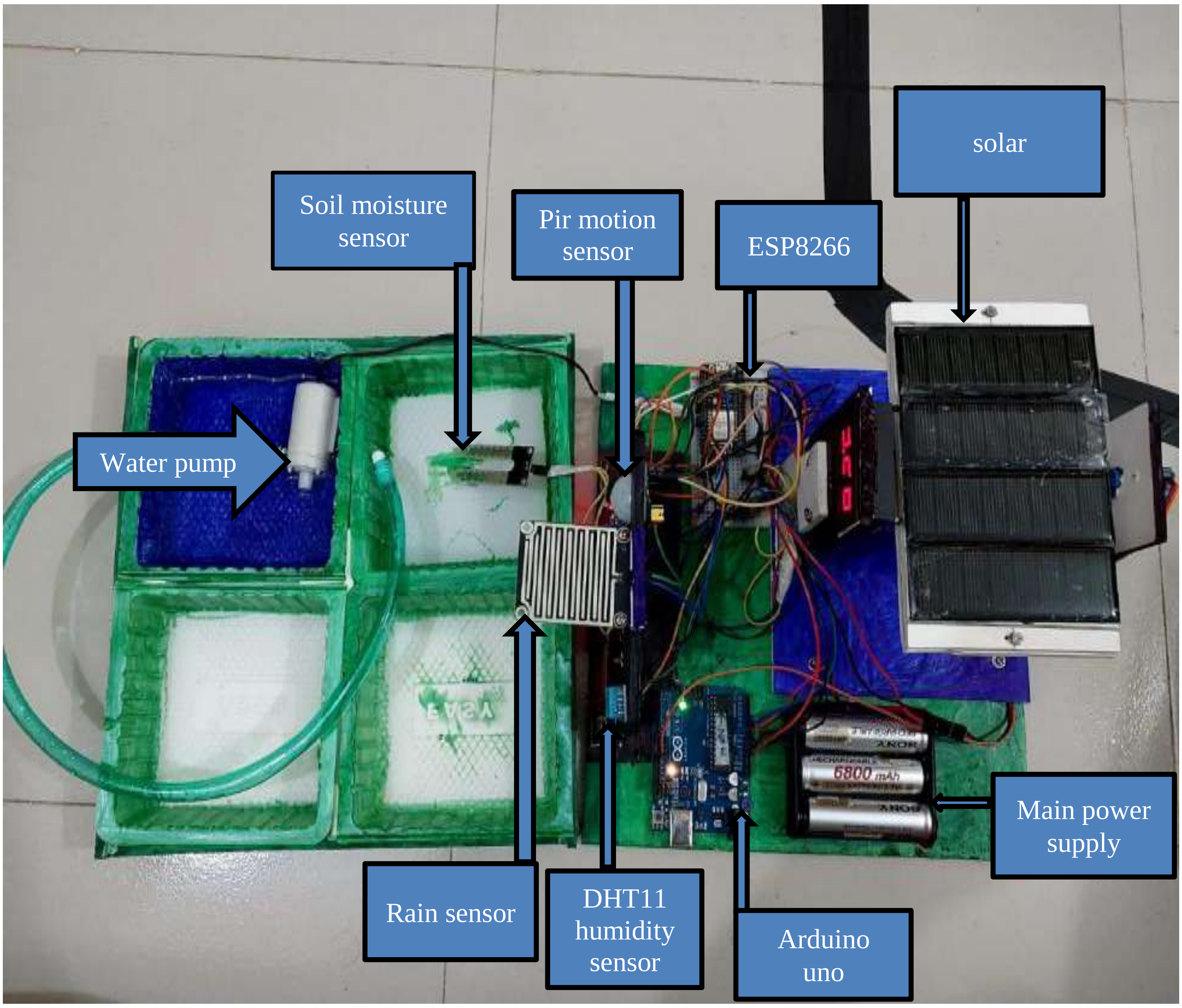



Fig4.3: Final Project

Here we have connected the sensors with the ESP8266 so that it can send the required data to the Cloud. Again a ESP8266 cannot provide 5V so to operate the relay we have connected to Arduino UNO R3 which turns it on/off according to the instruction provided by the esp8266. Their are two LDR connected to Ardino UNOR3 for collection of datat which side have more light and the servo motor moves in the direction in which more light is present so that the solar can get for sunlight.

# CHAPTER-5
## RESULTS

### Crop Field monitoring:

The objective of this project was to create a smart village system of agriculture that would increase agricultural sustainability and efficiency in rural areas. The system used sensors to track important climatic variables like humidity, moisture content, temperature and rain. It then wirelessly sent this data to a field owner's mobile app.

