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An Intelligent Solar water pump monitoring system using IOT technology

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ABSTRACT -Indian economy is 70% dependent on agriculture. Nowadays for irrigating fields farmers are shifting from non renewable methods of power generation to renewable methods of power generation. Basically we are shifting our focus to Solar energy. At present most of the agriculture field is having solar water pumps to water their crops. This article is based on intelligent monitoring of the solar water pumping stations using IOT technology. The monitoring system has been developed by modifying the controller by providing a proper *feedback mechanism to maintain constant* temperature. In this we are integrating outputs obtained from the sensors which are implanted on the PV panels , controller and water pump to the ESP-32 micro controller board . The main controller unit integrates with software , gather all data from every modules and with the help of GSM module display on the administrators mobile phone whether the motor is ON or OFF .If the motor is off it will tell which subsystem is faulty . This will help the administrator to inspect the pumping system without being physically present there.The system can be modified further to connect large areas.

KEYWORDS: Solar, water pump, solar pump, monitoring system, PV panel

1. INTRODUCTION

Solar water pumps is an attractive technology to supply water. These pumps can supply water to locations which are beyond the reach of power lines.In general such places rely on human or animal power which can not fulfill the crop water requirement properly Solar water pumps is a socially and environmentally . Sometimes they rely on diesel engines resulting in environmental pollution. Even using natural gas based engines was a problem due to its periodic maintenance. Solar water pumps can replace the current pump systems and result in both socioeconomic benefits as well as climate related benefits.

This system consists of PV panels, system controller, water pumps of different kinds, and water tank. A solar water pump system is basically an electrical pump system in which the electricity is provided by one or several Photo Voltaic (PV) panels. This solar panel array output is fed to the controller which in turn will regulate certain parameters and its output is use to power the electric motor which in turn powers a water pump.

Two main types of solar water pump technology:

1) **Centrifugal pump:** It uses high speed rotation to suck water through the middle of the pump. When it is operating at low power the performance of the pump drops drastically . This makes it less suitable for solar applications.

Example- Conventional Alternating Current(AC) pumps.

2) **The positive displacement pump** : This type of pump uses a piston to transfer water. Many solar water pumps use the positive displacement pump, which brings water into a chamber and then forces it out using a piston or helical screw.

They generally pump slower than other types of pumps , but have good performance under low power conditions and can achieve high lift compared to centrifugal pump.

A solar pump is considered of good quality only if it's efficiency is high.

Efficiency of the pump is defined as water pumped per watt of electricity used.

Two types of pump exist :

Suitability of the type depends on the type of source of water :

a) **Submersible pumps**: In the case of a well , the pump needs to be placed under water. This type is expensive as compared to the surface pumps.

b) **Surface pumps:** It can be placed at the side of a lake or, in the case of a floating pump, on top of water source. These are less expensive but they are not well suited for suction and can only draw water from about 6.5 meters of vertical height.

2. Literature Survey:

Conclusion drawn after going through various research papers:

1) Monitoring system for 5kW solar pumping system:

What's new: A system for recording the performance of solar pumping system consisting of various sensors such as voltage /current/power temperature/flow rate. The system also includes data display and export to communication devices.

Conclusion: After installing the monitoring system , the user can easily check the system status and parameter and not necessary to measure data by themselves .The system can report information to user directly. User can plan service/ maintenance while they are in office.

2) Developing monitoring system for solar water pump based on wireless sensor network:

What's new: Monitoring solar pump using RF transmitter and GPRS cellular network and sharing the data on a cloud server.

Conclusion: The monitoring system based on wireless sensor network consists of Sensor Node Series and Sensor Gateway Series. Data transmission between sensors uses an RF transmitter while an internet connection uses GPRS cellular networks. The monitoring results are displayed through the internet network on a predetermined cloud server.

3) Solar water pumping system using IOT monitoring system:

What's new:

Unique design for moisture sensing of fields.

Conclusion:

The research paper has executed the complete design and operation of IOT based automatic water pump controller from the engineering perspective and created an enhanced water pump controller integrated with sensors having significant improvement in moisture sensing which makes the design very unique.

