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PEST CONTROL & IOT BASED AGRICULTURE WITH SOLAR (Krshi Suraksha)

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Abstract: Pest control in agriculture is the deterrence or extermination of species threatening agricultural productivity. Farms are often businesses and depend on output so that the workers can earn money and fund their lives. Therefore, any factors affecting produce must be acted on swiftly and in a cost effective & chemical freeway mainly in India. IoT in agriculture uses remote sensors, and computer imaging combined with continuously progressing machine learning and analytical tools for monitoring crops, surveying, and mapping the fields, and providing data to farmers for rational farm management plans to save both time and money.

Our technology, krshi suraksa, controls pests and keeps an eye on farms by monitoring soil & weather parameters and agricultural fields to ensure that farming is done safely and effectively, even over vast tracts of land with minimal expense. This is a low-cost IOT-based pest management and agriculture tool that aids farmers in many ways, including safe & effective irrigation. The farmer may monitor his field from his home using a mobile device.

Keywords: IOT based control, Pest control, effective, low cost, chemical free, for large area.

I. INTRODUCTION

Pests such as insects, weeds, and diseases can cause significant damage to crops, leading to reduced yields and economic losses for farmers. Effective pest management strategies help protect crops from these threats, ensuring healthier plants and higher productivity. By controlling pests, farmers can minimize the damage caused to crops and maximize their yield potential. This is especially important in regions where pests are prevalent and can rapidly destroy entire harvests if left unchecked. So effective pest management in low cost & chemical free is important. Chemical-free pest control refers to the use of alternative methods and techniques to manage pests without relying on conventional chemical pesticides. It offers several benefits that make it useful in various contexts. Here are some advantages of chemical-free pest control: Environmentally friendly, Health and safety, Preservation of beneficial organisms, Reduced pesticide resistance, Sustainable agriculture, Consumer demand and preference It's important to note that while chemical-free pest control methods have numerous benefits, their effectiveness can vary depending on the specific pest species, severity of infestation, and environmental conditions. Here we use light. Using light traps in agriculture is a method of pest control that involves attracting and capturing pests using artificial light sources. Light traps are designed to exploit the behavior of certain insects that are attracted to light, such as moths, beetles, and flying pests. Attraction and capture, Targeted pest control, reduced chemical pesticide use, Monitoring and early detection are advantage of light traps.

IoT-based irrigation systems can monitor soil moisture levels, weather conditions, and crop water requirements in real-time. This data helps farmers apply water precisely where and when it is needed, reducing water waste and improving water use efficiency. Smart irrigation systems can be remotely controlled and automated, allowing farmers to save time and ensure optimal irrigation schedules. These devices collect real-time data on soil moisture, temperature, humidity, crop growth, and other environmental factors. Farmers can use this data to make informed decisions about irrigation, fertilization, pest control, and overall crop management. Monitoring NPK (nitrogen, phosphorus, and potassium) levels in soil is important for several reasons in agriculture and soil management. For Nutrient balance and plant growth, Fertilizer optimization, Soil fertility management, Crop-specific nutrient requirements, Cost-effective farming, Environmental impact and sustainability. Now a days farmers are not taking measures in soil and starting agriculture this is main reason of huge production or crop loss in agriculture.

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Real-time weather updates and forecasts tailored to the area of the farm can be provided by app-based IoT solutions. From planting and harvesting to safeguarding crops from harsh weather events, this information aids farmers in making better plans for their activities. Soil sensors and other IoT devices can gather information on the health of crops, nutrient levels, and pest infestations. After processing this data, the app may offer farmers practical insights that will help them apply fertilizers and pesticides more precisely, cut down on waste, and improve crop quality. Agriculture can benefit greatly from IOT-based automation or switching, such as no-off of water pumps, automation of lights, drip management, animal and bird monitoring, motion detection and alerts, etc. IoT-based rain warnings in agriculture use connected devices, sensors, and automated systems to track weather patterns and notify or inform farmers in real-time of coming rains.

To cut expenses and improve efficiency, farmers can remotely manage lighting setups, water pumps, and other energy-consuming equipment. On the basis of real-time information from soil moisture sensors, weather predictions, and crop water requirements, irrigation systems can be managed by IoT-enabled switches. Through a smartphone app or online interface, farmers may remotely activate or deactivate irrigation systems and modify watering schedules, optimizing water use and increasing crop yields.

Despite the fact that IoT-based agriculture has many advantages, there are still a number of problems that must be resolved before it can be successfully implemented. There are several challenges, including connectivity and network infrastructure, data security and privacy, cost and affordability, and data management and analytics. Building an IOT-based farm is challenging, but it is feasible if certain issues are addressed.

It would be quite difficult to integrate all of these characteristics into a single solar-powered device. Our goal is to create a single, integrated device called Krshi Suraksha that can be accessed by all government-based helplines, fertilizer dealers, and farmers in that field. This will allow them to monitor and manage agriculture using mobile apps and the Internet of Things through internet access.

II. LECTURE REVIEW

The Internet of Things (IoT) has gained significant attention in recent years for its potential to revolutionize various industries, including agriculture. This lecture review aims to provide an overview of the key findings and trends from a selection of research papers focusing on IoT applications in agriculture. The integration of IoT technologies in agriculture holds the promise of optimizing resource utilization, increasing productivity, and promoting sustainable practices in farming.

The standard practice for pest control in agriculture has overcome by the use of chemical pesticides. However, worries are rising about their effects on the environment, health risks, and the emergence of pests resistant to pesticides have prompted researchers to look for alternate strategies. This lecture review intends to offer an overview of the major conclusions and developments from a number of studies focusing on non-chemical pest management techniques in agriculture. These techniques provide effective and long-lasting ways to manage pests while causing the least amount of damage to the environment and human health.

1. Research Paper Title: "IoT-enabled Livestock Monitoring and Management System"
Authors: Justin Ophir Isaac
Published in: International journal of engineering applied science and technology
Year: January 2021
This paper explores the use of IoT technologies for livestock monitoring and management. The lecture review highlights the various IoT sensors employed to track animal health, behavior, and location. The researchers discuss the implementation of a cloud-based data management system, allowing farmers to remotely monitor and analyses livestock data. The review addresses challenges related to sensor durability, network connectivity in remote areas, and the integration of livestock data with other farm management systems.

2.Research Paper Title: Blockchain and IoT based Food Traceability for Smart Agriculture
Authors: Jun Lin, Anting Zhang, Yueting Chai.
Year: July 2018
This study investigates the potential of combining IoT with blockchain technology to improve food supply chain traceability. The lecture review explores how IoT sensors can record critical data points throughout the supply chain, such as temperature, humidity, and transportation conditions. The integration of blockchain ensures the immutability and transparency of this data. The paper discusses the benefits of this approach, including reduced food fraud and enhanced consumer trust in the agricultural products.

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3. Research Paper Title: Improved Light Traps for Early Detection of Insect Pests of Phytosanitary Concern in Shipping Containers
Authors: Matteo Marchioro
Published in: Journal of Economic Entomology, Volume 114, Issue 5.
Year: October 2021
This study focuses on attraction of light of different wavelengths (white, infrared, ultraviolet, and red) applied on sticky traps was tested for the development of new traps for hitchhiker insects. The addition of entomological glue and insecticide on the trap was also tested. Tests were conducted on Cadra cautella Walker (Lepidoptera: Pyralidae), Drosophila melanogaster Meigen (Diptera: Drosophilae), Sitophilus zeamais Motschulsky (Coleoptera: Curculionidae), and Tribolium castaneum (Herbst) (Coleoptera: Tenebrionidae) and released inside a shipping container. Firstly, one light color at a time was tested setting eight traps in the container, one for each possible combination of the variables: light on or off, glue added or not, and insecticide sprayed or not. In the second, five traps were used, all of them coated with the entomological glue: one for each light color and one with light off as control. In all the single-color tests (except for infrared), light-on traps captured more, except for T. castaneum that was not attracted to white. In the multi-colour test, C. cautella showed no preference among white, ultraviolet, or red; Drosophila melanogaster preferred ultraviolet and white over red; and beetles had a much greater attraction to red. Lastly, the stronger entomological glue improved catches of beetles, whereas insecticides did not. In conclusion, results suggest a possible application of sticky light traps against hitchhiker insects and further studies should verify if the simultaneous use of different light colours can improve the trap performance and does not act as a repellent.

Conclusion from the reviews: The potential for IoT technologies to revolutionize numerous facets of farming and agriculture is highlighted in the lecture review of IoT in agriculture research papers. IoT applications provide useful insights and prospects for enhanced efficiency, sustainability, and profitability in the agriculture sector, from precision farming to animal management and supply chain traceability. To fully realize the advantages of IoT in agriculture, however, connection, interoperability, and data security issues must be resolved. To overcome these challenges and promote the wider deployment of IoT technologies in the agriculture sector, additional research and development are essential. The need of looking into environmentally friendly alternatives to chemical pesticides is highlighted by research publications on chemical-free insect management in agriculture. Biological control, innovative trapping systems, plant-based biopesticides, microbial agents, and smart farming technologies offer promising solutions to manage pests effectively while minimizing environmental and health impacts. Implementing these approaches requires a multidisciplinary approach and a deeper understanding of the ecological dynamics within the agricultural systems. Continued research and adoption of chemical-free pest control methods are crucial for promoting sustainable and resilient agriculture in the face of evolving pest challenges. I promise that, my research will make agriculture effective & sustainable.

III. DESCRIPTION

Soil parameters to de monitored and their importance

- **NITROGEN**

The most crucial ingredient for the production of crops worldwide is nitrogen. It is essential to the growth and development of crops.

The status of Nitrogen in general soils is 0.03- 0.05% and can be found in soil in a various form, including organic and inorganic molecules.

Both soil organic matter and the breakdown of plant and animal remains as the sources of organic nitrogen in soil. It can be found as proteins, amino acids, and other chemical substances. Before it can be absorbed by plants, organic nitrogen must be changed into inorganic forms.

In soil, inorganic nitrogen is predominantly found in the form of ions; nitrate (N03-) and Ammonium (NH4+). The microbial conversion of organic nitrogen to ammonium is known as organic nitrogen mineralization. Nitrate is abstracted by the process of nitrification, in which soil bacteria turn ammonium into nitrate.

Nitrogen fixation is the process by which atmospheric nitrogen gas is transformed into organic nitrogen molecules. Some bacteria, like the symbiotic rhizobia in the root nodules of legume plants, can fix atmospheric nitrogen and transform it into a form that plants can use.

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Through their roots, plants absorb nitrate and ammonium ions, which are two different forms of nitrogen. Depending on the type of plant, the availability of nutrients, and the soil, nitrate or ammonium uptake is preferred. Ammonium is more readily kept by the soil particles while nitrate is more easily leached out of the soil due to its greater mobility.

Additionally, nitrogen is a part of the chlorophyll molecule, which helps plants use photosynthesis to absorb sunlight energy, promoting plant growth and grain yield. To guarantee energy is accessible when and where the plant needs it to maximize output, nitrogen plays a crucial role in the plant.