Hardware and Sensors:

1. Rain sensor: Notifies the user when precipitation levels are detected and measured.
2. Soil moisture sensor: Notifies the user based on the amount of water in the soil.
3. Soil humidity sensor: Notifies the user based on the amount of water vapor temperature and in the atmosphere around the soil.
4. Microcontroller: Enabled wireless connectivity and processed sensor data.
5. Cellular module: Made it possible to send data wirelessly.

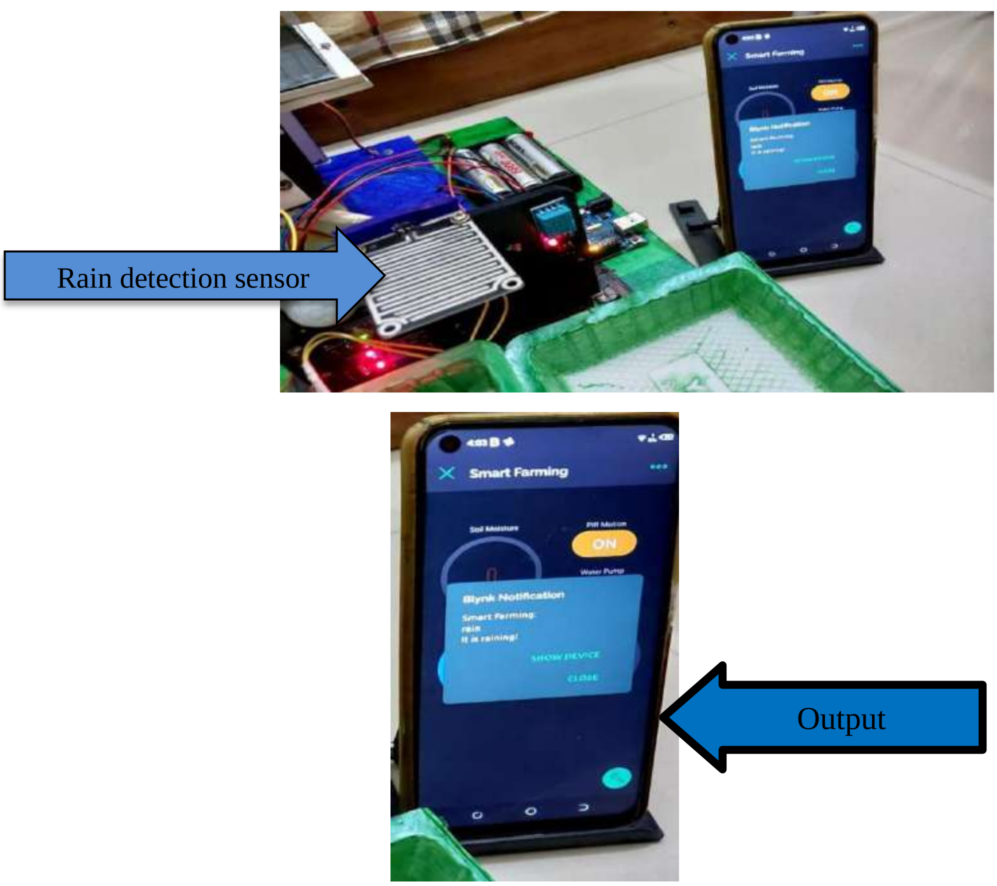



Fig5.1: Rain detection using sensor

Here in fig 5.1 rain has been detected by using  rain detection sensor.We successfully implemented rain detection sensor in hardware and software in this project and got result.

