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IOT Based Rain Roofing for Harvested Crop Protection and Water Management using Solar System

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Abstract: *Food deficit and population growth are the most challenges facing sustainable development all over the world. With a growing population, there's a need to increase agrarian products. During heavy rainfalls and showers, the growers face lots of problems as their cultivated crops get washed off or destroyed due to the water recession in the fields. The growers grow crops that are completely dependent on rainfall and natural conditions. Therefore, the focus of this paper is to execute a system that would help the farmers of our country to maximize their yields along with maximized gains. This project represents a visionary approach to modernizing agriculture by integrating renewable energy, cutting-edge technology, and precision farming methods. This project introduces an intelligent rain roofing system designed to safeguard crops from heavy rainfall. Leveraging Internet of Things (IoT) technology, the system continuously monitors soil moisture levels, automatically triggers irrigation when needed. This integrated approach addresses critical challenges faced by modern agriculture: crop protection from environmental hazards and security threats, while optimizing resource utilization. The system will leverage sensor technology, IoT connectivity, and data analytics to enhance farm efficiency, security, and sustainability.*

Keywords: Crop Protection, Rain Roofing, Water Harvesting, IOT, SMS alert, Smart Agriculture

I. INTRODUCTION

The Food is the most important requirement for living beings. The main product of our food come directly or indirectly from agriculture. Now a days security of agriculture field is very important Crops in farms are many times damaged by birds and animals these causes' major losses to farmers. In every day farmers facing a different kind of problem. The birds are the major problem in agriculture birds are falling on crop and eating it. farmers cannot stay on the field for 24 hours and protect it to overcome the this problem an birds and animal detection system has been designed to detect the presence of birds and animals and it offers a warning and divert the animal without any harm the designed system will continuously check for any bird and animal to entire field. Birds and animal is having a specific range of hearing frequency. There irritating frequency is estimated by a specific logic at early morning and evening time birds falling on the crops and eating rice seeds, ragi crops corns and wheat…etc. So we can create irritating sound for birds and the flay outside of the field by using this idea, we can reduce most affected problem in agriculture. This circuit uses the motion detector is an electrical device that utilizes a sensor to detect nearby motion. Such a device is often integrated as a component of a system that automatically performs a task or alerts a user motion in an area.

In this system an automatic roof is inculcated which works by taking the signals from the rain and soil moisture sensors and covers the whole field to protect it from heavy rains. Whenever there is rainfall the rain sensor gets activated. The water level in the soil is sensed by the soil moisture sensor. Whenever there is rain, the rain sensor is „ON" and when the water level in the soil is beyond the normal level then soil moisture sensor is „ON". If both the sensors are "ON" then this information is send to the controller. Then the controller indicates the DC motor to run which opens the roof automatically to close the field.

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IoT can be used in every sector of the Indian economy in which the farming sector can get an efficient contribution through the application. New smart agricultural techniques can enhance the productivity of the crops as well as it can reduce the number of waste crops. Our smart agricultural device will enable the farmers to reduce waste, protect the crops, and comparatively reduce the need for manpower for the productivity of the field. We have designed an automated Smart Agricultural system and rain protection management that reduces the time and resources that are required while performing it manually the purpose of the smart agriculture system is to help the farmers in producing crops more efficiently as they can monitor the field, and check the soil moisture content as well. Our proposed system also helps in security purposes by preventing the crops from excess rain through a rain shield and also letting the farmers know if any wild animal trespass to the field through the alarm. This device will help in reducing the need for manpower in cultivation so that it can be used in other fields for other work making both agriculture and time management easy for farm workers.

Objective:

- Design and implement a functional smart rain roofing system.
- Develop and deploy a reliable laser security system.
- Integrate sensor data and control systems using an IoT platform.
- Improve crop protection from environmental hazards and security threats.
- Optimize water resource utilization through rainwater harvesting.
- Enhance farm security and reduce losses due to intrusions.
- Provide real-time data and remote control capabilities to farmers.
- To create a system that is robust and reliable in the local climate.

