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Computational Intelligence plus Network Connected Based Soil Irrigation and Soil Health Monitoring using PV Grid-Tie Inverter System

S. Gangatharan[1], R. Manjari[2], R. Manikandan[3]

[1,3]Department of Mechatronics Engineering, SNS College of Technology, Coimbatore, Tamil Nadu, India
[2]Department of Electrical and Electronics Engineering, SNS College of Technology, Coimbatore, Tamil Nadu, India

ABSTRACT

The future tomorrow requires a clean and renewable source of energy to generate more power and maintain its increasing demands. One of the most cost-effective and practical viable sources for clean energy is solar photovoltaics. India is an agricultural country. Agriculture is the most important occupation for the most of the Indian families. In India, agriculture contributes about 16% of total GDP and 10% of total exports. Water is main resource for agriculture, irrigation is one method to supply water but, in some cases, there will be lot of water wastage. This paper completely discuss about how the Grid-tie Inverter PV system is used for production of energy and how it is used for running of electric pump in the field with smart irrigation system and soil health monitoring system which helps to decrease the wastage of water and also makes us easy to have a note of soil condition anytime and anywhere. In this proposed system we are using different types of soil sensor which senses the moisture value and the land gets automatically irrigated by ON/OFF of the motor using relay unit.

KEYWORDS: *GDP, PV system, Grid-Tie Inverter PV system*

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INTRODUCTION

Solar energy is an absolute available renewable energy source which substitutes the usage of fossil fuels and helps in reducing greenhouse gases. It is uncontaminated and environmentally responsible for improving health issues of people by limiting sulphur oxide, nitrous oxide and other emissions. Prices of solar panels result in fall by encouraging people to opt for it and save more money on electricity bills. The main advantage of this project is to make use of grid inverters where excess electricity generated can be fed back to the grid in exchange of credits. Not only by receiving profits but also in boosting the Indian Economy. Since there is a rapid increase in population and huge growth in modernization, industrialization and expandation in agriculture. Taking the population into account as per 2001 and 2011 census and estimation of the population by 2025 and 2050. The average annual per capita of water available is 1818, 1567, 1340 and 1140 cubic metre respectively creating a high demand for water. It emphasises to reduce wastage, maintain water quality and improve water management. Water conservation will also minimize the shortage of water by constructing a stronger defence against drought in the upcomingyears. Paddy and wheat production are calculated to be 70% from irrigated areas. So, an utmost concern is given to build the irrigation system to efficiently manage the rainfall and water availability. The main reason for wasting the energy and water is the heavy subsidies found in electricity bills used for agriculture. In the virtue of helping in such situations, this paper discusses about the grid-tie PV system for production of energy and smart irrigation system for reduction of water waste.

SMART IRRIGATION SYSTEM:

Soil moisture sensor is used to measure the water content in soil. Moisture in the soil is an important component in the atmospheric water cycle. Sensor module outputs a high level of resistance when the soil moisture is low. It has both digital and analog outputs. Digital output is simple to use, but it is not as accurate as analog output based on moisture level the motor gets turn on/off automatically using the relay unit.

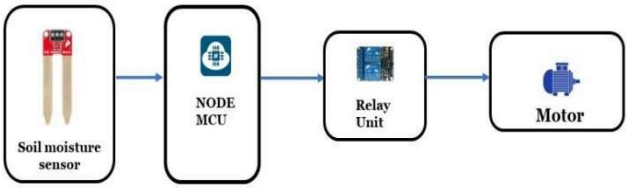

Fig - 1: Block diagram of smart irrigation system.

A. ALGORITHM:

The algorithm for smart irrigation is mentioned as Follows:

Step 1: Soil moisture sensor senses the moisture level of the soil.

Step 2: If the moisture sensed value is greater than the threshold value than no need to switch on the motor.

Step 3: If the Moisture level is less than the threshold value, then the switch-on motor automatically.

Step 4: Once moisture level becomes equal to the threshold value, switch-off the motor.

Step 5: End the process.