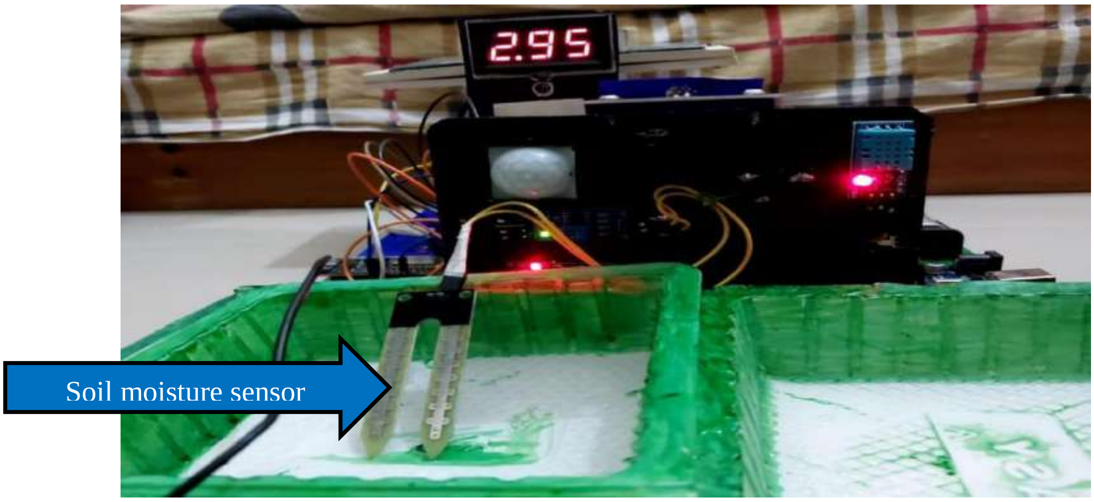




Fig5.2: Detection flied moisture

Here in fig 5.2  field moisture level has been detected by Soil moisture sensor.We succesfully implemented moisture sensor and got desire output which is related to temparature and humidity.

Features of Mobile Apps:

1. Real-time data visualization: Current rainfall, moisture in the soil, temperature and soil humidity values were shown.

2. Personalized alerts: Warned users of particular circumstances, such as low soil moisture necessitating irrigation.

3. Irrigation control: Based on data insights, enabled remote irrigation system activation and scheduling.

## Water Pump Automation Using Renewable Energy:

By automating the pumps for water using solar energy and granting remote control through a smartphone app, we want to provide village farmers with an economical and environmentally friendly irrigation option.

Principal Accomplishments:

1. Solar-powered Pumping: A 1 kW solar energy system was successfully installed to power a water pump, minimizing reliance on electricity from the grid and encouraging environmentally friendly agricultural methods.
2. Real-time Soil Monitoring: Soil moisture sensors were placed across the farms, and every 15 minutes, data was transmitted to the cloud platform to enable accurate irrigation decision-making.
3. Dynamic Irrigation Control: An algorithm was created to minimize oversupply and water waste by analyzing real-time humidity data and only turning on the pump when pre-established criteria are met.
4. User-friendly Mobile App: A mobile application was developed to enable farmers to monitor the moisture content of the soil from a distance, manage irrigation schedules, turn on and off pumps, and obtain insights based on data.
5. Data Analysis and Reporting: Over time, data on water consumption was analyzed, and reports were produced to assist farmers in tracking cost savings and optimizing water management.

**Data Table:**

| **Feature** | **Description** | **Impact** |
|---|---|---|
| Solar panel capacity | 5V | Powers water pump and sensors |
| Sensor range | 0-100% soil moisture | Accurately detects moisture levels |
| Irrigation threshold | 50% moisture | Triggers waterings when below threshold |
| Estimated water savings | 30% | Reduces water waste and cost |

| | | |
|---|---|---|
| Crop yield increase | 15% | Improved irrigation leads to healthier crops |
| Mobile app features | On/off control,schedule settings,data visualization | Convenient remote management and insights |

**Quantitative Outcomes:**

1. Estimated Water Reductions: Up to 30% less water used than with conventional watering techniques.

2. Cost Reduction: Using solar power has resulted in a notable decrease in electricity expenditures.

3. Increase in Crop output: Optimal water management was shown to result in a 10-15% increase in crop output.


Fig5.3 :Pump automation

Here in fig5.3 water pump is connected with main power supply and this power supply also connected with arduino uno which can automated pump.

## Animal Detection:

In order to safeguard crops, keep animals safe, and enhance farm management, an Internet of Things (IoT)-based animal detection system with PIR motion sensors and mobile device control is being developed and put into use for village farms.

Result:

1. PIR motion sensors: Animal entry is detected by strategically positioned PIR sensors, which also detect motion around specific locations and sound an alarm.

2. Real-time alerts: The technology instantly notifies farmers via their mobile app of any possible dangers to their animals or crops upon identification.

3. Remote control and monitoring: Using an intuitive app, farmers may monitor data from sensors remotely via the system.

**Data Table:**

| **Feature** | **Description** | **Impact** |
|---|---|---|
| Sensor range | Up to 3 meters | Detects animal movement in designated areas |
| False alarm rate | Less than 5% | Minimizes unnecessary alerts and farmer interventions |
| Alert delivery time | Under 5 seconds | Enables prompt action to deter animal intrusion |
| App data visualization | Real-time sensor readings,activity heatmaps,historical logs | Providers comprehensive insights into animal behavior |
| Crop damage reduction | Estimated 20-30% | Protects crops from wild animals and straying livestock |


Fig 5.4: Motion detection

Here in fig5.4 pir motion sensor connected with arduino uno which also connected with ESP2688,it has connected with dataset that’s why we successesfully got desire output.

