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SOLAR BASED IRRIGATION SYSTEM BY USING NODE MCU

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Abstract: The system is a solar based irrigation system using Node Micro-Control Unit (MCU) where the irrigation pump is powered by solar energy and operates through Website. This systems runs automatically as well as manual mode, the user will decide which mode he wants. It becomes tedious to manually operate the irrigation system and Hence the system uses solar power by using photovoltaic cells instead of commercial electricity Here we will use humidity and temperature which can measure real time environmental humidity and temperature. We can see the temperature and humidity data directly on the internet website, no needs to go there and check it again and again Now we can take the decisions from sensors data for to turn ON or OFF the motor or pump (for automatic mode only) Now for manual mode we can read the data and takes the decisions manually using Switch Auto/Manual on website. For example, If switch in ON condition than motor is "ON" If you want to Turn OFF motor than slide the switch motor get Turn "OFF". Hardware Specification Solar Panel, Micro-controller, Relay, Water, PCB, LED, Diodes, Humidity, Temperature sensors, Controller node MCU, Mini water pump Keywords- Solar, Node-MCU, Relay, Temperature & Humidity Sensor, Moisture sensor.

Index Terms **- Solar, Node-MCU, Relay, Temperature & Humidity Sensor, Moisture sensor.**

I. INTRODUCTION

Solar energy is the most abundant source of energy in the world. Solar power is not online answer to today's energy crisis but also an environmental friendly form of energy. Photovoltaic generation is an efficient approach for using the solar energy. Solar panels (an array of photovoltaic cells) are nowadays extensively used for running street lights, for powering water heaters and to meet domestic loads. The cost of solar panels has been constantly decreasing which encourages usage in various sectors. One of the application of this technology is used in irrigation systems for farming. Solar powered irrigation system by using Node MCU assistant can be a suitable alternative for farmers in the present state of energy crisis in India. This a green way for energy production which provides free energy once an initial investment is made. In this paper we propose an irrigation system by Node MCU (ESP8266) based using solar power which drives water pumps to pump water from bore well to a tank. Web assistant and Micro-controller control the flow rate of water from the tank to the irrigation field which optimizes the use of water

The objective of this project is to develop a system that will minimize the waste of water in an Agricultural Experiment Station farm. The smart system developed uses manually drip irrigation. The farm site has greenhouses, crops and administration houses. The manually system collects data from the humidity, temperature, moisture sensor and motor is ON/OFF. We can see this data at online by using website. The data collected and by using internet it is sent to website. The system is operated in two modes, either in a closed loop control mode where the microcontroller operates by manually the opening and closing of the solenoid valve for the required amount of water needed for the crops.

II. BLOCK DIAGRAM

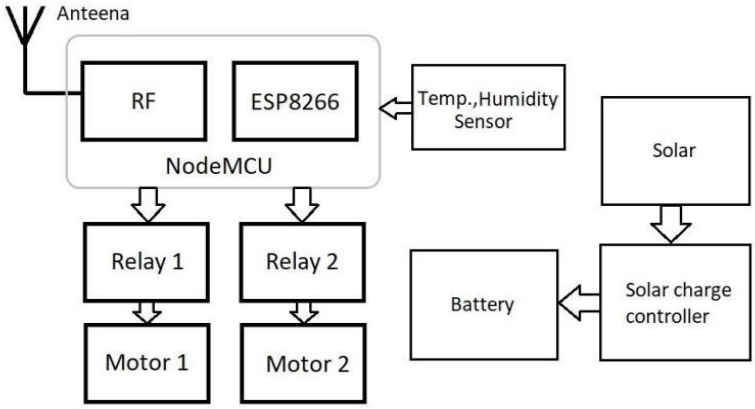

Fig.2 Block Diagram

- Node-MCU:
  Node MCU is an open source LUA based firmware developed for ESP8266 Wi-Fi chip. By exploring functionality with ESP8266 chip. Node MCU Development board is featured with Wi-Fi capability, analog pin, digital pins and serial communication protocols. To get start with using Node MCU for lot applications.
- Temperature & Humidity Sensor:
  This DHT11 Temperature and Humidity Sensor features a calibrated digital signal output with the temperature and humidity sensor capability. It is used to sense temperature and humidity in atmosphere.
- Moisture sensor:
  Moisture sensor used to sense moisture level of soil.
- Relay 1:
  Relay 1 is used to turn 'ON' & 'OFF' the Motor 1
- Relay 2:
  Relay 2 is used to turn 'ON' & 'OFF' the Motor 2.
- Motor 1:
  Motor 1 is gating 'ON' when relay 1 is turn ON i.e. NC=NO & NO=NC.
- Motor 2:
  Motor 2 is gating 'ON' when relay 2 is turn ON i.e. NC=NO & NO=NC.
- Solar:
  We are using power supply of solar energy; it can be stored in 6 volt battery.
- Solar Charge Controller:
  We are using power supply of solar energy it can be stored in 6 volt battery. Before that, we get the variable sun ray that's why we get variable output voltage from solar panel. The variable output voltage may damage the overall circuit. That's why we are using solar charge controller to control the variable output given by the solar panel and next we can store this controlled output voltage in 6 volt battery.