The roots contain nitrogen in the form of proteins and enzymes. They make it easier for plants to absorb nutrients and water.

Nitrogen levels in plants must be balanced in order to be in good health. Otherwise, plants could show signs of a deficiency. The early signs of a nitrogen deficit typically include slow growth and uniform yellowing of older leaves. Lack of nitrogen causes plants to grow smaller than average fruit, leaves, and shoots, which can also develop later than usual. Fall broadleaf foliage could be more reddish than usual and drop earlier than usual.

Farmers can estimate how much nitrogen is available for plant absorption by looking at the nitrogen content of the soil. Farmers can determine whether the soil has enough nitrogen to suit the needs of the crops they intend to produce by looking at the nitrogen concentration. For maintaining ideal plant nutrition and raising agricultural production, this knowledge is essential.

Farmers can choose where to apply fertilizer based on the amount of nitrogen in the soil. Supplemental nitrogen fertilizers may be required to supply the necessary nutrients for healthy plant growth if the soil's nitrogen level is low. On the other hand, if the nitrogen levels are already high, farmers can minimize or forgo applying nitrogen fertilizer, saving money and reducing the chance of nutrient runoff.

➢ PHOSPHORUS

Phosphorus, as it an important component of numerous physiological and biochemical processes, is a necessary nutrient for plant and animal growth.

The total phosphorus content of most surface soils is low, averaging only 0.6%. Three forms of soil phosphorus are typically distinguished: soluble phosphorus, stable phosphorus, and labile phosphorus.

Although it makes up a very minor portion of the total soil phosphorus, soluble phosphorus is the portion that is absorbed by plants. Labile phosphorus is more common than soluble phosphorus, but still makes up a very small fraction of all soil phosphorus. In soil, labile phosphorus can move rather fast into the soluble phase and is not strongly absorbed. The majority of the soil's total phosphorus is found in stable forms that are inaccessible to plants. A little amount of stable phosphorus eventually undergoes chemical or biological reactions to transform into labile and soluble phosphorus.

In soil, phosphorus can be found in both organic and inorganic compounds. Additionally, the soil's nutrient cycling will alter the phosphorus-containing molecules. Chemical fertilizer and organic sources, such as manure, are the main sources of phosphorus inputs to the soil for Most fertilizer formulations contain phosphorus in an inorganic or soluble form that is easily absorbed by plants. Fertilizers have standardized and uniform nutrient contents. Blending fertilizers can help meet crop nutrient needs more easily, preventing nutrient buildup and promoting optimal growth.

Phosphorus can be found in manure as both inorganic or soluble phosphates and organic molecules. Plants may easily use the soluble phosphorus found in manure that has been put to the soil. However, organic forms of phosphorus must be released or made available to plants through the process of mineralization, which is the microbial degradation of organic matter in the soil.

One of the most important soil minerals for plants is phosphorus. It is a component of plant cells and is necessary for cell division and the growth of the plant's growing tip.

Photosynthesis couldn't happen without phosphorus. Due to its essential role as a component of ATP (adenosine triphosphate), phosphorus is essential for the complicated energy conversions required by all life. It is essential for the synthesis of proteins and other chemicals and is a key component of DNA and RNA.

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From the seedling stage through maturity, phosphorus is needed by the plant, and it has a demonstrable effect on crop quality and output.

Phosphorus also helps in building nucleic acids, enzymes and proteins, strengthens stems and stalks, facilitates root growth, improves flower formation and seed production, increases disease resistance, facilitates nitrogen fixation abilities of legumes.

For plants to be healthy, their phosphorus levels must be in equilibrium. Otherwise, plants may exhibit deficient signs. The most typical signs of phosphorus shortage include.

- Affects lower and older leaves
- Leaves become shiny with yellow areas
- Leaves thicken becoming stiff and dry. Sometimes the leaves turn red or purple

Use one or more of the following remedies to make up for the shortfall

- Make pH adjustment
- Provide plants with correct nutrient ration
- Provide additional phosphorus for plant grown under high-powered lights
- Do not overwater plants

➢ **POTASSIUM**

Potassium is a nutrient that is required for plant growth. It is designated as a macronutrient because plants absorb considerable amounts of K throughout their life cycle.

The percentage of potassium in general soils is 2%. Potassium can be present in soil in both mineral and organic forms. Most of the potassium in soils comes from the weathering and breakdown of minerals that contain potassium, like feldspar, mica, and clay minerals. Over time, these minerals let go of potassium ions into the soil solution, making them accessible to plants.

The decomposition of organic matter, such as plant remnants, animal manures, and microbial biomass, is where organic potassium in soils comes from. Potassium ions are released as organic matter decomposes, and plant roots can absorb these ions. In soils, organic matter acts as a large potassium reservoir and increases the availability of potassium in the environment.

The form of potassium that plants may absorb is the potassium ion, or k+, which is present in soil solution. The most commonly used potassium fertilizer source is Potassium chloride (kcl) also called as Muriate of Potash and the important minerals are potash feldspars, biotite, muscovite. Greensand, hardwood and kelp meal are organic sources of potassium. For several physiological and metabolic processes, plants need the macronutrient potassium. In terms of total plant development, output, and quality, it is crucial to crop production.

Numerous physiological processes in plants involve potassium. It helps to control water intake and retention, boost turgor pressure, and promote photosynthesis and protein synthesis effectiveness. Additionally, potassium activates enzymes involved in a number of metabolic processes.

Plants with adequate potassium levels are better able to endure environmental challenges. Potassium aids in the resistance of plants to heat, drought, cold, and disease. It increases pest and pathogen resistance, water use efficiency, and general stress tolerance.

Potassium affects the productivity and qualitative characteristics of crops. It encourages root growth, which improves nutrition and water absorption. Higher biomass production, more blooming, and greater fruit quality, size, and Flavors are all influenced by adequate potassium levels.

Chlorosis between leaf veins and brown burning and curling of the leaf tips are typical signs of potassium shortage in plants. The undersides of the leaves may also develop purple markings. Typically, potassium deficient plants have diminished plant growth, root development, seed development, and fruit development.

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To establish the potassium level in agricultural fields, routine soil testing is essential. Appropriate potassium fertilizers can be applied based on soil analysis to repair insufficient levels and maintain optimal soil fertility. Nutrient management strategies that are well-balanced to increase the agricultural productivity while reducing the negative environmental effects.

Spread organic material underneath the plants and add potassium fertilizer, particularly in slow-release forms such potassium silicate, Sulphur-, or polymer-coated products, to make up the shortfall.

➢ **SOIL PH**

Because it directly affects the availability of vital nutrients to plants and plays a significant role in overall crop productivity and health, soil pH monitoring is extremely important in agriculture. On a scale from 0 to 14, with 7 representing neutrality, soil pH refers to the measurement of soil acidity or alkalinity. The following are the main arguments for why it is crucial to monitor soil pH for successful agricultural production:

Nutrient Availability: The availability of nutrients in the soil is influenced by the pH of the soil. Within particular pH ranges, different nutrients are soluble and available to plants. For instance, vital minerals like nitrogen, phosphate, and potassium are less available to plants in low pH (acidic soil). under contrast, micronutrients like iron, manganese, and zinc may become less accessible under high pH (alkaline soil). Plants can obtain a balanced amount of nutrients necessary for their growth and development if the proper soil pH is maintained.

Efficiency of Nutrient Uptake: Plant roots' ability to absorb nutrients is influenced by the pH of the soil. Roots can more efficiently absorb nutrients when pH is within the ideal range for a particular crop. This effective nutrient uptake encourages healthier plant development, more robust root systems, and improved pest and disease resistance.

Soil Microbial Activity: The pH of the soil affects the activity of helpful soil bacteria that are essential for the cycling of nutrients and the breakdown of organic materials. A diversified and active microbial population is encouraged by a pH level that is balanced, promoting a better soil ecology that supports plant growth.

➢ **SOIL MOISTURE**

Because soil moisture directly affects plant growth, crop yield, and overall farm productivity, soil moisture monitoring is essential for good agricultural production. In order to guarantee that plants receive the appropriate amount of water at the appropriate time, it is crucial to control soil moisture properly. The following are the main justifications for why it is crucial for agriculture to monitor soil moisture:

Optimal Plant Growth: For optimum plant growth, sufficient soil moisture is necessary for germination, root growth, and plant development as a whole. Monitoring the moisture content of the soil ensures that plants have access to the water they require for robust root development and healthy growth.

Efficiency in Water Use: Farmers can improve irrigation and water use by keeping an eye on soil moisture. Knowing the soil's moisture level enables farmers to water only when necessary and prevent overwatering, which can result in water loss, nutrient leaching, and higher production costs.

Nutrient Uptake: For plants to absorb nutrients properly, the soil moisture levels must be just right. Even when there are nutrients in the soil, nutrient absorption might be hampered by too much dryness. The availability of nutrients to plants is improved by maintaining appropriate moisture.

Weather parameters to be monitored

➢ **TEMPERATURE**

Agriculture benefits greatly from temperature monitoring because it is essential to many elements of managing crops and cattle. Farmers may make educated judgments, optimize crop growth conditions, improve animal health, and increase farm output by monitoring temperature in various agricultural scenarios. The following are some applications for temperature monitoring in agriculture:

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Frost protection: Keeping an eye on the temperature enables farmers to prepare for and react to frost incidents. Farmers can take precautions to preserve delicate crops when the temperature is about to drop below freezing by using frost prevention methods including irrigation, wind machines, or covering the crops.

Calculating Growing Degree Days (GDD) For the purpose of determining Growing Degree Days (GDD), temperature monitoring is necessary. GDD is a metric used to monitor heat buildup and forecast crop growth stages. It supports agricultural performance evaluation and helps farmers to choose the best dates for planting and harvesting.

Management of greenhouses: In greenhouse settings, temperature monitoring makes ensuring that crops get the proper amount of heat. Based on temperature information, automated systems can change the heating and ventilation to ensure the best possible growing circumstances for plants.

➢ AIR MOISTURE

As the moisture content of the air has a considerable impact on crops, plant health, and agricultural operations as a whole, measuring air humidity is very useful in the agricultural industry. Farmers may make informed judgments and put suitable plans in place to maximize crop growth and reduce potential problems by monitoring air humidity. Here are some applications for measuring air humidity in agriculture:

Irrigation management: Evaporation rates and soil water loss have a direct impact on air humidity. Farmers can change irrigation schedules by keeping track of humidity levels to make sure that crops receive the right amount of water without being overwatered, minimizing water waste and maximizing efficiency of water usage.

The prevention of disease: High humidity levels can foster the growth and spread of plant diseases, such as fungi infections. Farmers can lower the likelihood of disease outbreaks by taking preventive actions, such as enhancing ventilation and plant spacing, by monitoring humidity.

Management of greenhouse environments: In greenhouse settings, maintaining ideal humidity levels can stimulate plant growth and avert problems like Mold and mildew. Farmers may control greenhouse conditions by using humidity sensors to produce the optimal microclimate for plants.

Care for Transplants and Seedlings: Humidity levels are important for the transplants' and seedlings' healthy establishment. Farmers can create a proper environment for new plants throughout their crucial early stages of growth by keeping an eye on the humidity.