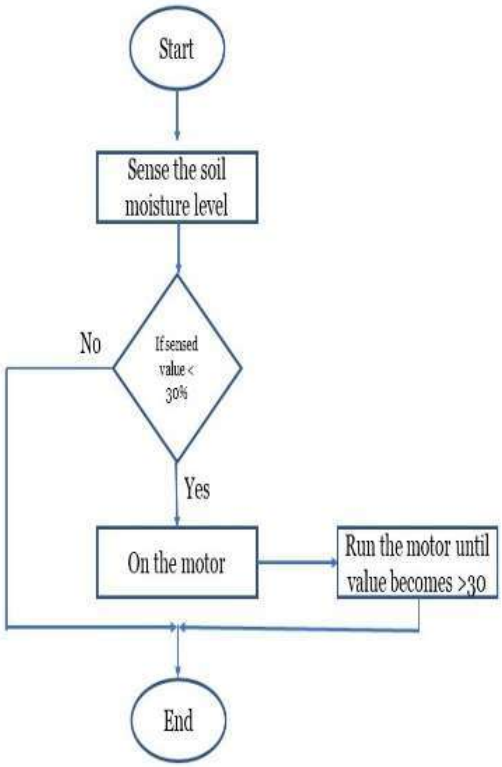

Fig-2: Flow diagram of smart irrigation system.

Grid - Tie PV System:

Grid- Tie PV system is a type of On-grid PV system which involves the direct connection of Grid-tie inverter to the grid. When the sunlight hits the solar panel, they start producing Direct Current. A grid tie inverter is used to invert DC power to AC power. Firstly, panel's loading is increased slightly and the power absorbed is measured. According to the measurement the loading is further increased or decreased. Inherently the output fluctuates closely by the maximum power point of the panel. Secondly, as the GIT is designed to adjust its feed going into the grid. The grid tie inverter should synchronise its frequency to match with the utility grid by an oscillator and its voltage is limited such that it does not exceed the grid voltage. GIT's power factor is fixed, meaning current and output voltage are accurately lined up, and AC power grid has a phase angle below 1 degree.

In case the utility grid breaks down, the grid tie inverter has the tendency to disconnect by preventing any harm to the line workers who are fixing the power grid.

A typical electricity meter indicates only the power flow through it whereas the net meter shows the amount of electricity consumed by spinning the meter forward. If the meter spins backward it means that a surplus electricity generated is transmitted to the utility grid where the owner gets the credit for excess production of electricity by exporting it to the grid also known as net metering. By this the owner gets benefited more effortlessly and masterfully.

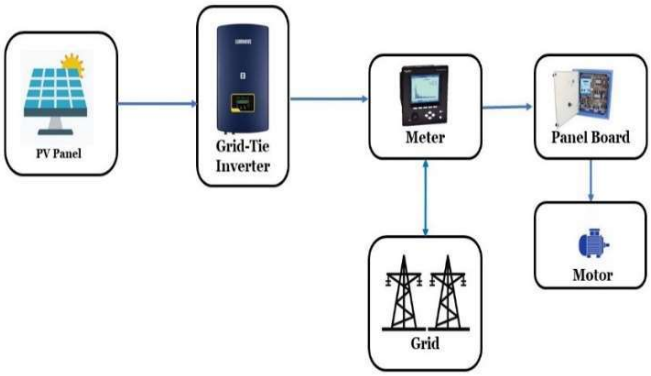

Fig-3: Block diagram of Grid-tie inverter system.

SOIL HEALTH MONITORING SYSTEM:

Soil health monitoring system comprises of 4 sensors- Soil moisture sensor, Soil temperature sensor, pH sensor and Humidity sensor.

- **Soil Moisture Sensor:** The Soil moisture sensor uses capacitance to measure dielectric permittivity of the surroundings medium. In soil, dielectric permittivity is a function of the water content.
- **Soil Temperature Sensor:** Soil temperature sensor is a high-quality temperature sensor that is especially designed for soil temperature measurement in extreme environments.
- **PH sensor:** pH sensor has probe that comes with them is inserted into the soil water, and the pH can be read directly from the display or it can be connected to any microcontroller.
- **Humidity Sensor:** Soil humidity sensor is used to measure both moisture and air temperature.

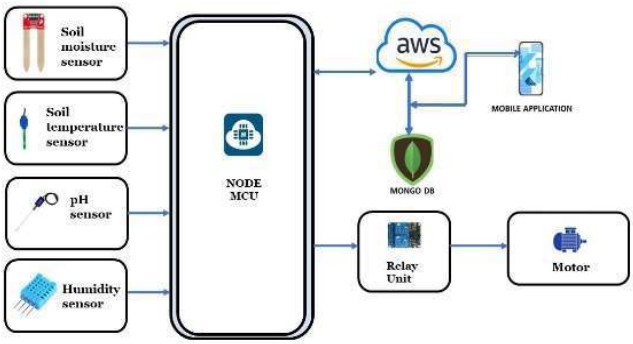

Fig-4: Working diagram of soil health monitoring system.