II. LITERATURE SURVEY

Paper title:- Smart Automated Farming System using IOT and Solar Panel

Author:- Anita Shukla and Ankit Jain

Summary:- The present work emphasizes the importance of using IoT technology for automation in farming. This automation involves monitoring and controlling various parameters to enhance productivity. The proposed system addresses issues such as water management, humidity control, and sensor-based monitoring and control. It utilizes a Wi-Fi module for real-time data access and alerts over the internet, with the added benefit of solar panel power supply. The system performs well under various environmental conditions and meets performance expectations.

Paper title :- Motorize Smart Roofing System using IoT for Sustainable development

Author: - P. Prathibha Swaraj, Deekshitha Shivuni ,Lasya Chatragadda, Srinidhi Ettom1 , V. K. Srivastava , K.HimaBindu

Summary:- Climate change caused by human activity has led to abnormal rainfall in India. In agriculture the abnormal rainfall patterns pose a significant threat to the industry. These variations in rainfall have caused damage to homes, and infrastructure, wash away crops and destroy water sanitation. Unusual rainfall is also affecting the Rooftop restaurants. The roof-top restaurant owners and farmers are all seeking solutions to address the impact of climate change in it. One potential solution is the development of a Smart Roofing System that can detect rainfall and respond according to that. This system would use a Rainfall Sensor to detect rain, which would then send signals to a Wi-Fi-enabled board. The mechanism then activates dc motors, opening the roof to protect against rainfall. When the Rain Sensor detects no rain, it sends a signal to the board to reverse the direction of the motors, closing the roof in way. The implementation of Smart Roofing System could help minimize the damage caused by unusual rainfall patterns and help towards the development of a sustainable environment. With a Smart Roofing System in roof-top restaurant owners could continue their service during periods of heavy rain, ensuring minimal disruption to their business. In short, development of a Smart Roofing System could help protect India's infrastructure, agriculture, and economy from the adverse effects of climate change with minimal cost.

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Paper title :- Smart Farming: Internet of Things (IoT)-Based Sustainable Agriculture

Author :-Muthumanickam Dhanaraju , PoongodiChenniappan , KumaraperumalRamalingam , Sellaperumal Pazhanivelan and Ragunath Kaliaperumal

Summary:- Smart farming is nothing but a development that has enhanced information and communication technology used in machinery, equipment, and sensors in network based hi-tech farm supervision. Innovative technologies, the IOT, and cloud computing are anticipated to inspire growth and initiate the use of robots and artificial intelligence in farming. Such ground-breaking deviations are unsettling current agriculture approaches while also presenting a range of challenges. This paper investigates the tools and equipment used in applications of wireless sensors in IoT agriculture, and the anticipated challenges faced in the technology with conventional farming activities. Further, this technical knowledge is helpful to growers during crop periods from sowing to harvest; and applications in both packing and transport are also investigated.

Paper title :- Solar Power Based Modernization of Agriculture For Crop Protection Using IOT

Author :- Ravikumar K I, Kavya Jain A, Lakshmi Priyanka, Nandini S K, Karishma S,

Summary:-This system presents a collaborative system made up of a Wireless Sensor Network (WSN) using sensor Temperature and air or dust sensor in this project depending on nature variation, sensor detects the value and take the decision to protect the crop by opening and closing the sheet or panel through dc motor. We can able to protect the crop by measuring the soil moisture level in the water depending on the the controller decides to supply the water. This work includes agriculture and has simulators with microprocessors, electronic farming that can attract farmers and use the m to manage natural resources. So this question has fueled the in front of farmers to use remote monitoring for agricultural fields in their agricultural work. The main moto is to communicate directly with the farmers and make their work easier. This is do ne using mobile phones to inform farmers about soil moisture, temperature, level, weather conditions and physical activity. The project will send notifications to farmers in a form on the website with the date and time so they can manage their land. Farmers using this method will feel comfortable working on their land stressfree. Using IoT, the farmers will be able to monitor their land. Farmers can access their land from anywhere remotely. They can also take care of their crops by using their smartphones.