➢ PRESSURE FOR RAIN DETECTION

Agriculture can benefit from early rain detection by monitoring the atmospheric pressure for a number of reasons. Changes in air pressure can signal the approach of weather systems, and by keeping an eye on these variations, farmers can learn important information that can aid in their decision-making and better organize their agricultural activities. In agriculture, early rain detection via air pressure has the following advantages:

Risk management: Extreme weather occurrences can have a disastrous effect on crops since the weather can be unexpected. Farmers can get ready for torrential downpours, storms, or other bad weather by spotting rain early using air pressure monitoring. To reduce damage and loss, they might take preventative actions including strengthening structures, safeguarding crops, and securing equipment. Crop Planning: Farmers can more efficiently plan their agricultural activities when they are aware of impending rain events. By aligning planting, fertilizing, and other crucial operations with the predicted rain, they may make the best use of available water resources and enhance crop development. Irrigation on Time: Tracking atmospheric pressure can aid in forecasting impending rain and weather patterns. Farmers can decide when to irrigate their crops by using early rain detection. Farmers should postpone or scale back irrigation if rain is anticipated soon, saving water and avoiding overwatering, which can result in waterlogging and other issues.

IV. METHODOLOGY

▶ CONSIST OF THREE UNITS:

- ➢ Pest control unit
- ➢ Sensor unit
- ➢ IOT based transmission unit

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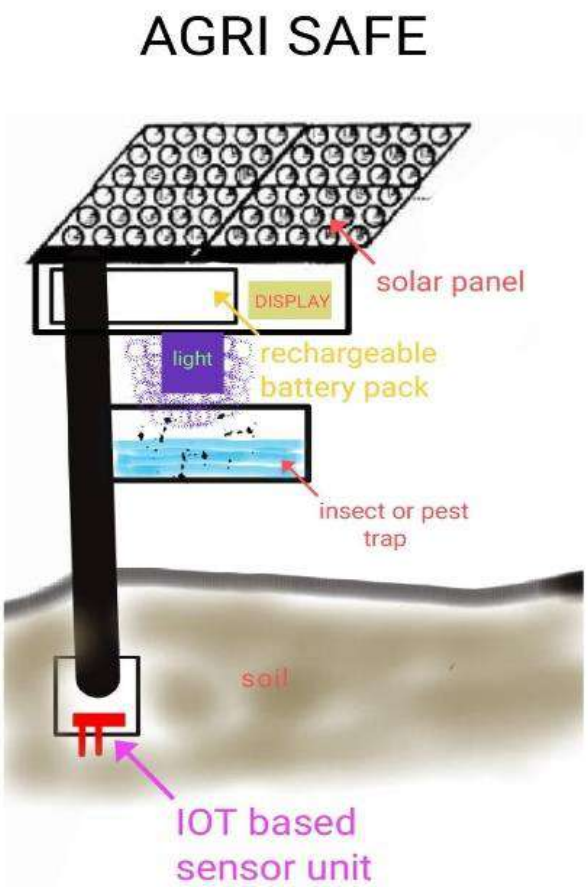
BLOCK DIAGRAM:



Pest control unit: Pest control unit is used to control the pest in agriculture field. In the evening, when the harmful pests cover the crop fields, the solar lamp will switch on automatically and attracts the insects that may destroy the crops. Attracted insects end up in a water-filled basin or trap to a oil paper. Lamp is charged by using solar panel in day hours.

Light Source: The trap uses light-emitting diodes (LEDs) or other types of lamps that emit wavelengths attractive to the target pests. Different pests are drawn to different colors of light, so the trap may use a combination of colors to target a broader range of pests.

The frequencies of light that attract pests in agriculture can vary depending on the type of pest. Different insects and pests are attracted to specific wavelengths, that is why some traps use a combination of colors to target a broader range of pests. Here are some examples of frequencies and the pests they may attract:

Ultraviolet (UV) Light (around 365-400 nm): Many flying insects, including mosquitoes, flies, and moths, are attracted to UV light.
Blue Light (around 450-495 nm): Some insects, such as fruit flies and cabbage loopers, are attracted to blue light.
Green Light (around 495-570 nm): Green light is attractive to certain types of beetles and plant bugs.
Red Light (around 620-750 nm): Some insects, like aphids and leafhoppers, are attracted to red light.
Yellow Light (around 570-590 nm): Yellow light is known to attract thrips, whiteflies, and fruit flies.

It's important to know that pest attraction to specific frequencies can vary based on the pest's species, geographic location, and environmental factors. Therefore, using a combination of wavelengths in light traps can be more effective in capturing a diverse range of pests.

Photocell Sensor: The trap is equipped with a photocell sensor that detects changes in light intensity. So entire circuit is turned on and off based on the sun light. The circuit automatically on in the evening and turn off by morning. Here is simple light sensor circuit.

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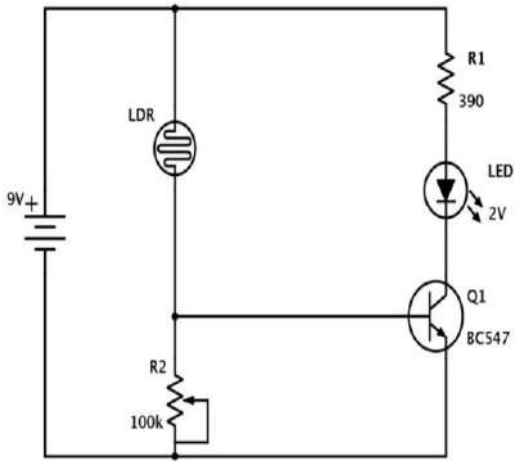
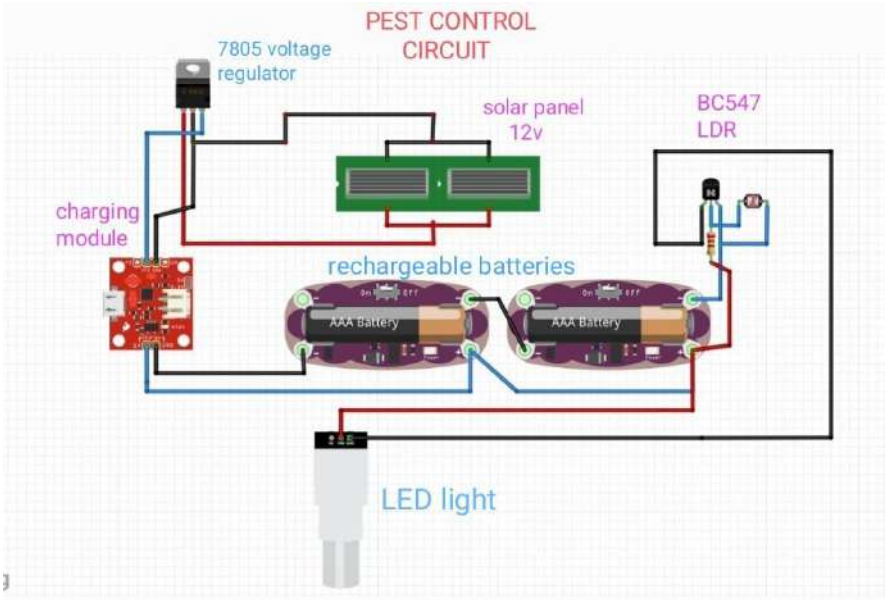
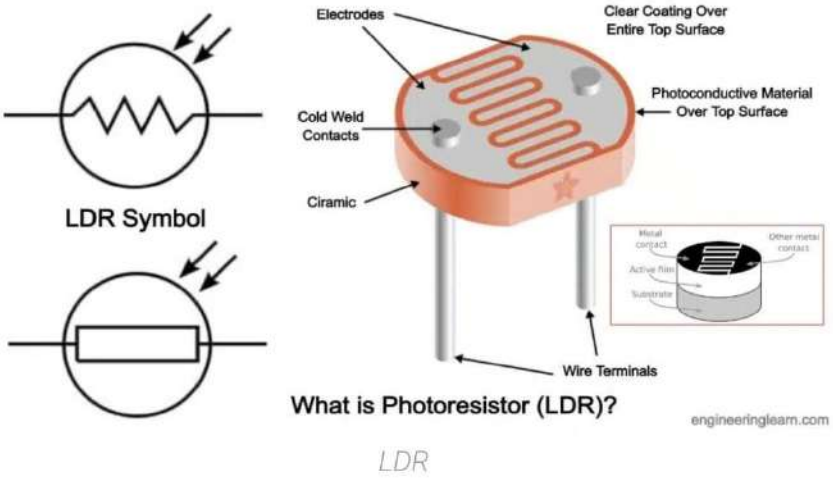


Trap Mechanism: light is surrounded by an oil paper or water container placed below which is used to trap the pest attracted toward light. Where these water and oil paper can be replaced day by day. Power Source and Control Unit: The trap circuit is powered by rechargeable batteries or a solar panel, and a control unit manages the operation of the circuit. The control unit may include a timer to activate the trap during specific hours or based on pest activity patterns.



▶ **Description of components:**



LDR

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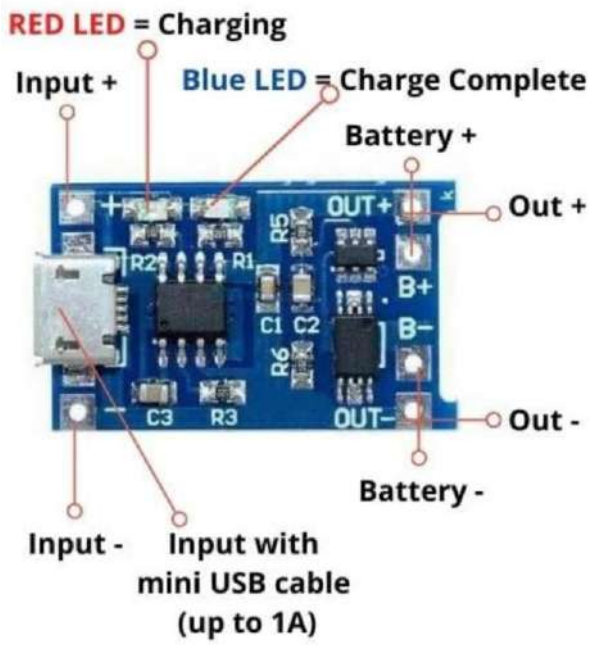
LDR: An LDR (Light Dependent Resistor), also known as a photoresistor, is a passive electronic component that changes its resistance based on the intensity of light falling on its surface. The working principle of an LDR is as follows:

Material: LDRs are typically made of semiconductor materials that exhibit a higher resistance in darkness and a lower resistance when exposed to light.

Light Absorption: When light photons strike the surface of the LDR, they excite electrons in the semiconductor material, causing them to move freely and reduce the resistance.

Dark Environment: In a dark environment with minimal light, few photons hit the LDR's surface, and the majority of electrons remain in their bound state. This leads to higher resistance.

Bright Environment: In a bright environment with a higher intensity of light, more photons reach the LDR's surface, causing more electrons to be excited and conduct electricity more efficiently, resulting in lower resistance.