III. COMPONENTS

3.1 NODE MICRO-CONTROL UNIT (ESP8266):

Node MCU is an open source LUA based firmware developed for ESP8266 wifi chip. By exploring functionality with ESP8266 chip, Node MCU firmware comes with ESP8266 Development board/kit i.e. Node MCU Development board.
Since Node MCU is open source platform, their hardware design is open for edit/modify/build.

Node MCU Dev Kit/Board consist of ESP8266 wifi enabled chip. The ESP8266 is a low-cost Wi-Fi chip developed by Espressif Systems with TCP/IP protocol. For more information about ESP8266, you can refer ESP8266 wifi Module. There is Version2 (V2) available for Node MCU Dev Kit i.e. Node MCU Development Board v1.0 (Version2), which usually comes in black colored PCB.

Node MCU Development board is featured with wifi capability, analog pin, digital pins and serial communication protocols. To get start with using Node MCU for lot applications first we need to know about how to write/download Node MCU firmware in Node MCU Development Boards. And before that where this Node MCU firmware will get as per our requirement.
There is online Node MCU custom builds available using which we can easily get our custom Node MCU firmware as per our requirement.

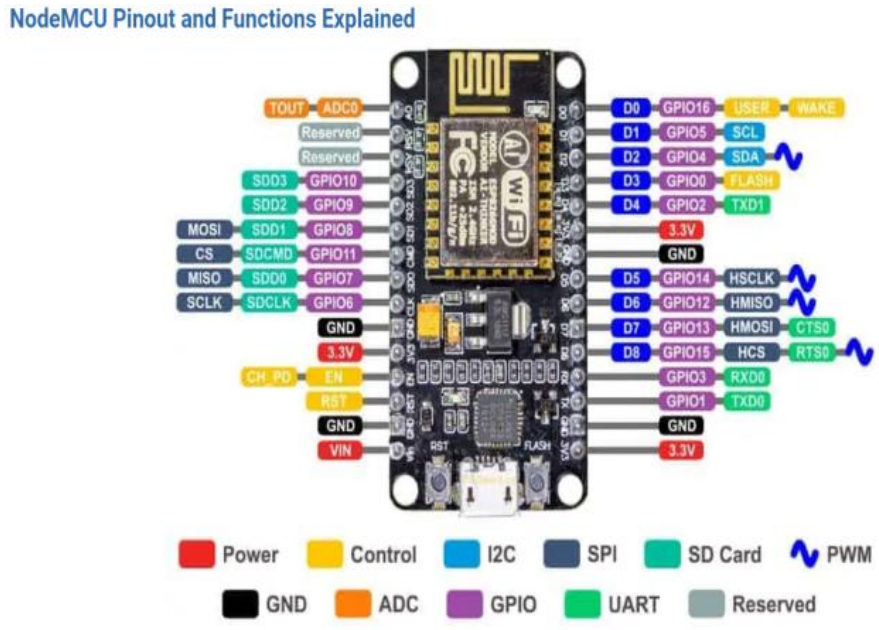

Fig.3.1 Node-MCU Pin Diagram

3.2 Solar Panel:

Photovoltaic solar panels absorb sunlight as a source of energy to generate electricity. A photovoltaic (PV) module is a packaged, connected assembly of typically 6x10 photovoltaic solar cells. Photovoltaic modules constitute the photovoltaic array of a photovoltaic system that generates and supplies solar electricity in commercial and residential applications.

Photovoltaic modules use light energy (photons) from the Sun to generate electricity through the photovoltaic effect. The majority of modules use wafer-based crystalline silicon cells or thin-film cells. The structural (load carrying) member of a module can either be the top layer or the back layer. Cells must also be protected from mechanical damage and moisture. Most modules are rigid, but semi-flexible ones based on thin-film cells are also available. The cells must be connected electrically in series, one to another.

Some special solar PV modules include concentrators in which light is focused by lenses or mirrors onto smaller cells. This enables the use of cells with a high cost per unit area (such as gallium arsenide) in a cost-effective way. Solar panels also use metal frames consisting of racking components, brackets, reflector shapes, and troughs to better support the panel structure.