Paper title :- A study on IoT Based Smart Agriculture System

Author :- Puja Kumari , AmanPrajapati, Shreya Manjhi , Prithvi raj Mahto , Aniket Kumar Saw, SubashisKarmakar

Summary:- In this fast growing world of automation there is an increase in IOT based systems installed for time and labor management. Agriculture industry is one of the industries which require precise time management. AI based smart agriculture[2] is one of the solutions to overcome this problem. This paper focuses on a smart agriculture system. The objectives of this smart agriculture system is to efficiently manage water and fertilizer can be used to increase the productivity of the crop and saves time. This system provides an automatic pathway for irrigation and crop management technique with the help of sensors and micro controller for machine guidance in accordance with moisture control and other parameters of soil for a particular crop to manage requirement of water. Argo-tech gives a new vision of agriculture.

Paper title :- IOT in Agricultural Crop Protection and Power Generation

Author :-Anjana M , Charan Kumar A , Monisha R , Sahana R H

Summary:- Agriculture is the science and art of growing plants. Agriculture plays an important role in the financial improvement of our country and this is the primary profession from many years. To extend the efficiency of the yields and to limit the costs of rural practices we go for smart techniques of agriculture by innovative technology. By incorporating Greenhouse technology, an environment condition for a crop to grown will created along the various features like sensor based totally monitoring, crop safety from excessive rain and automatic roof overlaying facility. Greenhouse is operated in two modes-automatic mode and manual mode. It makes use of various apps for communicating with the cultivators about various environmental factors continuously. Various sensor nodes are deployed at special locations in the greenhouse system. Controlling different parameters are through any remote device or internet services and the operations are completed by means of interfacing sensors with microcontroller device. For this purpose, the power generation and supply is usually a massive problem. This project is also consisting of solar power based generation and rainwater harvesting technology method is implemented along with crop safety.

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III. METHOD OF DISEASE DETECTION

In this proposed block diagram consist of several sensors (rain sensor, moisture sensor, GSM module)is connected to our controller. This system uses renewable energy sources as solar power that is generated from solar panel. Then generated solar power is stored in DC battery. During cloudy season, the power supply is recovered from DC battery. The auto roof is mainly depends on the rain sensor, soil moisture sensor. Here Keypad access having major role for automatically closing roof. If there is any problem in sensors then roof is manually set by using keypad access. Based on rainy season and sunny season it will control the auto roof. The decision making capability carried out by PIC 18F4520.Then the rain water in the roof is collected by the Water tank. This way the wastage rain water is saved. The controller gets command from keypad control by user. According to sensor value as command DC motor to run so that the automatic roof gets opened and the field gets covered by the polythene sheet. Then the rain water in the roof is collected to the Water tank. When water scarcity in agricultural field, these collected water is pumped out using sprinkler. In this way the wastage rainwater is saved. The collected rainwater can also be used for other purposes.