Battery charging module: Lithium-Ion and Lithium-Polymer cells may explode if a shorted, overcharged, charged, or discharged with too high currents. TP4056 module is a combination of charger and protection for single cell 3.7V lithium batteries. Hence this module will monitor the voltage level of the lithium battery during charging and discharging. Inside the module IC TP4056A, DW01A, and P-type MOSFET FS8205A are used. The charging process is controlled by the TP4056A Liner voltage IC, charge current is set by connecting a 1.2KΩ resistor from RPROG (Pin: 2) to GND. The DW01A battery protection IC is designed to protect lithium-ion/polymer battery from damage or degrading the lifetime due to overcharge, over discharge. No blocking of diode is required due to the FS8205A internal PMOSFET architecture has prevented to negative charge current circuit.

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Solar panel: Photovoltaic Cells: The solar panel is composed of multiple photovoltaic (PV) cells made from semiconductor materials, usually silicon. When sunlight (photons) strikes these cells, it excites electrons, generating a flow of electric current.

Series Connection: The individual PV cells are connected in series inside the solar panel. This means the positive terminal of one cell is connected to the negative terminal of the next, and so on. This arrangement increases the total voltage output. Output Voltage: The voltage output of a solar panel depends on the number of PV cells connected in series. A standard 12V solar panel typically has 36 PV cells (each producing around 0.5V), resulting in an output voltage of around 18V in bright sunlight.

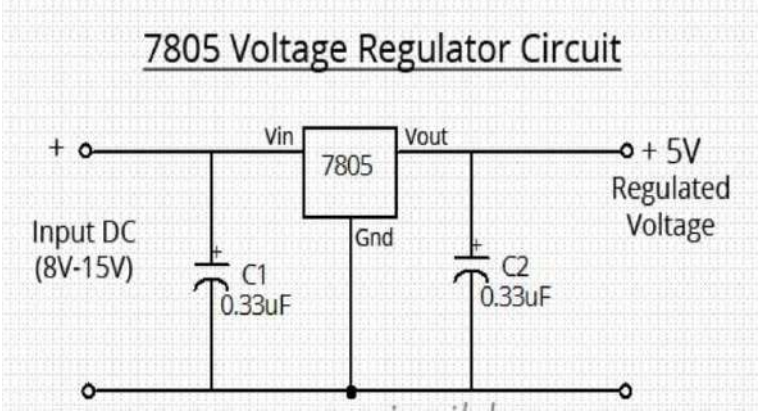
Lithium-ion batteries: Electrodes: A Li-ion battery consists of two electrodes: a positive electrode (cathode) and a negative electrode (anode). The cathode is typically made of lithium cobalt oxide (LiCoO2), while the anode is made of graphite.

Electrolyte: Between the two electrodes, there is an electrolyte that allows lithium ions to move front and back during charging and discharging. The electrolyte is usually a lithium salt dissolved in an organic solvent.

Charging: When you charge a Li-ion battery, a voltage is applied to the battery terminals. This causes lithium ions move from the cathode through the electrolyte and intercalate into the anode material (graphite). The anode acts as a host for these lithium ions.

Discharging: When you use the Li-ion battery to power a device, the opposite happens. The lithium ions move back from the anode through the electrolyte to the cathode, generating an electric current that adds power to the device.

Reversibility: One of the key features of Li-ion batteries is their reversibility. It means that during the charging and discharging cycles, the lithium ions move back and front between the cathode and the anode without causing significant structural changes in the electrodes, allowing the battery to be recharged multiple times.



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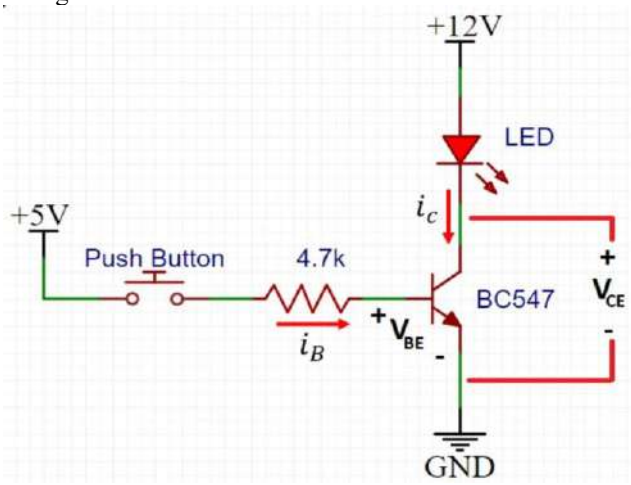
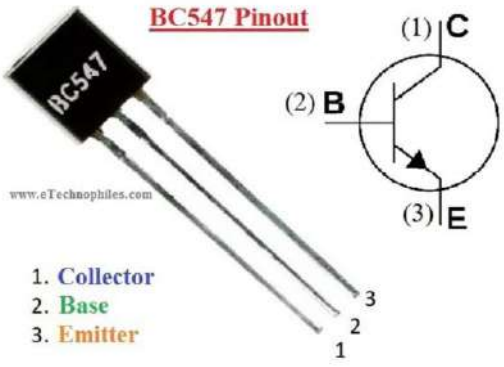
BC547 as switch: NPN Transistor Configuration: The BC547 has three terminals - the Base (B), the Collector (C), and the Emitter (E). When using it as a switch, it's typically configured as a common-emitter NPN transistor.

Base Current Control: To turn the BC547 transistor "ON" and allow current to flow from the collector to the emitter, you need to apply a small current (base current) to the base terminal. This current allows the transistor to conduct, effectively acting as a closed switch.





Base-Emitter Junction: When you apply the base current, it causes a forward bias across the base-emitter junction, allowing the transistor to enter its active region and conduct.

Collector Current Flow: With the base-emitter junction forward-biased, current can flow freely from the collector to the emitter. The amount of current that can flow through the transistor is determined by the base current and the transistor's current gain (hFE).

Turning the Transistor "OFF": To turn the transistor "OFF" and act as an open switch, you need to stop the base current flow. When there is no base current, the base-emitter junction remains reverse-biased, and the transistor is in a cutoff state, preventing current flow from the collector to the emitter.

LEDS: LEDs, or Light Emitting Diodes, are semiconductor devices that emit light when an electric current passes through them. They are energy-efficient, durable, and come in various colors. LEDs have revolutionized lighting technology, offering longer lifespans and lower energy consumption compared to traditional incandescent bulbs. They are widely used in lighting, displays, indicators, and various electronic devices.

Sensor unit & transmission unit: IoT-based devices for measuring and analyzing the soil nutrients utilizing Arduino and ESP8266. Agriculture is based on soil if a crop grows more quickly than we are thankful for the nutrients in the soil. The yield of a crop is greatly influenced by the number of chemical and physical characteristics of the soil, including its moisture content, temperature, atmospheric pressure and levels of nitrogen, phosphorus, and potassium. The field-useable open-source hardware is capable of sensing these features. The farmer will be able to monitor soil moisture, soil temperature, and soil nutrient content like nitrogen, phosphorus, and potassium with the help of a proposed soil nutrient monitoring & analysis system. On a smartphone or computer system, the farmer can wirelessly monitor all these parameters.

We'll utilize a capacitive soil moisture sensor to detect the moisture content of the soil. The Dht11 Temperature Sensor can be used to gauge the soil's temperature. Similarly, we will utilize a soil NPK sensor to measure the soil NPK values. The Arduino platform is easily interfaced with all of these sensors. The data will be tracked using the Thingspeak Server or mobile based blynk app in both graphical and numerical forms. For communicating the data to the server, we require a GSM or WiFi network in the field. But these networks are not available to the agricultural sector. We will utilize the NRF2401 Wireless transceiver Module to transfer the data from the sensor node to the gateway in order to fix this. Wireless transmission of data from the transmitter to the receiver across distances of up to one kilometer is possible. The ESP8266 WiFi Module, which has access to the WiFi Network, is used to construct the receiver. The information can be uploaded to Thingspeak server or mobile based blynk app via this WiFi network.

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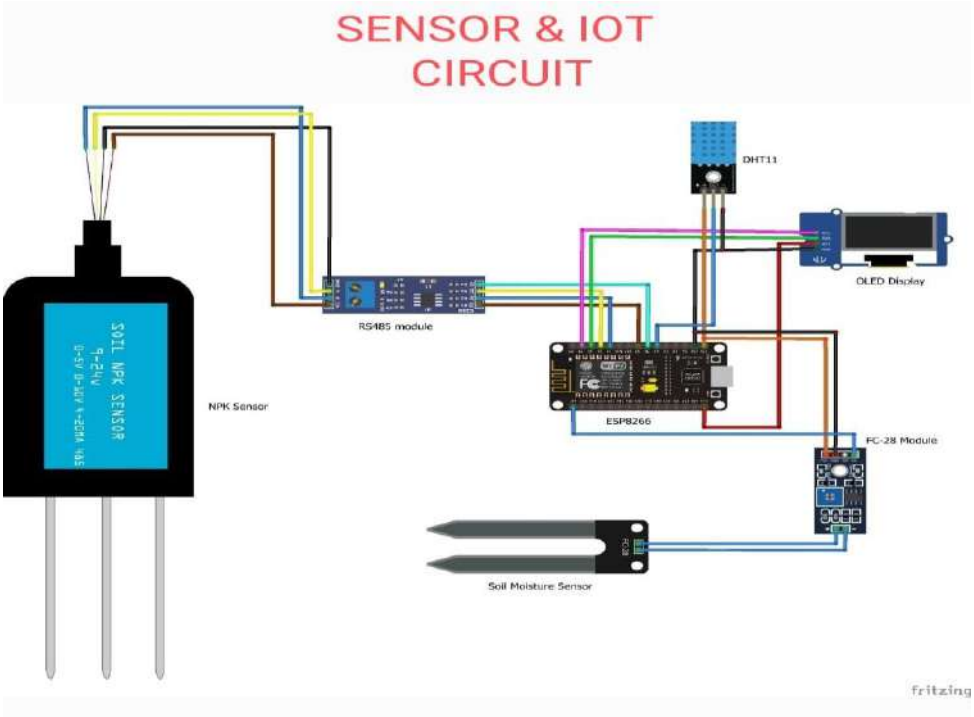


▶ Description of components

ESP8266: The ESP8266 module enables microcontrollers to connect to 2.4 GHz Wi-Fi, using IEEE 802.11 bgn. It can be used with ESP-AT firmware to provide Wi-Fi connectivity to external host MCUs, or it can be used as a self-sufficient MCU by running an RTOS-based SDK. The module has a full TCP/IP stack and provides the ability for data processing, reads and controls of GPIOs.

