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Energy Efficient to Polyhouse Automation Design, Installation Testing and IOT Platform

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Abstract: *Agriculture is a backbone of our country. About 70% of our country's revenue comes from agriculture. But during heavy rain falls, the farmers face lot of problems because there cultivated crops get washed off or destroyed. So in order to avoid this problem this project is designed which helps if protecting the crops from heavy rainfall and saving that rain water to use it for other purposes. The saved water can be used for feeding animals, washing, cooking etc. and can also be reused to sprinkle it back to the field when needed. 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 using a polythene sheet*

Keywords: Solid waste management, municipal solid waste, waste collection, waste disposal, recycling, composting, landfilling, waste-to-energy

I. INTRODUCTION

1.1 Introduction:

Time As Now a days, during the rainy seasons the cultivated crops gets affected due to the heavy rain fall. The main theme of this project is that to prevent the crops from the heavy rain and save the rain water. The rain sensor and soil moisture sensor is used for the working of automatic roof. This system involves protects the crops by the auto roof which covers the whole field. The rain sensor is activated when there is a rain fall. The soil moisture sensor will sense the water level in the field. If the water level is beyond the normal level it will gives intimation to the controller. So when both the sensor is 'ON', it will gives intimation to the controller, the roof is open automatically when both the sensor is 'ON'. . If there is any problem with opening the roof automatically, manually set by remote access. The power is supplied to this project is using renewable energy sources as solar power human beings we cannot control the natural phenomenon such as rain, humidity, high temperature, etc. Some of the measures are taken against this environmental hazard but they are performed manually. In the Current system there is no protection for crops against natural disasters such as Floods, Rains and as well as from over Sun heat. Which are in turn Reduces the plant growth in turn reduces yield. In this project we are proposing the system which prevents the spoilage of crops due to heavy rains. This is achieved with embedded system design using GSM technology. Here comes the need of automation. Automation greatly decreases the need for human sensory and mental requirements as well. An automation system consisting of a connection between hardware and software has freed the individuals from their day to day chores.

1.2 Need Of Project:

Agriculture is a backbone of our country. About 70% of our country's revenue comes from agriculture. But during heavy rain falls, the farmers face lot of problems because there cultivated crops get washed off or destroyed. So in order to avoid this problem this project is designed which helps if protecting the crops from heavy rainfall and saving that rain water to use it for other purposes. The saved water can be used for feeding animals, washing, cooking etc. and can

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also be reused to sprinkle it back to the field when needed. 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 using a polythene sheet. If there is any problem in opening of the roof, then this is performed manually by the farmers. Community Engagement: Involves local communities in discussions about road safety and emergency response, fostering collaboration.

1.3 Objectives:

The main objective of this project is to design automatic rain water and crop saving system protects crops from excess amount of rain water and also saves water from wastage This system uses renewable energy sources as solar power that is generated from solar panel. Then generated solar power is stored in DC battery.

This system involves protects the crops by the auto roof which covers the whole field. The rain sensor is activated when there is a rain fall. The soil moisture sensor will sense the water level in the field. If the water level is beyond the normal level it will gives intimation to the controller. So when both the sensor is 'ON', it will gives intimation to the controller, the roof is open automatically when both the sensor is 'ON'. . If there is any problem with opening the roof automatically, manually set by remote access. The power is supplied to this project is using renewable energy sources as solar power human beings we cannot control the natural phenomenon such as rain, humidity, high temperature, etc. Some of the measures are taken against this environmental hazard but they are performed manually. In the Current system there is no protection for crops against natural disasters such as Floods, Rains and as well as from over Sun heat. Which are in turn Reduces the plant growth in turn reduces yield. In this project we are proposing the system which prevents the spoilage of crops due to heavy rains. This is achieved with embedded system design using GSM technology. Here comes the need of automation. Automation greatly decreases the need for human sensory and mental requirements as well. An automation system consisting of a connection between hardware and software has freed the individuals from their day to day chores. In this paper we try to establish new intelligent system which helps to protect the user daily home application and other useful material against environmental impact like rain. In the Current system there is no protection for crops against natural disasters such as Floods, Rains and as well as from over Sun heat. Which are in turn Reduces the plant growth in turn reduces yield. In this project we are proposing the system which prevents the spoilage of crops due to heavy rains. This is achieved with embedded system design using embedded technology.

II. LITERATURE SURVEY

The concept of polyhouse automation focuses on improving agricultural productivity and efficiency, particularly in controlled environments such as greenhouses or polyhouses. By incorporating modern technologies like energy-efficient systems, automation, and Internet of Things (IoT) platforms, polyhouses can offer optimized conditions for plant growth while minimizing resource usage. A literature survey on this topic will cover existing work on energy efficiency, automation systems, IoT integration, and overall polyhouse management.