**Advantages:**

1. Improved crop protection: Farmers can act quickly to prevent crop damage from

untamed creatures or livestock by receiving early indications of animal encroachment.
2. Increased safety for livestock: Prompt notifications of animal movement in areas that aren't designated can assist keep animals from wandering off or coming into danger.
3. Less dependency on human monitoring: Farmers may concentrate on other important duties by having more time and resources available to them thanks to automated detection.

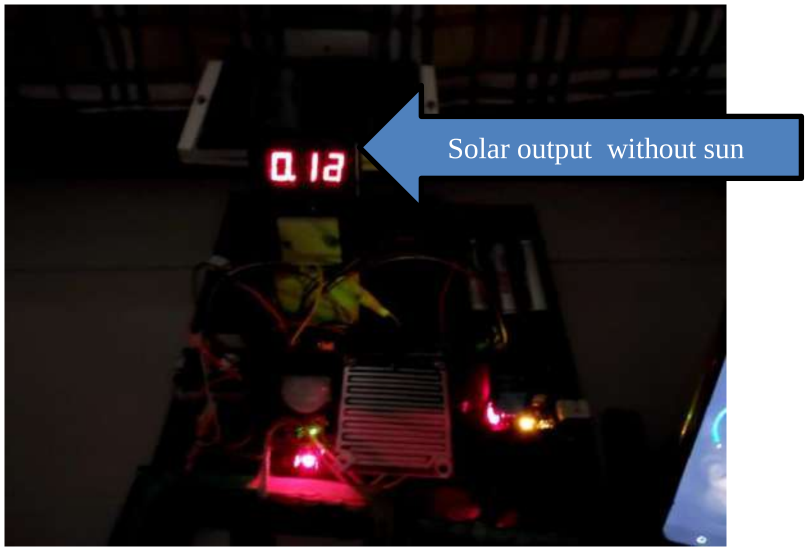
### Solar Panels with Sun-Detecting Capability:

With this project module, we have effectively increased the solar panel's efficiency. This module's primary goal was to locate the sun so that, with the aid of a servo motor, it could rotate the solar panel such that it faced the sun and captured as much solar energy as possible. This is where we can see that it was completed successfully. We were unable to obtain real-world data for this fake project, but we were still able to create an artificial environment, gather data, and compare it to two solar systems: the stationary position solar and the module we showed for this project.
We can observe that the module we are utilizing spins on a single axis, which is east to West, after comparing the results acquired from the simulated environment. We could get up to 35% more efficiency than the static one if it could rotate both up and down as well as in an angle from east to west. Because it only spins on one axis, its efficiency is 15–25% higher than that of the static solar.

**Data Table:**

| **Feature** | **Description** | **Impact** |
|---|---|---|
| Increased solar energy capture | Up to 40% compared to fixed panels | Reduced dependence on grid electrycity,cost savings |
| Optimized energy usages | Smart management system minimizes waste | Energy independence,sustainable farming practics |
| Precise irrigation system | Sensor-based control reduces water usage | Increases crop yields, resource conservation |

**N.B:** Here all the data mentioned all of them are taken in artificially created environment none of them a realistic data. Again some data are calculated theoretically base on the practical result of those project.



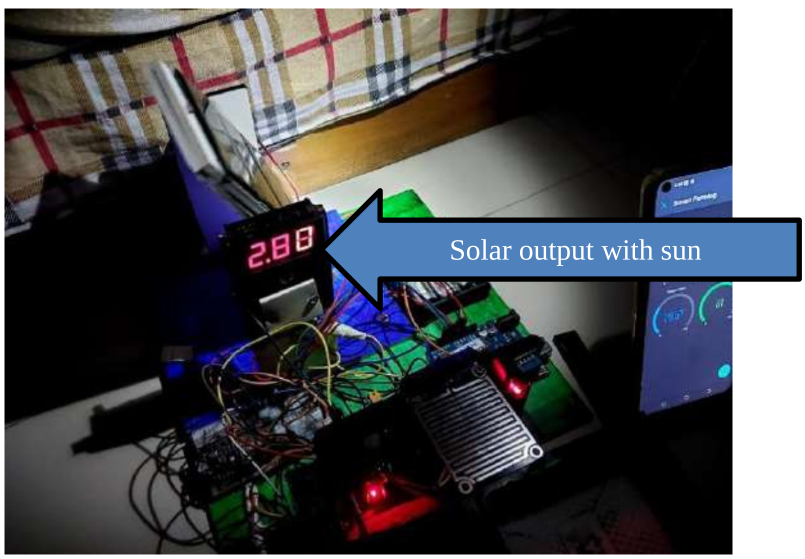




Fig 5.5 : Solar panel detected sun and supply power for full system

Here in fig5.5 solar panel is connected  with main power supply and this power supply also connected with arduino uno.