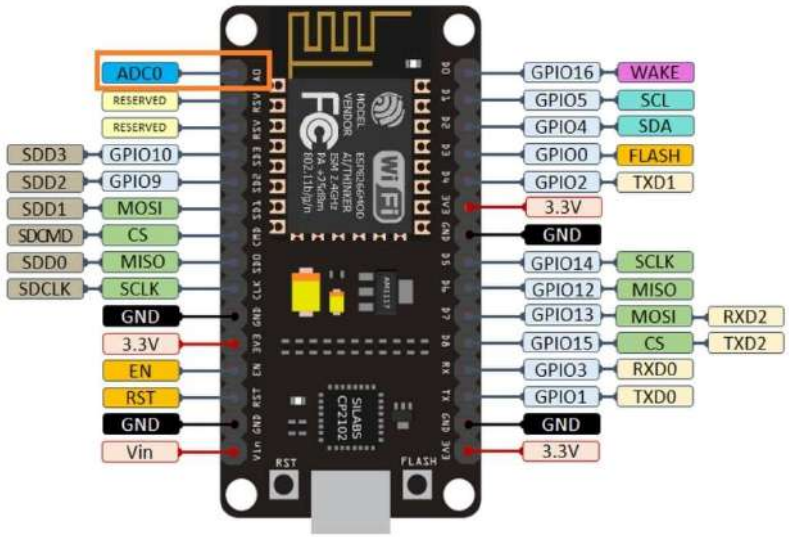
ESP8266 has many applications when it comes to the IoT. Here are just some of the functions the chip is used for:

Networking: The module's Wi-Fi antenna enables embedded devices to connect to routers and transmit data.

Data Processing: Includes processing basic inputs from analog and digital sensors for far more complex calculations with an RTOS or Non-OS SDK.

P2P Connectivity: Create direct communication between ESPs and other devices using IoT P2P connectivity.

Web Server: Access pages written in HTML or development languages.



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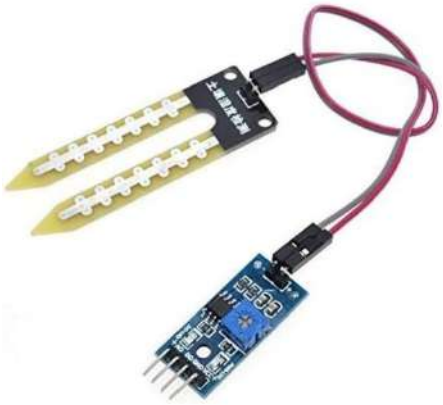
DHT11 sensor: The DHT11 module is a temperature and humidity sensing module that uses Digital Signal Acquisition to translate temperature and humidity to a digital reading that a microcontroller can easily read. It makes the use of specific digital module capture technology as well as temperature and humidity sensor technology to provide high dependability and long-term stability in its products. A resistive element and a sense of moist NTC temperature measuring devices are included in the sensor, which is coupled to a high-performance 8-bit microprocessor.

Soil moisture sensor: The soil moisture sensor consists of two probes which are used to measure the volumetric content of water. The two probes allow the current to pass through the soil and then it gets the resistance value to measure the moisture value.

When there is more water, the soil will conduct more electricity which means that there will be less resistance. Therefore, the moisture level will be higher. Dry soil conducts electricity poorly, so when there will be less water, then the soil will conduct less electricity which means that there will be more resistance. Therefore, the moisture level will be lower.



NPK sensor: The soil NPK sensor is suitable for detecting the content of nitrogen, phosphorus, and potassium in the soil. It helps in determining the fertility of the soil. The sensor can be buried in the soil for a long time. The sensor doesn't require any chemical reagent. The sensor has high measurement accuracy, fast response speed, and good interchangeability & can be used with any microcontroller. To read the NPK Data you need a Modbus Module like RS485/MAX485. The Modbus module is connected to Microcontroller & to Sensor. The sensor operates on 9-24V. The accuracy of the sensor is up to within 2%. The nitrogen, phosphorous & potassium measuring resolution is up to 1mg/kg (mg/l).

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MAX485 module: This low power transceiver module is based on the Maxim MAX485 IC to allow serial communication over very long cable runs (up 4000 feet / 1200 meters). Serial data can be transmitted in both directions (half duplex) at a data rate up to 2.5Mbps. The modules operate from a standard 5V power.

OLED display: The Organic Light-Emitting Diode, or simply OLED, is the technology used for the screen in the Arduino Sensor Kit. The OLED uses an organic, carbon-based material for emitting light. When electricity is applied to this material, it emits light. The Grove OLED display 0.96" module's behavior can be controlled by using the Arduino Sensor Kit library.

ADDITIONAL SENSORS FOR NEW FEATURES:

Soil Ph Sensor: This is a waterproof and dustproof Soil Ph Sensor that can measure the Soil Ph value from 3 to 9 with high accuracy up to ±0.3PH. The sensor has an IP68 protective case & is sealed with High-density epoxy resin which can prevent moisture from entering the body interior part. The sensor is suitable for agricultural cultivation, industrial production, environmental monitoring, animal husbandry, and sewage treatment. For soil Ph detection.

BMP280 sensor: The BMP280 sensor is a high-precision sensor module that detects atmospheric temperature, atmospheric pressure and air humidity. The module supports both, the SPl interface as well as the l2C interface. Unlike other sensors, these sensors have already been calibrated. They can start measuring temperature, pressure, and humidity as soon as they are turned on, and no further calibration is required. For atmospheric pressure for rain detection.

Web Server:
Web servers that use the internet network may visualize information data in line with requests made by using HTTP communication, which is very beneficial for IoT projects. Data from input in the form of sensors or other devices would be shown on a web server's open user interface. In this project, we'll create a soil monitor web server using the Arduino IDE and ESP8266 NodeMCU. The potassium, phosphorus, and nitrogen contents of soil are tracked using the NPK sensor.

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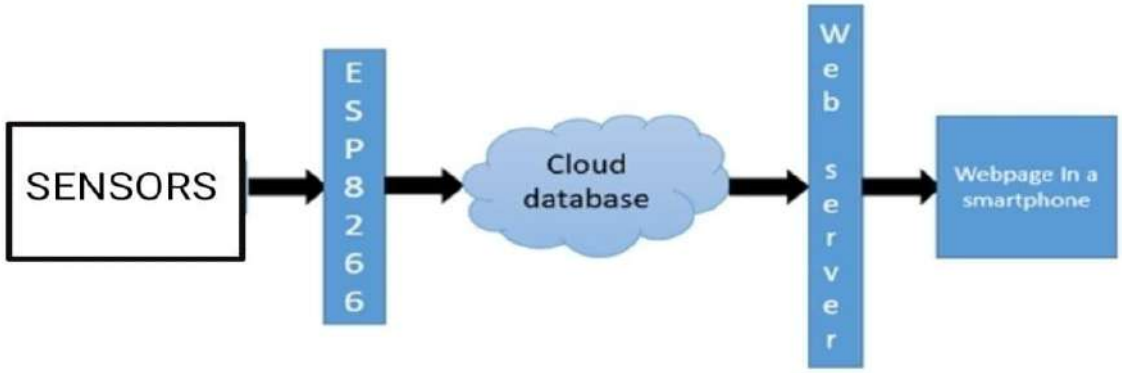
This web server will act as a soil nutrient monitor by displaying measurements for N (nitrogen), P (phosphorus), and K (potassium) on the web page. The sensor values will automatically update on a web page. because we create a Server-Sent Events (SSE) server and asynchronous web server library. The ESP Async Web Server package makes it simple to create asynchronous web servers. These nutritional indicators show the elements potassium, phosphorus, and nitrogen. In order to utilize the Arduino IDE to create a responsive ESP8266 NodeMCU web server that can be accessed from any device that has a web browser, the ESP8266 NodeMCU would also need to be connected to the user's local area network. This requires that the ESP8266 NodeMCU device and the smartphone or computer must be connected to the same network.



PROCEDURE:

The chapters that follow provide a brief overview of the paper's study of its techniques and materials. A hypothetical technical flow diagram is shown in Figure.

Temperature, humidity, NPK, and Soil Moisture It is simple to keep track of the soil's nutritional composition, other parameter levels, and weather conditions thanks to sensors and the ESP8266. Measurements of the soil's N (nitrogen), P (phosphorus), and K (potassium) content are needed to determine how much additional nutrient value needs to be added to the plant in order to increase crop fertilization. To assess soil fertility, NPK sensors are employed. A seizable amount of soil fertilizer is made up of the element’s nitrogen, phosphorus, and potassium. The availability or scarcity of nutrients in soils that enables the plant growth can be determined by knowing the concentration of nutrients there. DHT 11 is used to monitor temperature and humidity, while soil moisture measures water content in the soil and BMP180 uses atmospheric pressure to warn of impending rain.

The Nodemcu Application programming code, which is authorized in the Nodemcu software system to show an IP address on a web page using an internet that can be tracked from a smartphone, Therefore, the sensors modules can track micronutrients and other soil parameters & weather factors if the probe is injected into the soil where they want to detect some are open to the air. This IP address will be used to process and show the results that the sensors have detected on a webpage.

Many of the primary indicators can be controlled by a Modbus Controller, including changes in the value of one of its registers so that it is written to the coil and holding registers.

I/O port display: Figure out the information from the Coil and Discrete ports. You can tell the device to send back any number of values from its coil and holding register by giving it instructions. The request (1 to 247) contains the Modbus address of the device for which a command is intended. Another name for the Modbus IP is a query framework. Even though a component with more connection might get the instruction, only that particular component will respond and do something. While monitoring the values of Nitrogen (N), Phosphorous (P), and Potassium (K), the NPK Sensor includes three separate inquiry frames (K).

The code is used to connect the sensors to the ESP 8266 microcontroller and collect the soil's nutrient content and other values from the sensing element once more using Modbus. The user can send the command and receive the value in HEX code in return. The HEX code must be converted into decimal in order to retrieve the measured values information.

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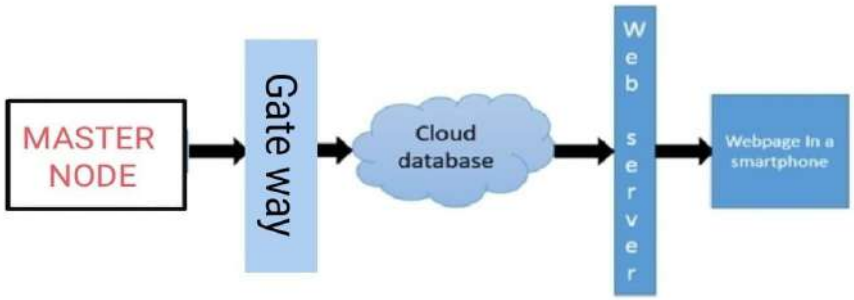
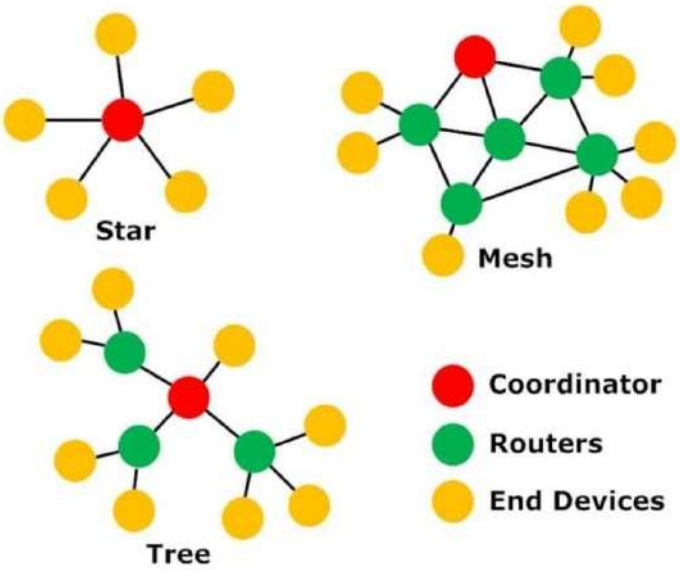
Once the user uploads the application code to the Esp8266, the web server and sensors will both start up. It may take a while for the sensor modules to stabilize, and the initial reading can be inaccurate. Once the sensors have stabilized, the user can submerge the sensor modules in the ground to get a reading. The amounts of the various elements—nitrogen, phosphorus, potassium, temperature, humidity, and soil moisture—that contribute to the soil's ammonium content will be displayed along with their corresponding magnitudes.