1. Polyhouse Automation and Energy Efficiency

Polyhouses, which are structures designed to protect crops from environmental factors, often require climate control systems to maintain optimal growing conditions. Energy efficiency in polyhouse systems is essential for reducing operational costs and ensuring sustainability.

• Energy-efficient climate control systems: Recent studies have focused on the integration of solar power (photovoltaic panels) and wind energy for polyhouse applications. For example, solar-powered fans, automated shading systems, and cooling systems are commonly used to reduce energy consumption.

o Alkhalaf et al. (2021) proposed a model for reducing energy consumption in polyhouses by integrating passive energy-efficient systems like insulation, natural ventilation, and reflective materials.

o Sharma et al. (2020) explored the use of solar energy in powering automated irrigation, cooling, and lighting systems, significantly reducing the dependency on external power sources and lowering carbon footprints.

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• Energy Harvesting: Research in energy harvesting focuses on capturing renewable energy within the polyhouse to power the sensors and automated systems. Pashaei et al. (2019) discussed integrating thermal energy harvesting systems to power microcontroller-based automation units.

2. Automation in Polyhouses

Automation in polyhouses involves the use of intelligent systems and machines to manage various environmental parameters, such as temperature, humidity, CO2 levels, and soil moisture. These systems enhance productivity, reduce human intervention, and create optimal conditions for plant growth.

III. SYSTEM DESIGN

3.1 Block Diagram:

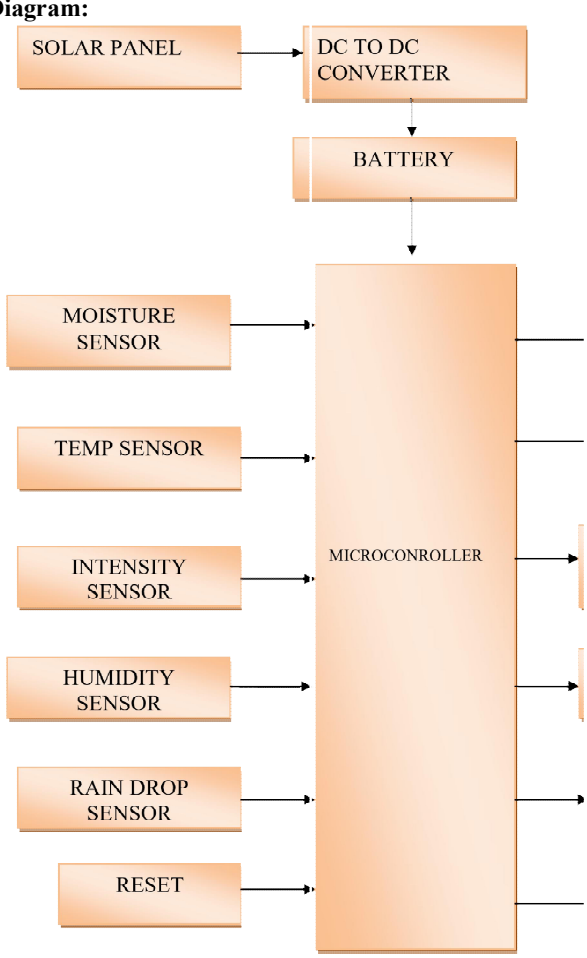

Fig 3.1: Block diagram

3.2 Block Diagram Description:

Based on rainy season and sunny season it will control the auto roof. The decision making capability carried out by PIC 18f4520.Then the rainwater in the roof is collected by the Water tank. In this way the wastage rain water is saved. The dynamo are fixed at both the top end of poles, when there is water coming down through water collector unit, it generates the power.

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In this, we present the theory on "IOT based rain roofing for crop protection & water management system using solar system". In this proposed block diagram consist of several sensors (rain sensor, moisture sensor, Humidity sensor GSM module) is connected to our controller.

3.3: Specification of components

PIC18F4520 is a PIC microcontroller, introduced Microchip, and mainly used in automation and embedded systems. It comes in three packages known as PDIP, QFN, and TQFP where the first one is 40-pin (mostly used) while other two come with a 44-pin interfacePIC18F4520 also comes with 3 programmable external interrupts & 4 Interrupts-On-Change (IOC) pins, which are reliable features for interrupts related applications. Also, the system
wide operating voltage range, from 2V to 5.5V., Thus it can be used in 3.3V or 5.0V logic level operations. The below image is showing the detailed pin diagram of the PIC18F4520.