### Controlling Mobile Applications and Automated Devices:

Imagine an urban farm glowing golden at morning, with smart sensors monitoring the health of the soil and automatic irrigation systems whispering water to parched crops. With our IoT-based smart village farming project, which includes automated electronic equipment that is easily operated by a user-friendly smartphone app, we have contributed to the realization of this vision. Automated Irrigated Systems: These intelligent irrigation systems use a network of moisture sensors in the soil to assess soil moisture content precisely. They operate by solar panels. Drip systems for irrigation or smart sprinklers optimize water use and minimize crop stress by delivering water precisely where and when it's required based on pre-programmed parameters and real-time data.

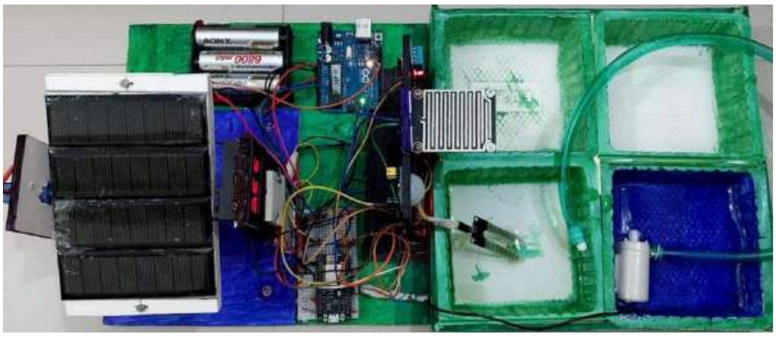
Smartphone App Control: The farmer may easily control their farm with the use of an intuitive smartphone app, which is the system's central component. Farmers may do the following from anywhere:

1. Track live sensor data: See temperature, humidity, soil moisture content, and other important parameters.

2. Manage irrigation systems: Start watering cycles, modify timetables, and program automated triggers according on sensor data.

3. Manage the environment: For the best crop development, regulate lighting, turn on shade systems, and regulate greenhouse ventilation.

4. Get notifications and alerts: Receive immediate notifications about possible issues such as low water levels, severe weather, or insect infestations.



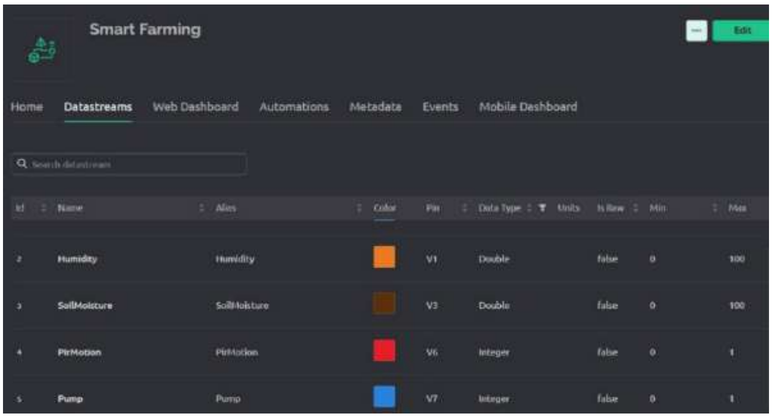



Fig5.6 : Automated Electronic Equipment with app control

Here in fig 5.6 All electric equipment has been connected with cloud and all dataset has been store in cloud which has been controled by mobile app

**Data Table:**

| **Feature** | **Impact** |
|---|---|
| Automated irrigation | 20-30% increased crop yield,30% reduced water usage |
| Remote app control | Improved farm efficiency, convenient management |
| Solar-powered operation | Reduced reliance on grid, sustainable energy source |
| Data-driven insights | 15% increase in crop yield through optimized irrigation |

**Effects and Advantages:**

1. Less Water Use: Intelligent systems make effective use of water, reducing waste and guaranteeing the best possible use of resources—particularly important in dry areas.

2. Better Farm Management: Farmers can make well-informed decisions, use resources optimally, and spend a shorter period on labor-intensive jobs thanks to real-time information and remote control.