MOBILE APPLICATION:

The mobile application is used to know about certain important parameters like the soil health and motor status. The mobile application will be having a user interface which has the ability to track the soil health by knowing the value of different sensors connected to the micro controller via cloud computing and also it will be having the ability to know about the motor status at any point in time. The main advantage of this mobile application is that with the help of this we can have track of the soil condition and motor operation at anytime and anywhere.

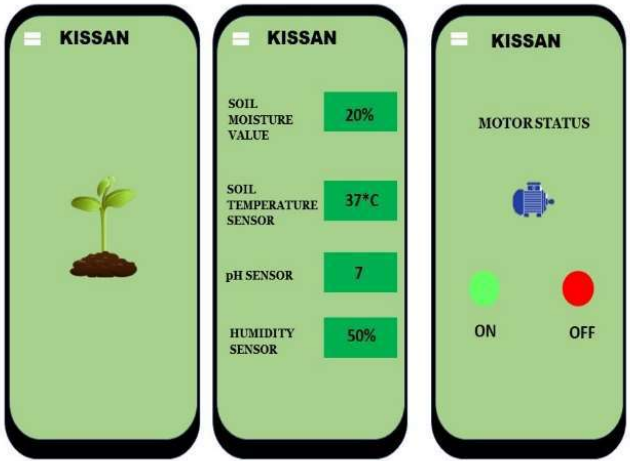

Fig-5: User-Interface of mobile application.

OVERALL WORKING:

Soil moisture sensor, Soil Temperature sensor, pH sensor, Humidity sensor and relay units are connected directly to the node MCU. Node MCU is built with codes using IoT to perform certain operation such as automatic ON/OFF of motor pump to water the field in means of proper irrigation and it further displays the status regarding soil health and water pump to the owner's mobile which can be easily accessed and monitored also the user can operate the mobile whenever he want to actuate the motor in field. Relay unit is attached to the pump. The main advantage of a relay unit is to act as a switch. The circuit is incomplete when the switch is open and complete once it is closed making the motor run. The programming in node MCU controls the devices for efficient functioning. The overall setup needs electricity where we make use of Grid Tie Inverters to derive current from the solar panels. A meter is connected in between GTI and panel board. The excess electricity is fed to the utility grid through the meter.

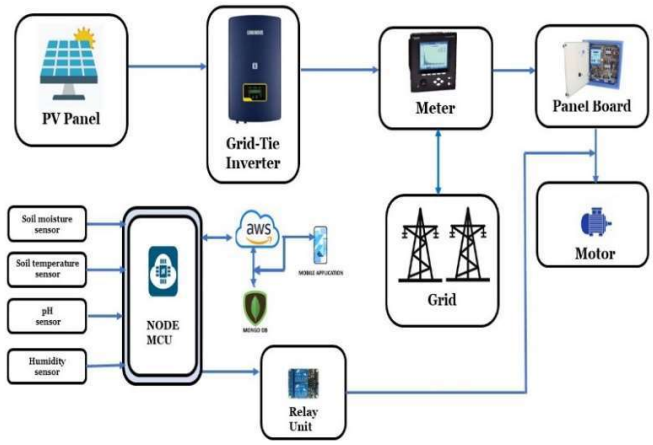

Fig-6: Overall block diagram of the system.

CONCLUSION:

The solar systems can almost solve all the environmental problems if it is installed in a proper manner according to the use cases. We should make the use of renewable source of energy like solar systems so that the non-renewable source of energy like fossil fuels are not exhausted. Proper grid-tie PV system setup should be developed to reduce the use of fossil fuels. We hope there will be a time when we all will be having Solar panels installed in all agriculture fields and home. In this paper we have informed about the IoT based smart irrigation system and grid-tie inverter PV system for generation of electricity. If the proposed system is installed in all the fields, we can contribute enormously for the reduction of power generation from nonrenewable sources of energy and also, we can stop the wastage of water in the agricultural field.

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