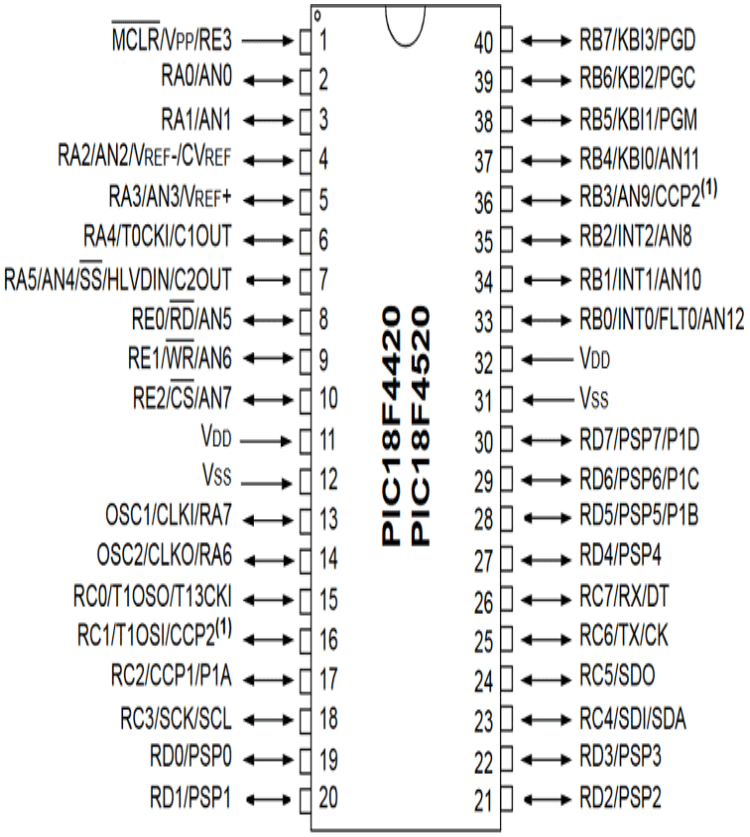

Fig 3.3.1(b): pin diagram of PIC18f4520

3.3.2: Power Supply:

All electronic circuits use DC power supply of adequate voltage for their operation. To obtain this DC voltage from 230V AC mains, we need to use a 'rectifier'. The rectified DC voltage is 'pulsating' in nature. We know that a combination of rectifier & filter can produce a dc voltage which is almost pure i.e. ripple free. However, the problem with such a power supply is that its output voltage will not remain constant in the event of fluctuations in ac input voltage or changes in load current. This type of power supply is called as unregulated power supply.

The power supply, which provides a constant output voltage irrespective of everything is called, regulated power supply. So we have to design a regulated power supply using series voltage regulator IC 7805.

Following figure shows general block diagram of regulated power supply.

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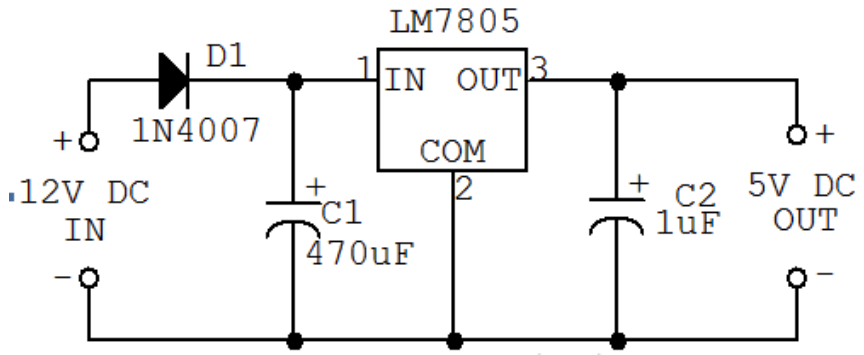
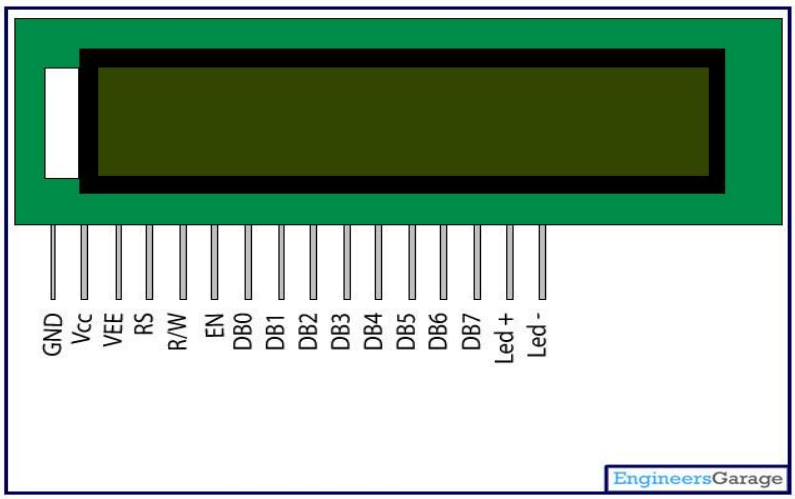


3.3.3: 16*2 LCD Display:

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.