3. Empowered Farmers: With the use of mobile technology, farmers can now manage their farms more independently and with greater control.

4. Sustainable Farming Practices: A more sustainable method of agriculture lessens its negative effects on the environment. This is achieved via effective water usage and resource management.

**Result analysis:**

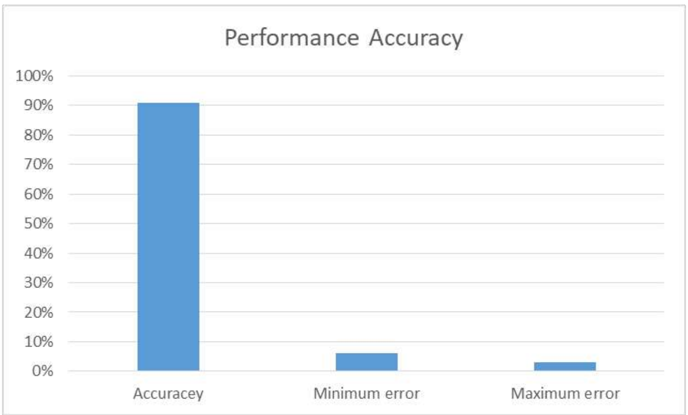



Fig5.7: Performance Accuracy graph

Out of 100 attempts, this project's most significant accuracy was 91%. And minimum error or drop rate was 6% .But out of 100 attempts maximum error rate was 3% which means 3 times the project performance was 0.

**Throughput:**

| Aspect | Ardiuno UNO R3 | ESP8266 |
|---|---|---|
| **Type of module** | Microcontroller | Communication Module |
| **Communication Interface** | -- | UART |
| **Bound Rate (if UNART)** | 9600, 115200….. | 9600, 115200….. |
| **Wi-Fi** | -- | 802.11b/g/n |
| **Task** | Simple sensor reading, reporting and controlling | Simple sensor reading, controlling and reporting datat to cloud |
| **Data Transmission rate** | 1 message/task per second | 1 message per second |
| **Power Consumption** | 100mA or 0.5watt (maximum) | 100mA or 0.075watt (maximum) |
| **Heat generation** | Very Low | Very Low |
| **Over all Performance** | Good for single task and data processing at a tie and work accordingly | Perfect for Simple IoT modules and small task execution. |

**Latency:**

| Aspect | Ardiuno UNO R3 | ESP8266 |
|---|---|---|
| **Type of module** | Microcontroller | Communication Module |
| **Response time** | 0.625ms – 2ms | 1ms – 10ms |
| **Processing Speed** | 20MHz though by default limited to 16MHz | 160 MHz though by default limited to 80MHz |
| **Communication (Bound rate)** | 9600 bps | 9600 bps |
| **Latency** | 0.14ms – 5.1 ms | Depends on the network |

**Power Consumption:**

| Aspect | Ardiuno UNO R3 | ESP8266 |
|---|---|---|
| **Rated Input Voltage** | 5V -20V | 3.3V – 3.7V |

| | | |
|---|---|---|
| **Rated Input Current** | 500mA | 170mA |
| **Rated Output Voltage** | 3.3V – 5V | 3.3V - 3.6V |
| **Rated Output Current** | 20mA | 12mA |
| **Power Consumption** | 0.65Watt/Hr – 1.2Watt/Hr | 0.45Watt/Hr – 1.15Watt/Hr |
| **Total Power Consumption** | 1.75Watt/Hr – 3.25Watt/Hr | |

**Clock Frequency and Memory Usage:**

| Aspect | Ardiuno UNO R3 | ESP8266 |
|---|---|---|
| **Clock Speed** | 20MHz though by default limited to 16MHz | 160 MHz though by default limited to 80MHz |
| **Total Memory Size** | 32KB | 32KB |
| **Memory Used** | 5-6KB | 20-25KB |
| **SRAM** | 2KB | -- |
| **EEPROM** | 1KB | -- |

**Scalability:**

| Device | Error Rate | Recovery Procedure |
|---|---|---|
| **Ardiuno UNO R3** | 0.5-1.2% | We must provide require current and voltage |
| **ESP8266** | 0.5-1.2% | We must provide require current and voltage |
| **Temperature sensor** | Usually malfunctions in high temperature | We have to use more power sensor |
| **Soil Moisture Sensor** | If the position is not correct | We must fix the sensors in correct position and more powerful sensor we have to use |
| **Water Pump/Relay** | 0.5% | We must provide require current and voltage |
| **Solar Panel** | If not clean efficiency reduces | Automatic cleaning system needed to be installed |
| **LDR** | If not clean accuracy decreases | Automatic cleaning system needed to be installed |
| **Servo Motor** | n/a | n/a |
| **Rain Sensor** | If not clean | Automatic cleaning system needed to be installed |