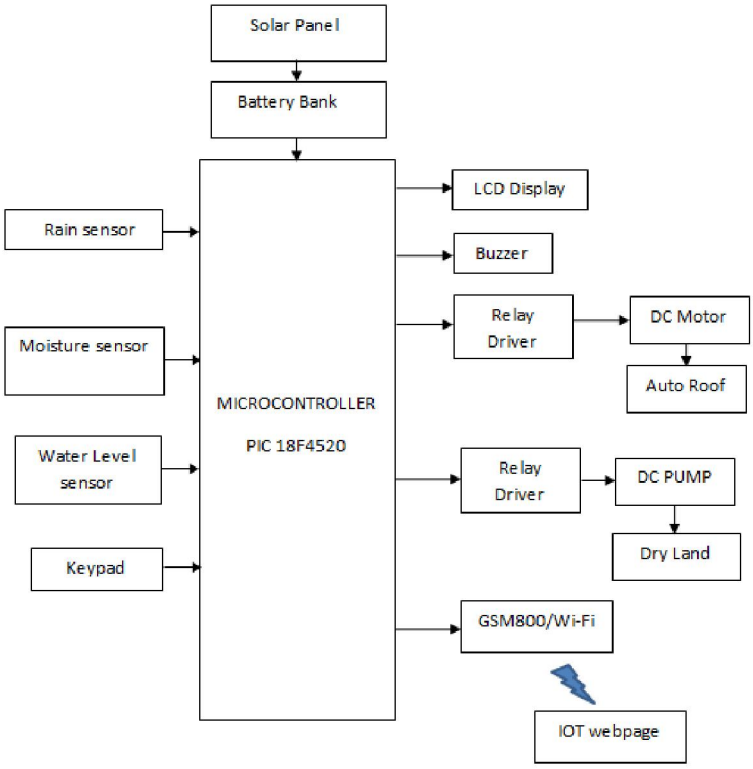

Fig. 1. Block Diagram

If moisture is > threshold value it displays the respective moisture content reading (Eg: If moisture content =540). It indicates that the land is moist and does not need water. 2. If moisture content < threshold value it displays the respective reading (Eg: If moisture content =120). It indicates that the land is dry and requires water. In the same way we track the conditions of other Sensors and the respective action will be taken.

Moisture Sensor measures the amount of moisture content in the soil. If the moisture level is normal then it indicates there is sufficient amount of water present in the soil. If the moisture level is above the normal value it indicates that the land is getting over water due to heavy rain, in that case the roof panels will be closed by sending signals to the Motors attached to the panel. If in case the moisture level is below the normal value it indicates that the land is dry, in that case the pump attached to the water storage is turned ON to water the field.

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Sensor Selection: Identify and procure appropriate sensors (rain, soil moisture, water level).
Roofing System Development: Design and construct a prototype rain-responsive roofing structure with automated control mechanisms.
IoT Platform Development: Develop a cloud-based platform for data collection, storage, and analysis.
System Integration: Integrate all components and develop control algorithms.
Testing and Validation: Conduct field tests to evaluate system performance and reliability.
Data Analysis and Optimization: Analyze collected data to optimize system parameters and improve efficiency.

PIC18f4520 Microcontroller

It is an 8-bit enhanced flash PIC microcontroller that comes with nano Watt technology and is based on RISC architecture. Many electronic applications house this controller and cover wide areas ranging from home appliances, industrial automation, security system and end-user products. This microcontroller has made a renowned place in the market and becomes a major concern for university students for designing their projects, setting them free from the use of a plethora of components for a specific purpose, as this controller comes with inbuilt peripheral with the ability to perform multiple functions on a single chip.
Data Memory up to 4k bytesn Data register map - with 12-bit address bus 000-FFF
Divided into 256-byte banks
Half of bank 0 and half ofbank 15 form a virtual (oraccess) bank that is accessibleno matter which bank isselected – this selection isdone via 8-bit
Program memory is 16-bits wide accessed through a separate program data bus and address bus inside the PIC18.
Program memory stores the program and also static data in the system.
On-chip program memory is either PROM or EEPROM.

Fig. 2. PIC 18f4520 Microcontroller

Rain Sensor

The Raindrops Detection sensor module is used for rain detection. This raindrop sensor is also used for measuring rainfall intensity. The rain sensor can be used for all kinds of weather monitoring and translated into output signals and AO. The rain sensor can be used to monitor a variety of weather conditions and turned into several fixed output signals and Analog outputs.

Fig.3. Raindrop Sensor

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Soil Moisture

The Soil Hygrometer module is convenient to sense the moisture level of the soil and determine whether the plants have been overwatered or under watered. It has 2 probes which act as variable resistors. The two probes allow the current to pass through the soil and then it gets the resistance value to measure the moisture value.