Unfortunately, many farmers still rely on antiquated farming methods, which leads to subpar crop and fruit yields. However, where there is automation, machines are replaced by workers. The majority of individuals utilize sensors that collect data from several sensor types and send it wirelessly to cloud storage. In return, remote monitoring is made possible by the data collection, which provides more information on specific soil conditions. Since soil conditions need to be properly monitored in order to maximize agricultural productivity, they are not currently acceptable.

Transmission from large area of land:

As area of land increases the no.of nodes and data need to be collected from many parts of lands so data collection also increases no.of router access. Our idea is communication between nodes is needed to entire data that is transmitted to one master node, from that master node through Gate way transmitted to cloud.





For that using ZigBee is best way which have different network topologies. ZigBee is a low-rate task group 4 personal area network task group. It is a form of home networking technology. A technological standard called ZigBee was developed for managing and sensing the network. Since ZigBee is the Personal Area Network for Task, Group 4 and was developed by the Zigbee Alliance, it is based on IEEE 802.15.4.

ZigBee is an open, worldwide, packet-based technology created to offer a simple user interface for low-power, secure wireless networks. Equipment for controlling flow or processes can be installed anywhere and yet communicate with other parts of the system. Since the network is unconcerned with a sensor, pump, or valve's precise location, it can also be moved.

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For short-range wireless communications, a standard called ZigBee solves the need for relatively affordable implementation of low-power devices with low data rates. Both star and peer-to-peer topologies are supported by IEEE 802.15.4. The star topology as well as the mesh and cluster tree peer-to-peer topologies are supported by the ZigBee specification. Point-to-point and point-to-multipoint topologies are sometimes listed as supported by devices that are ZigBee compatible.

Types of ZigBee Devices:

Zigbee Coordinator Device: It communicates with routers. This device is used for connecting the devices.
Zigbee Router: It is used for passing the data between devices.
Zigbee End Device: It is the device that is going to be controlled.

In a Zigbee network, data transmission occurs between three types of devices: the Zigbee coordinator, routers, and end devices (also known as end users). Here's how data transmits between these devices:

1. Data Transmission from End Device to Coordinator:
- An end device generates data, such as sensor readings or commands, to be sent to the Zigbee coordinator.
- The end device encapsulates the data into a packet at the application layer of the Zigbee protocol stack.
- The packet is then sent to the network layer, where Zigbee network addresses are added, including the source address of the end device and the destination address of the coordinator.
- If the end device is in direct communication range of the coordinator, it transmits the packet directly to the coordinator.
- If the end device is not within direct range, it sends the packet to an intermediate router (if available) using multi-hop communication.
- The router, in turn, forwards the packet to other routers or directly to the coordinator until the packet reaches the coordinator.
- The coordinator receives the packet, processes the data, and takes appropriate actions based on the information received.

2. Data Transmission from Coordinator to End Device:
- The coordinator generates data or commands to be sent to a specific end device or group of end devices in the Zigbee network.
- The coordinator encapsulates the data into a packet at the application layer and adds the appropriate Zigbee network addresses, including the source address of the coordinator and the destination address of the intended end device(s).
- If the end device(s) is within direct communication range of the coordinator, it transmits the packet directly to the end device(s).
- If the end device(s) is not within direct range, the coordinator sends the packet to an intermediate router (if available) using multi-hop communication.
- The routers forward the packet until it reaches the destination end device(s), either directly or through other routers in the Zigbee network.
- The end device(s) receive the packet, process the data, and respond or take appropriate actions if needed.

3. Data Transmission between Routers:
- Routers within the Zigbee Mesh network can also communicate with each other.
- Routers help to relay data between devices that are not within direct communication range, ensuring multi-hop communication paths for data transmission.

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- Routers act as intermediate nodes to extend the network coverage and enhance the reliability of data transmission within the Zigbee network.

Throughout the data transmission process, Zigbee's self-healing capabilities and mesh networking ensure that the data reaches its intended destination efficiently, even in the presence of device failures or changes in the network topology. This makes Zigbee a reliable and flexible communication solution for various IoT applications.

For smart agriculture applications, the Zigbee Mesh topology is commonly used. The Mesh topology is well-suited for smart agriculture due to its robustness, scalability, and self-healing capabilities. In a Zigbee Mesh network, all devices can communicate with each other, creating a self-organizing and self-healing network.

Extensive coverage: In agricultural settings, farms can be vast and spread out, requiring a network with extensive coverage. Zigbee Mesh allows devices to act as routers, forming multiple paths for data transmission and ensuring reliable communication across the entire farm.

Scalability: Smart agriculture often involves deploying a large number of IoT sensors and devices. The Mesh topology can easily scale to accommodate these devices, as new nodes can be added to the network without disrupting the existing communication.

Self-healing: Zigbee Mesh networks have self-healing capabilities. If a device fails or a communication path is abstracted, the network automatically reroutes the data through an alternative path, ensuring continuous data transmission and reducing downtime.

Low power consumption: Zigbee's low-power characteristics are essential for battery-operated IoT sensors and devices commonly used in smart agriculture. Devices can operate for extended periods without frequent battery replacements.

Ad-hoc networking: Zigbee Mesh networks can be set up without relying on a pre-existing infrastructure, which is advantageous in agricultural settings where connectivity infrastructure may not be readily available.

By employing the Zigbee Mesh topology, smart agriculture solutions can efficiently collect data from various sensors and devices spread across large agricultural areas, enabling better monitoring, optimization of resources, and improved crop yields.

V. RESULT & DISCUSSION

The device has different units. Each unit as to be properly tested

Images of device:

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PEST CONTROL UNIT:

The unit is properly working. During day the entire system is in charging mode. During night the unit start working by automation of LDR makes it on.

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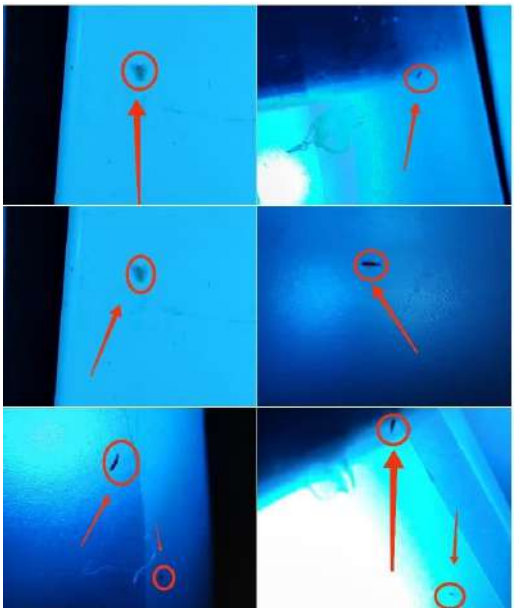
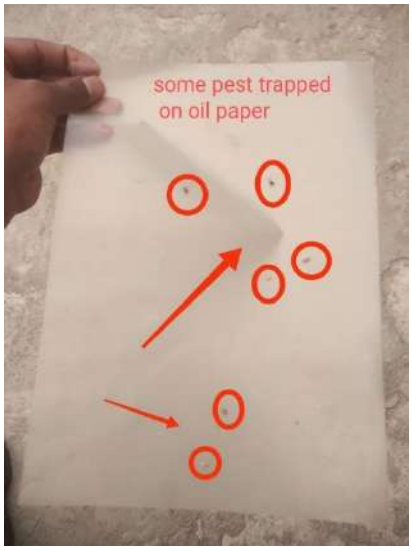
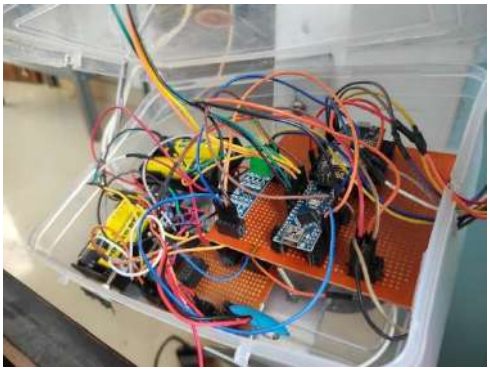


The photos how pest is attracted and trapped.



SENSORS AND IOT TRANSMISSION:

The soil parameters are detected by sensors in soil & transmitted to thingspeak or blink app.



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Observation of parameters in oled display:

Observation of parameters in ThingSpeak platform:

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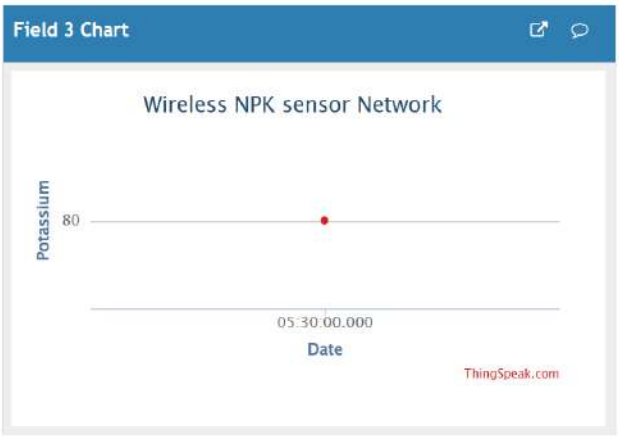