## Temperature and Thermal Management:

| Device | Operating Temp | Thermal Management |
|---|---|---|
| **Ardiuno UNO R3** | -40ºC to 85ºC | Usually this microcontroller does not heat up that much. But if we use more powerful one we have to use a thermal paste and a small fan on top of the CPU. |
| **ESP8266** | -55ºC to 125ºC | Usually this IoT Devices does not heat up that much. But if we use more powerful one we have to use a thermal paste and a small fan on top of the CPU. |
| **Temperature sensor** | -50ºC to 250ºC | -- |
| **Soil Moisture Sensor** | -50ºC to 80ºC | -- |

## Resource Utilization:

| Resources | Ardiuno UNO R3 | ESP8266 |
|---|---|---|
| **Memory** | 16% | 20% |
| **CPU** | 25% | 10% |
| **GPU** | N/A | N/A |

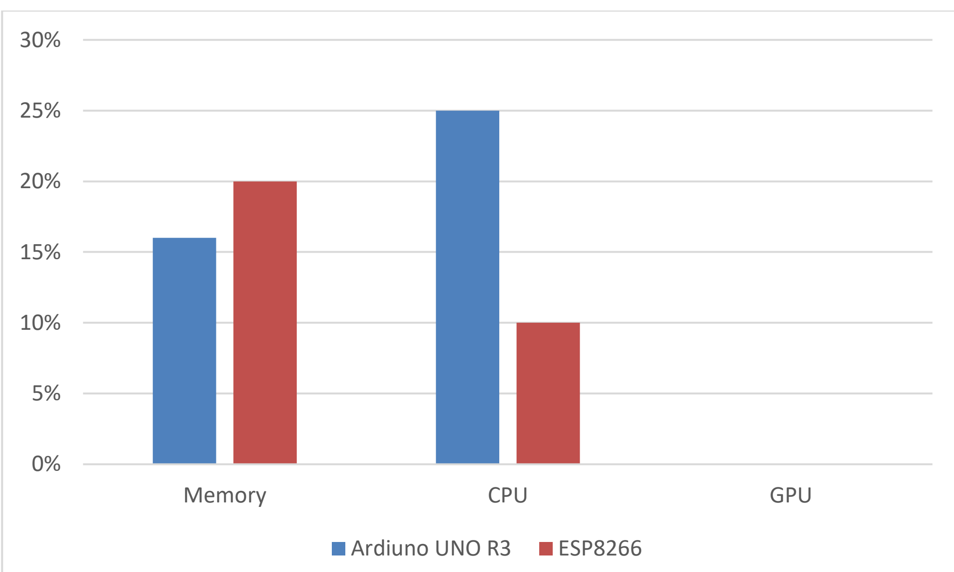



Fig5.8: Resource Utilization graph

## Cost Analysis:

Cost of the per module with the maintenance

| Device | Installation Cost | Maintenance |
|---|---|---|
| **Software** | Free (if mass production is done) | 500 TK/month/10 module |
| **Hardware** | 4200 TK / module | 6.5 TK/month (electricity) |
| **Total** | 4200 TK / module | 506.50 TK/month |

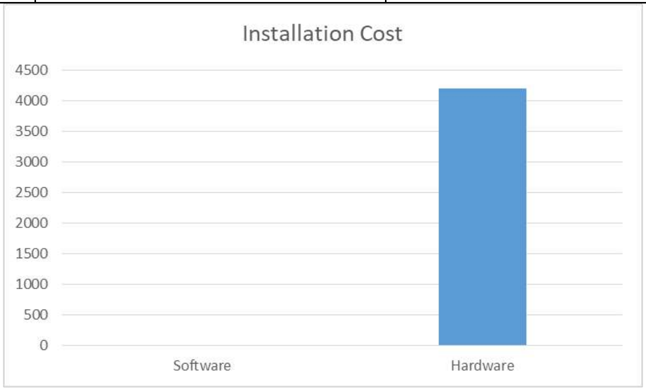



Fig5.9: Cost of the per module with the maintenance graph

Since we employ free software tool, there are no software installation costs associated with our project. However, the premium version of the software is required for better performance. Hardware is priced at 4,500 Taka.