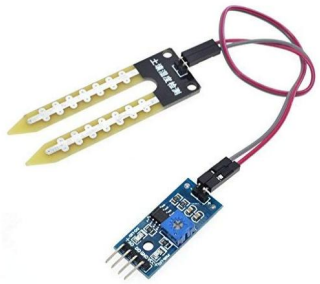

Fig. 4.Soil Moisture Sensor

DC Gear Motor

This is 60RPM 12V Low Noise Dc Motor With Metal Gears – Grade A

The metal gears have better wear and tear properties. The gearbox is sealed and lubricated with lithium grease and requires no maintenance. Although motor gives 60 RPM at 12V, the motor runs smoothly from 4V to 12V and gives a wide range of RPM, and torque. The shaft has a hole for better coupling.

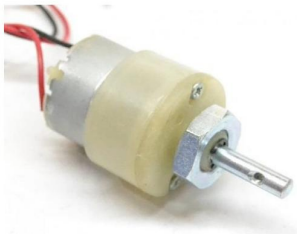

Fig -5: DC Gear Motor

Water level sensor

The Water Level Sensor is an easy-to-use and cost-effective with high level/drop recognition sensor by having a series of parallel wires exposed traces measure droplets/water volume in order to determine the water level.

Easy to complete water to analog signal conversion and output analog values can be directly read Arduino development board to achieve the level alarm effect.

The Water Level Depth Detection Sensor for Arduino has Operating voltage DC3-5V and Operating current less than 20mA. The Sensor is the Analog type which produces analog output signals according to the water pressure with its Detection Area of 40x16mm

Fig. 6.Water Level Sensor

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LCD Display

A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD.

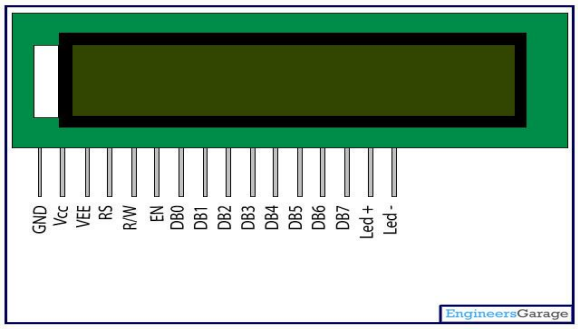

Fig. 7.LCD Display

IV. CONCLUSION

This is real time model which is used to automatic rain water and crop saving system protects crops from excess amount of rain water and also saves water from wastage. By using microcontroller operations of the entire system is going to be controlled these system saves the electricity, maximizes the productivity during both rainy season and sunny season. Solar energy is also the best outcomes of this project. Controlling of system on users virtue can also be achieved through device like Bluetooth. Hardware implementation is reliable and cheap of this project. The corrective action can be taken and reduce the human power, but it also allows user to see accurate changes in it. Project with a Rain Roofing System for Crop Protection" holds promise as a game changer in modern agriculture. By seamlessly integrating solar power, IoTtechnology, and cloud-based data analytics, it empowers farmers to protect their crops, optimize resource usage, and make informed decisions. With a commitment to sustainability and improved crop yield, this project paves the way for a smarter, more resilient, and eco-friendly future in farming.

V. FUTURE SCOPE

In the future, the Solar-Powered Smart Farming Project with a Rain Roofing System for Crop Protection could expand its capabilities by integrating block chain technology for transparent and secure data management, facilitating traceability and certification of sustainably produced crops. Furthermore, partnerships with financial institutions could enable the implementation of innovative financing models, allowing farmers to access capital for the adoption of advanced agricultural technologies and practices. Additionally, the project could explore opportunities for community engagement and capacity building, empowering farmers with training and support to maximize the benefits of the system and foster local agricultural resilience and prosperity.

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