3.3 Small Water Pump:

Micro DC 3-6volt Micro Submersible Pump Mini water pump For Fountain Garden Mini water circulation System DIY project. This is a low cost, small size Submersible Pump Motor which can be operated from a 3 ~ 6V power supply. It can take up to 120 liters per hour with very low current consumption of 220mA. Just connect tube pipe to the motor outlet, submerge it in water and power it. Make sure that the water level is always higher than the motor. Dry run may damage the motor due to heating and it will also produce noise.

3.4 Moisture Sensor (YL-69):

This is a simple sensor that can be used to detect soil moisture/ relative humidity within the soil The module is able to detect when the soil is too dry or wet. Great for use with automatic plant watering systemsUse this sensor make an automatic watering system, to keep your garden plants well without anyone having to manage them.

Usually sold as two parts: a fork-shaped moisture probe with two connections and a module board with 2 connections for the probe and 4 connections: Vcc, GND, D0, A0.

3.5 Relay (PW-SH-105D):

Relay is an electromagnetic device which is used to isolate two circuits electrically and connect them magnetically. They are very useful devices and allow one circuit to switch another one while they are completely separate. They are often used to interface an electronic circuit (working at a low voltage) to an electrical circuit which works at very high voltage. For example, a relay can make a 5V DC battery circuit to switch a 230V AC mains circuit. Thus a small sensor circuit can drive, say, a fan or an electric bulb.

IV. CIRCUIT DIAGRAM

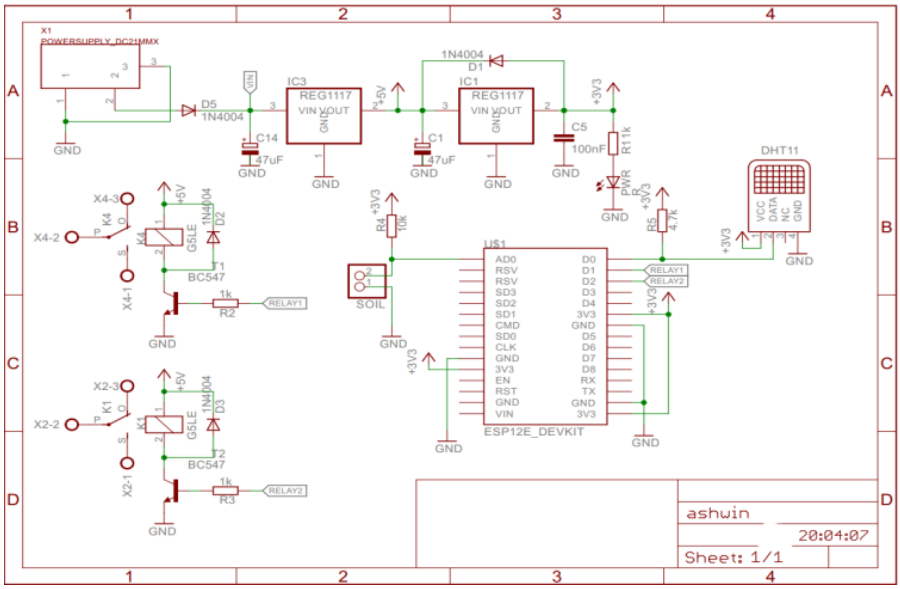

Fig.4 Circuit Diagram

We are using power supply of solar energy, it can be stored in 6 volt battery. Before that, we get the variable sun rays that are why we get variable output voltage from solar panel. The variable output voltage may damage the overall circuit. That's why we are using solar charge controller to control the variable output given by the solar panel and next we can store this controlled output voltage in 12 volt battery.

Then, output of 6 volt battery is given to our controller circuit in that we are using regulator, micro-controller Node MCU, capacitors & resisters, diodes.

The microcontroller Node MCU works on 3.5 input voltage (6 volt is converted to 3.5 volt), for this we can use a regulator which converts 6 volt to 3.5 volt. For operation of smart irrigation we want the Wi-Fi which can be provided by hotspot of any smartphone or iPhone or ipad. Then the output of node MCU is given to operating circuit which contains relay diodes, resisters and transistors & also to sensing circuit in that we are using temperature sensor, humidity sensor and moisture sensor. Then the output of these sensors is given to 5 volt water pump. Through the regulator because we are using 6 volt battery for the input supply.