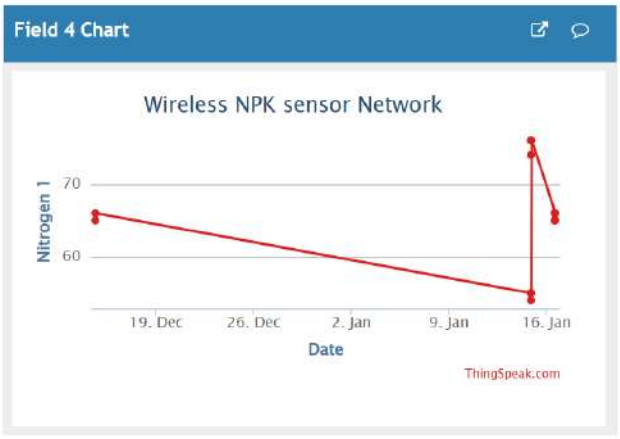

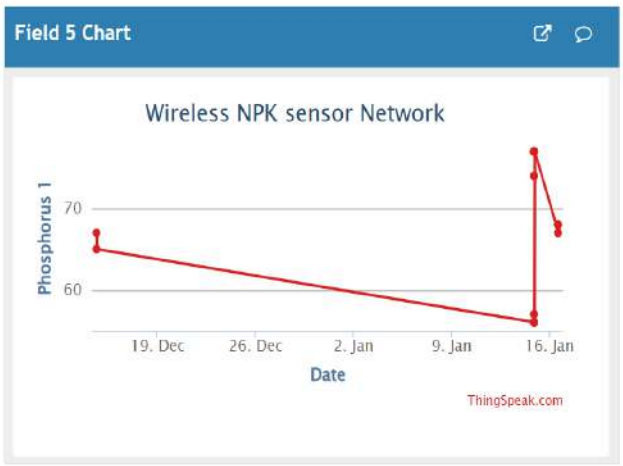

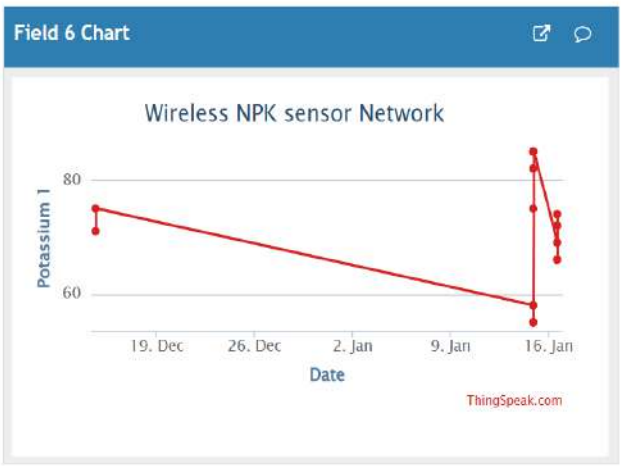

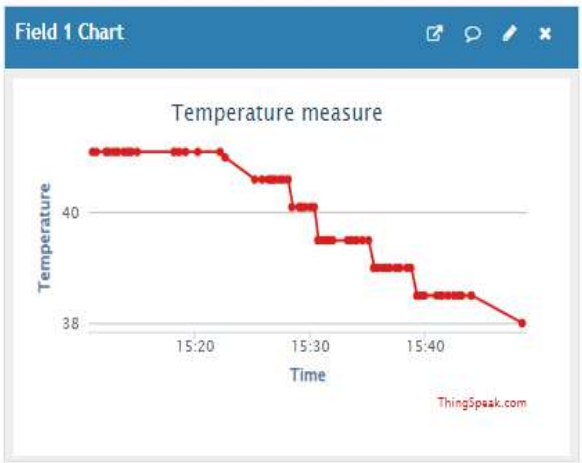

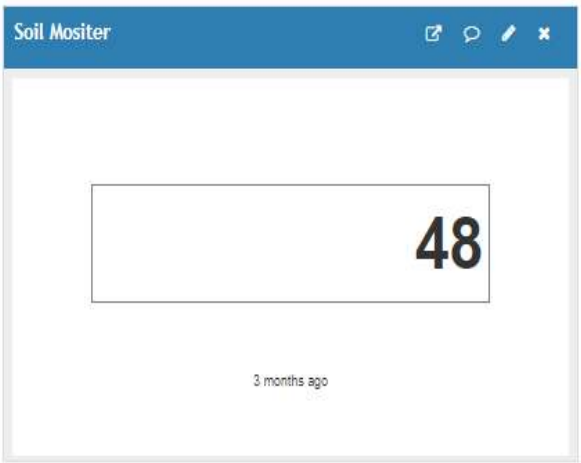

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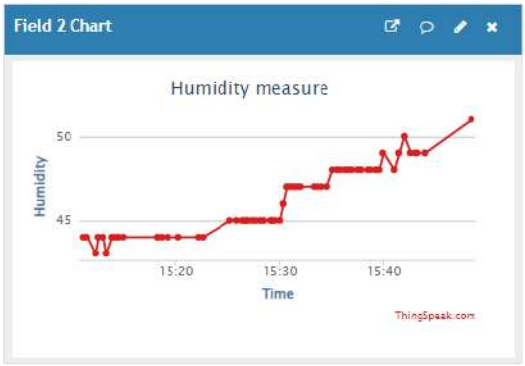
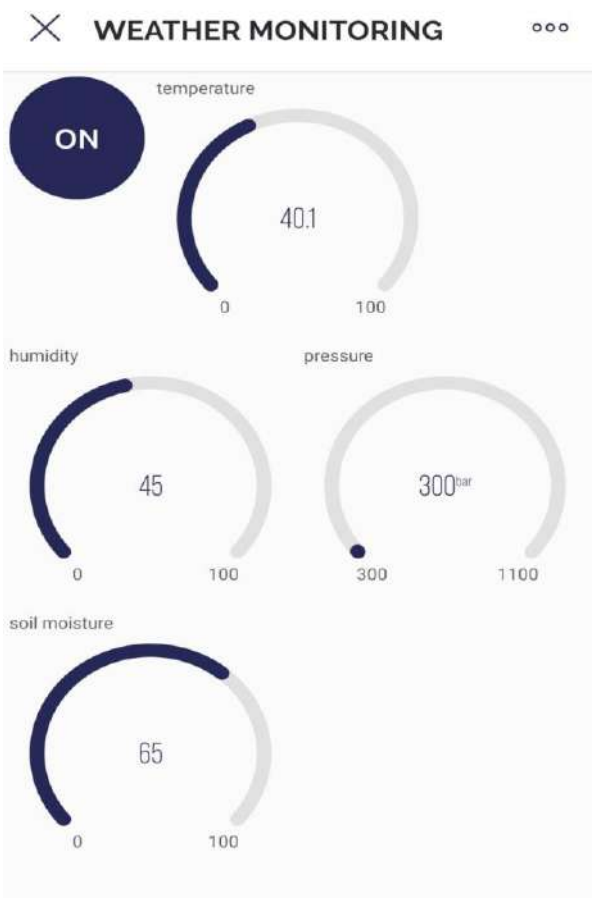


Observation of parameters in BLYNK APP:



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It's important to note that the effectiveness of such a device depends on various factors, including its design, data accuracy, and integration into existing farming practices. As per our results this device is successful and very useful to farmers.

VI. ADDITIONAL FEATURES AND FEATURE RESEARCH:

Health monitoring of crop by OpenCV: OpenCV (Open-Source Computer Vision) can be used for disease identification in agriculture by analyzing images or videos of crops. Here's how it can be utilized:

Image Capture: Images of crops with suspected disease symptoms are captured using cameras or drones.

Preprocessing: The images are preprocessed to enhance quality, remove noise, and normalize lighting conditions.

Image Segmentation: OpenCV can segment the image to isolate regions of interest, such as the infected parts of the plant.

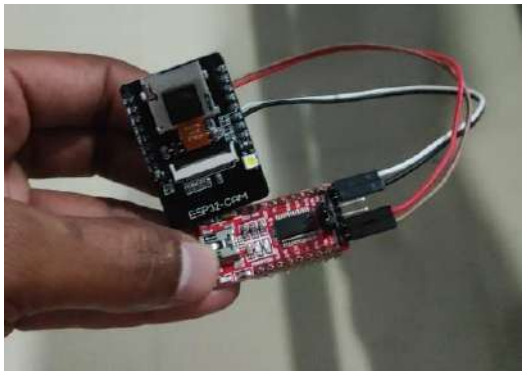
Feature Extraction: Relevant features are extracted from the segmented regions to represent the disease characteristics.

Machine Learning: OpenCV can be integrated with machine learning algorithms to train a model on labeled data, where the features are associated with specific disease types.

Disease Identification: Once the model is trained, it can be used to identify diseases in new images by predicting the disease type based on the extracted features.

Decision Support: The identified diseases can help farmers and agricultural experts make informed decisions about crop management and disease control strategies.

By leveraging OpenCV's computer vision capabilities along with machine learning techniques, agriculture professionals can enhance disease detection and improve crop health monitoring to prevent potential crop losses. We are planning OpenCV with esp32 cam.



Solar tracking systems: Solar tracking systems are used for effective energy management in solar power generation to maximize the efficiency and output of solar panels. Here's how they work:

Sun Tracking: Solar tracking systems continuously adjust the position of solar panels to track the movement of the sun throughout the day. This ensures that the panels are always facing the sun directly, optimizing their exposure to sunlight. Increased Efficiency: By tracking the sun, solar panels receive more direct sunlight, which increases their efficiency in converting solar energy into electricity. This leads to higher energy production compared to fixed solar panel installations. Single and Dual-axis Tracking: There are two main types of solar tracking systems: single-axis and dual-axis. Single-axis trackers move panels either east-west or north-south, while dual-axis trackers adjust for both azimuth (east-west) and elevation (north-south) angles, providing even higher energy yields.

Real-time Data: Some solar tracking systems use sensors and real-time data to adjust the solar panel positions dynamically based on the sun's position in the sky.

Energy Management: By utilizing solar tracking systems, solar power plants can generate more electricity during peak sun hours, optimizing energy management and potentially reducing the need for additional energy sources during high demand periods. Overall, solar tracking systems help increase the energy efficiency and output of solar power installations, making them an essential component of effective energy management in solar energy generation.

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An animal and birds alert system: An animal and birds alert system with sound in agriculture is designed to deter wildlife from entering crop fields using audible alerts. Here's how such a system can work:

Sensor Integration: The system includes various types of sensors, such as infrared sensors or motion sensors, placed strategically around the agricultural fields to detect the presence of animals and birds.

Detection of Wildlife: When the sensors detect movement or heat signatures, they activate the alert system.

Sound Generation: The system is equipped with speakers or sound-emitting devices strategically positioned to cover the target area. When activated, the system generates loud and specific sound patterns to scare away animals and birds.

Customized Sounds: The alert system can be programmed to produce sounds that are specific to the types of wildlife commonly found in the area. For example, sounds resembling predators or distress calls of animals might be used.

Randomization: To avoid habituation by wildlife, the system can be designed to randomize the timing and type of sounds emitted, making it less predictable and more effective in deterring animals and birds.

Real-time Alerts: In addition to sound alerts, the system can also send real-time alerts to the farmer or relevant personnel, notifying them of the wildlife presence and the activation of the sound deterrent.

Remote Control: Farmers can have remote control over the system, enabling them to adjust settings, volume levels, or even turn it on or off as needed.

Monitoring and Effectiveness: The system can record data on wildlife activity and the frequency of sound activations, helping farmers monitor its effectiveness in deterring animals and birds.

By using sound as a deterrent, the animal and birds alert system helps protect crops from potential damage caused by wildlife without causing any harm to the animals or birds themselves. It offers a humane and effective solution to minimize crop losses in agriculture.