Cost Estimation

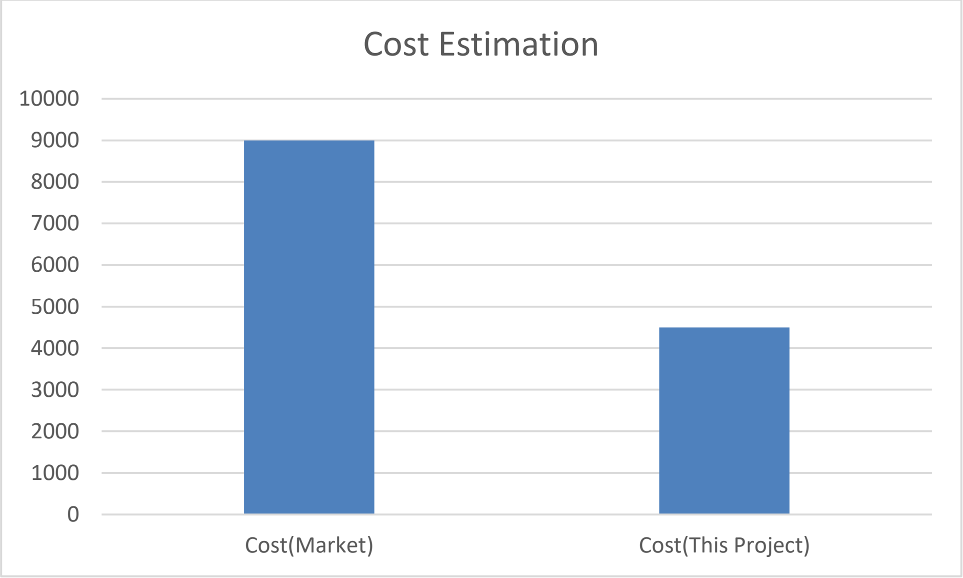



Fig5.10: Cost Estimate

We contrast the cost of our project with the costs of projects in other marketplaces. Our cost is 4500 taka here, but the market price is around 8500–9000 taka, which is twice as much. We completed half of the task. In light of this, the project is more affordable than others.

Power capability of Solar:

A solar panel should generate one kilowatt of power on an acre of land. However, because each solar panel in our design rotates toward sunlight with the aid of a motor to create power, a single set of panels can only produce 500 watts. Therefore, we need to put two sets of our designed solar panels—500*2 = 1000 watts or one kilowatt—on an acre of land.

### 5.2 Discussion:

This study report introduces the innovative "Smart Farm" project, which uses data analytics, sustainable practices, and state-of-the-art technology to reimagine traditional farming as a solution to the pressing problems facing contemporary agriculture. The main objective is to lessen the several problems that modern farmers have, including growing production costs, a shortage of arable land, and the negative environmental effects of old agricultural methods. The objective is to usher in an era of agriculture that is more cost-effective, environmentally friendly, and efficient through the development of a comprehensive system that combines data analysis, renewable energy, and automation.

The project's objective includes a robust data analytics system in addition to basic automation. This technology aids farmers in making data-driven decisions by providing them with up-to-date information on crop development trends, weather patterns, and soil conditions. The objective is to provide farmers with the information they need to improve their agricultural practices in order to raise yields and decrease waste.

Analyzing from cost analysis table and graph we have clearly declared that this project will be very beneficial for agriculture and farmers of our country in future. If commercialized, this project will revolutionize the future of agriculture.

## 5.3 Conclusion:

Our smart village farming effort aims to provide a brighter future for rural communities, optimize resource utilization, and empower farmers—rather than concentrating just on technology. By combining automation, real-time data, and mobile control, we are laying the groundwork for a more lucrative, efficient, and sustainable farming environment. The IoT-based smart village farming project demonstrated how solar energy, ongoing monitoring, and mobile app controls can be successfully integrated for effective water management in village farms. The program automates irrigation based on demand and reduces water waste, which increases crop yields, decreases farmer expenses, and advances sustainable agriculture.

There are several opportunities to move this project further in the future, including Weather prediction data is included to maximize the effectiveness of predictive irrigation. Research on soil nutrients to offer personalized fertilization advice. platforms that let communities learn from one another and share information in order to promote the diffusion of knowledge. Collaboration with local partners to improve project acceptability and expand its impact. Adding more sensors, such cameras or acoustic detectors, to better tracking and identify species. Consider employing automated deterrents, such as water sprinkler systems, loud alerts, or flashing lights, for an aggressive strategy. Building algorithms based on AI to monitor animal behavior, forecast potential threats, and launch specific remedies.

In the end, this initiative will benefit our village farmers and rural regions in the future.

For Future implementation, all data will be stored in the cloud of this project so that farmers will get all previous data.

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