IV. PROJECT PLAN

Week No. Action plan
1 Searching of Project information
2 Collection of components required for project
3 Designing of PCB , printing of copper for interior layer
4 Etching, drilling, layer alignment of PCB
5 Mounting components on PCB as per circuit diagram
6 Soldering components on PCB
7 Software Development for the project
8 Testing circuit is proper or not
9 Troubleshooting for any problems
10 Checking project is properly working or not if not then correct
11 Presentation of report

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12 Presentation of PPT
13 Checking project from project guide
14 Checking report & PPT from project guide
15 Confirmation from project guide, co-ordinator , HOD
16 Submission of Project model, Project report, PPT

V. ADVANTAGES & APPLICATION

5.1 Advantages:

Advantages

1. Energy Efficiency:

o Reduced energy consumption through solar-powered or other renewable energy sources.
o Automated climate control adjusts systems based on real-time conditions, optimizing energy use.
o Minimizes reliance on grid electricity, reducing operational costs and carbon footprints.

2. Cost Savings:

o Decreases energy bills and labor costs due to automation and optimization.
o Long-term ROI through reduced utility costs and improved productivity.
o Financial savings from efficient irrigation, temperature control, and lighting systems.

5.2 Disadvantages:

• High Initial Cost:
• The upfront investment in energy-efficient technologies, automation systems, and IoT infrastructure can be significant.
• Installation and setup costs for sensors, actuators, controllers, and renewable energy sources may be a barrier for small-scale farmers.
• Complexity in Setup and Integration:
• Initial setup of an energy-efficient polyhouse with IoT systems may require specialized knowledge and expertise.
• Integration of multiple systems (climate control, irrigation, energy management) can be complex and require careful planning.
• Technical Dependence:

5.3 Application:

• Energy-Efficient Climate Control Systems:
• Automation of ventilation, cooling, and heating based on real-time data to maintain optimal growing conditions, improving energy use efficiency.
• Shading systems that adjust based on solar radiation to optimize light and temperature, minimizing energy consumption from artificial lighting and cooling.
• Automated Irrigation and Water Management:
• IoT-based soil moisture sensors control irrigation schedules to ensure efficient water use.
• Integration of rainwater harvesting with automated irrigation systems, powered by energy-efficient pumps, reduces water usage and costs.
• Energy Management and Optimization:
• Solar-powered polyhouses reduce grid dependency by powering systems like irrigation, sensors, and ventilation.
• Smart energy management systems to switch between solar power, wind energy, or grid electricity based on demand, availability, and cost.
• Smart Fertigation (Nutrient Management):
• IoT-enabled fertigation systems adjust the delivery of fertilizers and nutrients based on real-time data from soil sensors, ensuring precise and efficient nutrient application.
• Automates the blending of fertilizers and water, delivering it directly to plants when needed.

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VI. CONCLUSION & FUTURE SCOPE

6.1 Conclusion

Conclusion

The integration of energy-efficient systems, automation, and Internet of Things (IoT) platforms in polyhouse management represents a significant advancement in modern agricultural practices. These technologies have proven to offer numerous advantages, including:

• Energy conservation through renewable energy sources (such as solar and wind), and smart energy management systems.

• Cost reduction by optimizing resource usage, such as water, energy, and fertilizers, and by automating labor-intensive tasks like irrigation, climate control, and nutrient delivery.

• Increased crop yield and quality through precise control of environmental factors, which creates optimal conditions for plant growth.

6.2 Future Scope:

The future of energy-efficient polyhouse automation, powered by IoT and smart technologies, holds vast potential for further innovation and growth. Key areas of future development and research include:

1. Advanced IoT Integration and AI-Based Optimization:

o AI and machine learning (ML) algorithms can be further integrated into polyhouse automation systems to enhance predictive analytics, improve decision-making, and optimize energy use based on weather patterns, crop needs, and environmental factors.

o For example, machine learning models could predict pest outbreaks, optimize watering schedules based on weather forecasts, and automatically adjust climate conditions for different crops at different growth stages.

2. Improved Energy Harvesting and Storage Solutions:

o Future systems will see enhanced energy harvesting technologies, including more efficient solar panels, wind turbines, and even bioenergy systems integrated within the polyhouse.

o Energy storage solutions, such as batteries or smart grids, will improve the management of energy and allow polyhouses to function efficiently during off-peak hours or in areas with unreliable electricity supply.

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