3. HARDWARE INTERFACES:

3.1 ESP-32

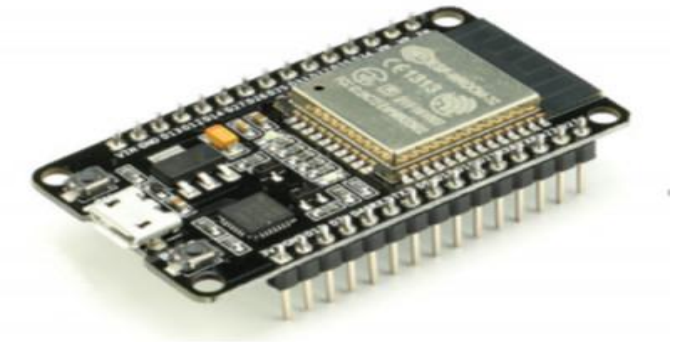

Fig1: ESP-32 module

A feature rich microcontroller with inbuilt Bluetooth and Wi-Fi module. Below mentioned are some of the properties related to ESP-32:

1) Robust Design:

ESP32 can function efficiently in industrial environments, with an operating temperature ranging from –40°C to +125°C. It is powered by advanced calibration circuitries. This module can easily adapt to changes in external environment and can remove external circuit imperfections if any.

2) Ultra-Low Power Consumption:

This module is basically engineered for mobile devices, wearable electronics and IoT applications.With the help of certain proprietary software it is designed such that it consumes ultra -low power. It also includes state-of-the-art features, such as fine-grained clock gating, various power modes as well as dynamic power scaling.

3) ESP32 is integration of in-built antenna switches, power amplifier,power management modules and filters.

4) ESP32 can perform as a complete standalone system or as a slave device to a host MCU, reducing communication stack overhead on the main application processor. ESP32 can interface with other systems to provide Wi-Fi and Bluetooth functionality through its I2C ,UART or SPI , SDI interfaces.

3.1 GSM module:

Figure:2 GSM SIM-900 module

The SIM900 shield packs a surprising amount of features into its little frame. Some of them are listed below:

1) It supports Quad-band: GSM850, EGSM900, DCS1800 and PCS1900.

2) We can connect onto any global GSM network with any available 2G SIM.

3) With the help of external earphone it can make and receive calls.

4) Send and receive SMS messages

5) Send and receive GPRS data (TCP/IP, HTTP, etc.)

6) Scan and receive FM radio broadcasts

7)It can transmit power, below are the two classes based on power:

- Class 1 (1W) for DCS1800
- Class 4 (2W) for GSM850

8) It is having serial-based AT Command Set

9) Contains connectors such as U.FL and SMA for cell antenna.

10) It accepts full size SIM cards.

3.2 Water Pumps

Figure:3 Water pumps

It is an essential tool to pump out water from the reservoirs , underground or other natural water resources. It basically controls the speed of the water and is incredibly used in conserving water.

4. SOFTWARE INTERFACES

4.1 Arduino Software(IDE)

Arduino software has text editor which is used for writing codes and programs , which are known as sketches. These sketches along with the extension '.ino' are stored at a standard place called sketchbook . After completion of programming part IDE software compile and upload the program on the microcontroller (here ESP-32). IDE is also used as simulator for some application.

5. SYSTEM DESIGN

The IOT based remote controlled solar water pump consist of number of sensors, water pump, system controller connected with the micro controller(ESP-32) .This system is operated through PV panels. Communication can take place either through Bluetooth or Wi-Fi as ESP-32 is both Wi-Fi and Bluetooth enabled. Micro-controller output is fed to the GSM module. After receiving the signal through the GSM module administrator can inspect that particular solar water pumping station.

By providing a proper feedback to the system controller we will be able to maintain a constant temperature through the system controller which will resolve one issue due to which pump can be off . This technique will save the repair cost. No human involvement required for such issue. Voltage and current sensor will help to maintain constant temperature whereas temperature sensor for maintaining constant temperature specially across the system controller.

Connection of every subsystem to the ESP-32 micro controller will ease out the inspection work through

which administrator will decide which subsystem is faulty. If the Pump will be off it will be displayed on his phone which subsystem is not producing output . If system controller is not producing output we will get to know the wire across that portion is cut . If this happens with water pump then the administrator will check whether it is getting output from the system controller or not.

This clears how involving IOT will make the solar water pump monitoring system more efficient.