IOT based remote switches:
In agriculture, IoT can be used for remote switch control of motors, drip irrigation systems, and lights in the field. Here's how it works:

IoT Devices: Install IoT devices such as smart switches or relays on motors, drip irrigation valves, and lights.

Sensor Integration: Add sensors like soil moisture sensors or weather sensors to monitor environmental conditions and soil moisture levels.

Data Collection: IoT devices collect data from sensors and transmit it to a central cloud-based platform.

Remote Monitoring: Farmers can access the cloud-based platform through a mobile app or web interface to remotely monitor the field conditions.

Remote Control: Using the mobile app or web interface, farmers can remotely switch on or off the motors, control the drip irrigation systems, and adjust the lighting conditions as needed.

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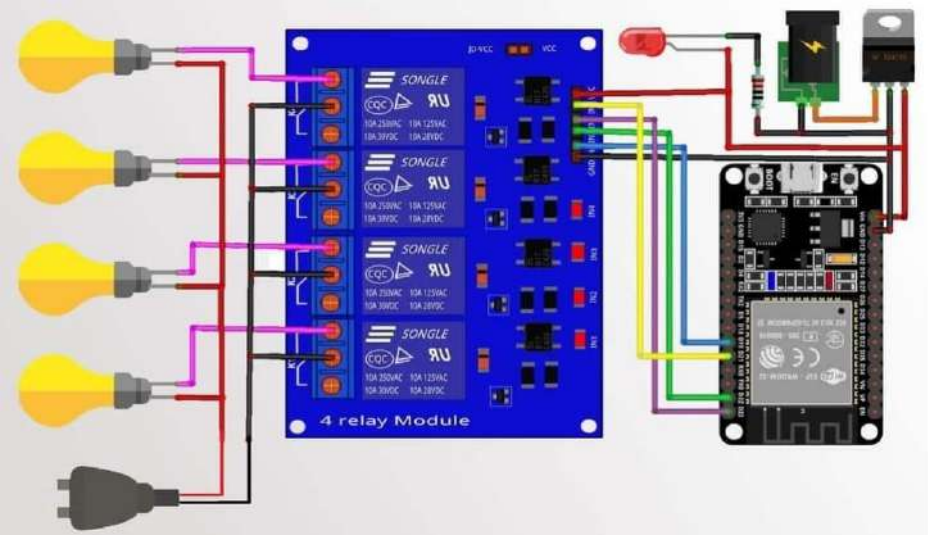
Automation: Farmers can set up automation rules based on sensor data. For example, the drip irrigation system can be programmed to turn on when soil moisture levels fall below a certain threshold.

Energy Efficiency: With remote control, farmers can optimize energy usage by turning off motors and lights when they are not required.

Timed Scheduling: The IoT devices can be scheduled to turn on or off at specific times, ensuring that the irrigation and lighting systems operate at the most appropriate times of the day.

Alerts and Notifications: The IoT platform can send alerts and notifications to farmers in case of abnormal conditions, such as low soil moisture or equipment malfunctions.

By using IoT for remote switch control in agriculture, farmers can efficiently manage water resources, reduce energy consumption, and improve overall farm productivity. It enables precision agriculture and helps farmers make data-driven decisions to optimize crop growth and yield.



single app control: Creating a single app that caters to all agriculture needs, including IoT functionalities, would be a comprehensive and powerful solution for farmers. Such an app could have the following features:

Crop Monitoring: The app would provide real-time data on crop health, growth, and environmental conditions through IoT sensors and remote monitoring.

Irrigation Management: Farmers can control and schedule irrigation systems remotely using IoT-based smart switches.
Weather Forecast: The app would integrate weather data to help farmers plan their farming activities and make informed decisions.

Soil Analysis: Farmers can access soil analysis reports and receive recommendations for fertilizers and soil amendments based on IoT soil sensors.

Pest and Disease Monitoring: The app could use IoT devices to detect pests and diseases in crops and provide early warnings.

Precision Farming: Utilizing IoT data, the app can enable precision agriculture by optimizing resource use and reducing wastage.

Livestock Monitoring: For farmers with livestock, the app can include IoT-enabled sensors for monitoring animal health and behavior.

Equipment Tracking: Farmers can track and manage their agricultural machinery and equipment through IoT-enabled GPS trackers.

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Automated Tasks: The app could offer automation options, allowing farmers to set up rules for specific actions based on sensor data, like turning on/off irrigation at certain soil moisture levels.

Data Analytics: The app could analyze collected data and provide actionable insights for better decision-making.

Market Information: Farmers can access market prices and trends, helping them plan their crop sales more effectively.

Farm Management: The app could also have features for managing farm finances, inventories, and workforce.

Integrating all these functionalities into a single app would require careful design and development. Additionally, ensuring compatibility with various IoT devices and maintaining data security and privacy would be essential considerations. Nonetheless, such a comprehensive app could significantly enhance efficiency and productivity in agriculture and offer farmers a valuable tool for modern farming practices.

An app for logistics and supply chain in agriculture can streamline and optimize various processes involved in transporting agricultural products from farms to consumers or markets. Here are the key features such an app could include:

Inventory Management: The app can track and manage inventory levels of crops, fertilizers, seeds, and other agricultural supplies.

Order Management: Farmers can place orders for supplies, and suppliers can receive and process orders through the app.Route Planning: The app can optimize transportation routes for delivery trucks to reduce time and costs.

Real-time Tracking: It allows tracking the location and status of shipments in real-time, providing transparency to both farmers and consumers.

Delivery Scheduling: The app can schedule deliveries based on farmer preferences, market demands, and transportation availability.

Supply Chain Analytics: Utilize data analytics to identify inefficiencies, monitor performance, and make data-driven decisions.

Payment and Invoicing: The app can facilitate seamless payments and generate invoices for transactions.

Quality Control: Implement quality checks and inspections along the supply chain to ensure product integrity.

Feedback and Reviews: Allow consumers and farmers to provide feedback and reviews, helping improve services and products.

Integration with Marketplaces: Integrate with e-commerce platforms or marketplaces to expand market reach.

By integrating all these features into a user-friendly and efficient app, logistics and supply chain management in agriculture can be streamlined, leading to reduced costs, improved delivery times, and enhanced overall efficiency in the agricultural supply chain.

An agriculture app that connects research centers and helplines can be a valuable tool for farmers, providing them with access to expert knowledge, research-based information, and assistance in real-time. Here are the key features such an app could include:

Research Center Directory: The app can maintain a directory of agricultural research centers, universities, and institutes, providing details about their expertise and areas of specialization.

Helpline Access: Farmers can access helpline numbers, chat support, or video calls to connect with agriculture experts for immediate advice and solutions to their queries.

Knowledge Sharing: The app can offer a platform for research centers to share their findings, publications, and articles related to best practices and innovative agricultural techniques.

Notifications and Updates: Users can receive regular updates on new research findings, upcoming workshops, webinars, and events organized by research centers.

Crop-specific Information: Provide crop-specific advice, guidelines, and recommendations based on ongoing research and regional agricultural practices.

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Language and Regional Support: Offer multi-language support and regional content to cater to farmers in different areas. Offline Access: Enable farmers to access certain basic information offline to overcome connectivity challenges in rural areas.

Collaborative Forums: Create discussion forums where farmers, researchers, and experts can interact, share experiences, and exchange ideas.

All the above features need to be embedded in the same device “krshi Suraksha” Having all features in a single IoT device can offer benefits such as streamlined management, reduced complexity, improved interoperability, and potentially lower costs due to shared components. simplified setup, enhanced user experience, reduced clutter, and potentially lower power consumption. It can also promote better communication between integrated features, leading to improved efficiency and automation. This is our research aim to build a single IOT device with integrated app as single IOT agriculture platform for farmers.

VII. CONCLUSION

This leads me to the conclusion that the combination of pest control and IoT-based agriculture offers a wealth of advantages and has the potential to completely transform the agricultural sector. Farmers may monitor and manage their crops more effectively by utilizing IoT devices and technology, which will enhance productivity, better resource management, and reduced environmental impact. With this strategy, the usage of dangerous chemicals is reduced, crop losses are decreased, and crop health is generally improved. resulting in strategies for sustainable and more effective food production.

REFERENCES

[1] Nikesh Gondchawar, Dr. R.Complexion.Kawitkar, "IoT based agriculture", all-embracing almanac consisting of contemporary analysis smart minicomputer additionally conversation planning (ijarcce), vol.5, affair 6, June 2016. Overall Journal on Recent and Innovation Trends in Computing and Communication ISSN: 2321- 8169 Volume: 5 Issue: 2 177 – 18
[2] SoumilHeble, Ajay Kumar, K.V. V Durga Prasad, Soumya Samirana, P.Rajalakshmi, U. B. Desai. A Low Power IoT Network for Smart Agriculture Rajesh M, Salmon S, Dr. Veena.
[3] Kassim, Mohamed Rawidean Mohd. "IoT Applications in Smart Agriculture: Issues and Challenges." In 2020 IEEE Conference on Open Systems (ICOS), pp. 19-24. IEEE, 2020.
[4] Kumar, Dr A. Senthil, Dr AR, L. Ganesh Babu, and Dr G. Suresh. "Smart Agriculture Robo with Leaf Diseases Detection Using IOT." European Journal of Molecular & Clinical Medicine 7, no. 11 (2022): 2462-2469.
[5] Dhaware, Chaitali G., and K. H. Wanjale. "A modern approach for plant leaf disease classification which depends on leaf image processing." In 2017 International Conference on Computer Communication and Informatics (ICCCI), pp. 1-4. IEEE, 2017.
[6] Dr. N. Suma, Sandra Rhea Samson, S. Saranya, G. Shanmugapriya, R. Subhashri, (2017). IOT Based Smart Agriculture Monitoring System. International journal on recent and innovation trends in computing, energy efficiency and communication-IJRITCC volume: 5 issues
[7] Agricultural information collection system based on mobile GIS,Agric. Eng., 8 (05) (2018), pp. 31-34
[8] Yick, J., Biswanath, M., Ghosal, D., Wireless Sensor Network Survey, Computer Networks, vol.52, issue 12: p.2292-2330, 2008.
[9] Anand Nayyar, Er. Vikram Puri, (2016). Smart farming: IoT based smart sensors agriculture stick for live temperature and moisture monitoring using Arduino, WSN (Wireless Sensor Networking) systems& solar technology. Internet of things: a review. In Computer Science and Electronics Engineering (ICCSEE), 2012 International Conference on (Vol. 3, pp. 648-651). IEEE.
[10] Haseeb, Khalid, Ikram Ud Din, Ahmad Almogren, and Naveed Islam. "An energy efficient and secure IoT-based WSN framework: An application to smart agriculture." Sensors 20, no. 7 (2020): 2081
[11] Ashfaq, M., Khan, R.A., Khan, M.A., Rasheed, F. and Hafeez, S. (2005). Insect orientation to various color lights in the agricultural biomes of Faisalabad. Pak. Entomol., 27(1): 49-52.
[12] Barghini, A. and Medeiros, B.A.S. (2012). UV radiation as an attractor for insects. Leukos, 9(1): 47–56.