V. WORKING OF PROTOTYPE MODEL

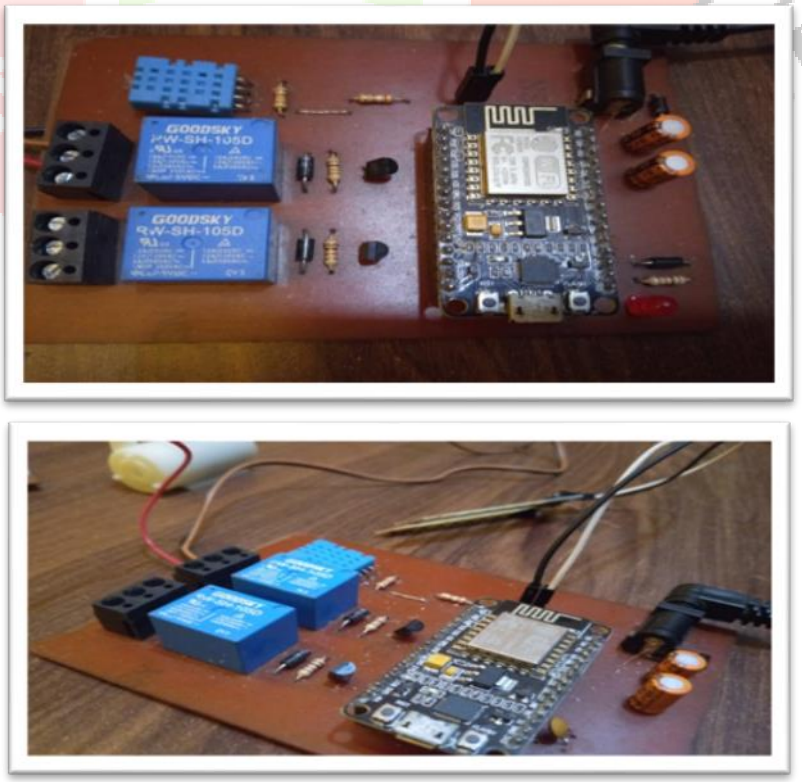

Fig. 5 Working Prototype Model

5.1 Construction:

We are using power supply of solar energy, it can be stored in 6 volt battery. Before that, we get the variable sun rays that are why we get variable output voltage from solar panel. The variable output voltage may damage the overall circuit. That's why we are using solar charge controller to control the variable output given by the solar panel and next we can store this controlled output voltage in 6 volt battery.

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5.1 Working:

When the supply is given to microcontroller node MCU, then it turns ON. Then the operating signal is given by the microcontroller node MCU to relay by using website (io.adafruit.com) with the manually operation. We are used temperature sensor, humidity sensor and moisture sensor these sensors are used for automatic operation.

When we are using manually operation mode, then we can give the operating signal (turn ON or turn OFF) by using the website (io.adafruit.com). Due to this command, the relay is operated. Due to this operation of relay, the motor is operated (turns ON or OFF). We can see the results (temperature, humidity in nature and moisture in the soil) of this operation on mobile by using a website.

When we are using the automatic operation mode, it can operated by using temperature sensor (it measures the temperature of the environment) and moisture sensor (which is put on the soil to measure the moisture level of the soil). Firstly we start the automatic mode in the website which is logged in the mobile. Due to the condition of the moisture, the motor is operated. When the moisture level of the soil is increased above the percentage level which is set by the user then motor is turned OFF and when the moisture level of the soil is decreased below the percentage level which is set by the user then the motor is turned ON

VII. ADVANTAGES AND APPLICATION

6.1 Advantages:

- It is more efficient.
- It can save water.
- It saves electrical energy.
- It saves fuel.
- It saves time.
- It is self-power generated system.
- The energy source for this system is easily available.
- We can operate this system from anywhere.
- This system is operated at very low voltage.
- We can operate many appliances and lighting system by using this project.

6.2 Applications:

1. By simple changes in this system it used in bore-well motor in hose.
2. This system is used in sugar farm and other farming.
3. Useful irrigation in field
4. Useful irrigation in Gardens, Parks.
5. This irrigation system is very efficient for Paddy, Rice Fields.
6. By small changes we can use this system for home light control system.
7. We can use this system for protection from fire, by small changes.

VI. CONCLUSION

Thus the "Smart Irrigation system based on soil moisture by using Node-MCU" has been designed and tested successfully. It has been developed by integrated features of all the hardware components used. The system has been tested to function automatically. The moisture sensors measure the moisture level (water content) of the soil. If the moisture level goes below the desired and limited level, the moisture sensor sends the signal to the node MCU board which triggers the Water Pump to turn ON and supply the water to respective plant. When the desired moisture level is reached, the system halts on its own and the water Pump is turned OFF. Thus, the functionality of the entire system has been tested thoroughly and it is said to function successfully.

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