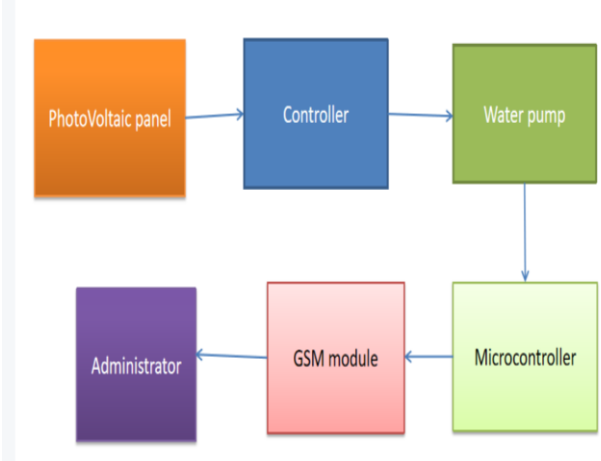

Fig-4 Block diagram of system

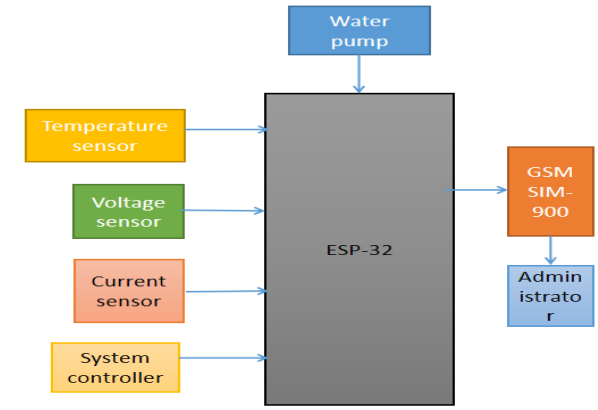

Fig-4:Working model of system

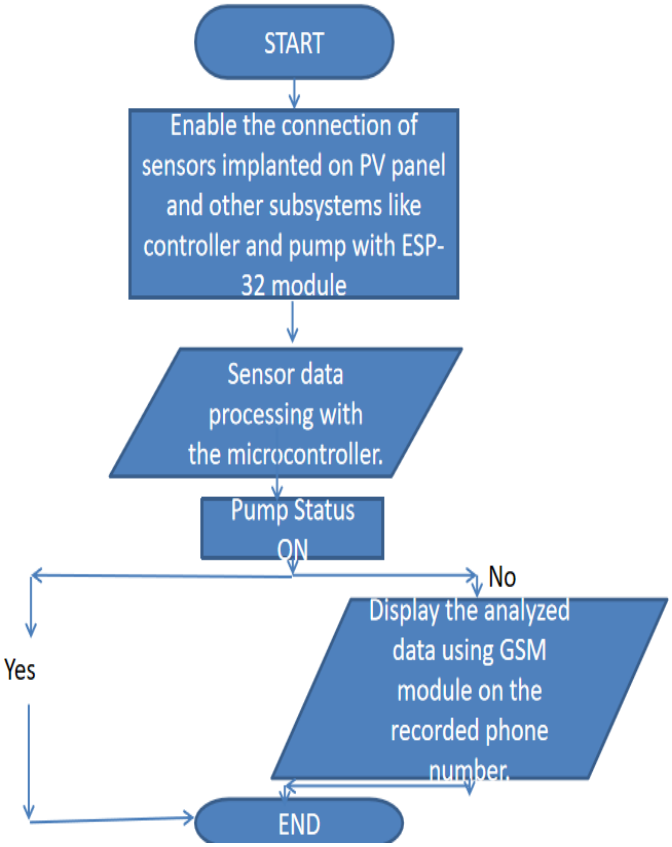

Fig-6: Flowchart of system

8. CONCLUSION

With the help of the proposed system we can reduce the human involvement. This system will help the administrator to remotely inspect the site without physical appearance. Using Internet Of Things will even reduce the inspection cost making it an ease for the farmers or the solar pump users. As earlier they were bearing double the cost since administrators first used to visit the site for inspecting the problem then they again come for resolving the issue and bring the needy equipment's to resolve the problem. This kind of monitoring will provide the fields with sufficient amount of water for the respective crops.

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