RASPBERRY PI BASED SOLAR POWERED AUTOMATIC IRRIGATION SYSTEM

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***Abstract*: According to the Department of Agriculture Economic Research Service, agriculture is a major consumer of ground and surface water in India. Although India is surrounded by water, there has always been scarcity of water for irrigation system. This paper addresses water scarcity issue by proposing a smart irrigation model based on solar-power that can control the amount of water needed by the soil. The proposed model may help farmers to reduce water waste, avoid evaporation and hence productivity can be increased.**

***Keywords*: Soil moisture, Soil temperature, Automatic Irrigation System, Raspberry pi, PV Cells.**

I. Introduction

Agriculture accounts for 70% of all water usage in India, according to the Food and Agriculture Organization of India, compared to 20% for industrial and 10% for domestic. As a result, there is a pressing need to apply water conservation methods in agriculture. Also, it is required to develop water-use strategies based on science and technology, encompassing technical, agronomic, and environmental considerations [1][2].

The goal of this research is to develop a model that can reduce water waste. The objective is to design automatic drip irrigation that delivers precisely the amount of water required based on soil moisture. Greenhouses, vegetables, and administrative buildings can all be found on the farm. Data from the humidity, temperature, and flow sensors can be collected by the automated system and can be transmitted wirelessly to the cloud. The proposed model can be used in one of two modes: closed loop control and open loop control. In closed loop control, the microcontroller controls the opening and closing of the solenoid valve to provide the required amount of water to the crops. While in open loop control, the microcontroller controls the opening and closing of the solenoid valve to provide the required amount of water to the crops, based on an average soil moisture level [2].

II. Objectives

The main objective of the project is to develop an automatic irrigation system that can have the following facilities:

- Harvesting of solar energy using PV cells for irrigation.
- A farmer friendly drip irrigation system which can be easily integrated into existing fields.
- A mechanism to analyse the soil moisture patterns.
- Architecture for interaction between various components.
- User friendly Application Program Interface (API) on the mobile device to display the recognized sensor data.

III. Problem statement

In term of population, India is the second biggest country after China. So it is important to build the creation of food to feedstuff a huge number of individuals. However, it suffers due to following reasons:

- There is lopsided and vague circulation of precipitation which cause dry season.
- For various water necessities of harvests must be met through water system conveniences.
- Being tropical country there is speedy expansion in the high temperature and vanishing.

An irrigation system is a mechanism that distributes water to a specific area and is the cornerstone of human life. The system chosen determines the irrigation efficiency. There are numerous more types of irrigation systems in use around the world, but they all have their own set of issues. There are a few recent systems, but they have all failed in some fashion. Engineers strive to come up with combined automatic devices in order to produce sophisticated systems that support humans in their tasks so that the system automatically processes itself without any human interaction [3].

IV. Proposed system

In this article, we are utilizing solar board which gives power supply to the engine and fundamental control framework. We effectively mindful about the framework, which works on portable, however engine controlling utilizing PIC regulator. In these venture, our entire framework is worked on power which created by sunlight based board. Today, chamber ON/OFF framework is done physically so it is exercise in futility. It is done consequently by checking the situation with soil sensor for controlling the chamber by utilizing solenoid valve which works on 12 volt DC supply. In the event that the yield of soil sensor is pause, valve is open else it is shut. Communicating and getting message is finished by GSM model. Test run implies if there is no water in the well and engine is running unreservedly. Out of all components, engine consuming possibility is more. To ensure the engine, it is consistently important to check the engine trial run condition before it begins, the status is shown on LCD and utilize versatile or control board [4].

To decide the temperature and mugginess of air, we utilize the DHT11 sensor. It comprises of two parts, a dampness estimating segment and a NTC temperature sensor i.e., a thermistor. The mugginess estimating chips away at a comparable rule as a dirt dampness estimating sensor. Everything comprises of two anodes with the dampness holding substrate between them. Current is passed between the two terminals. The measure of opposition offered by the substrate changes as the measure of dampness in air changes. These progressions are estimated and mugginess is calculated [5].
The reasonable PV cells for gathering sun oriented energy and capacity utilizing battery to incite different agrarian parts like Arduino Uno, engine, solenoid esteems and sprinkler are chosen.
Arduino UNO board ceaselessly facilitate the information from the sensors associated with it which estimates the dirt dampness, advances it to Raspberry-Pi over USB interface which investigates the information, if actual boundaries pass the boundary esteems, the equivalent is told to the client utilizing GCM Administration [6].

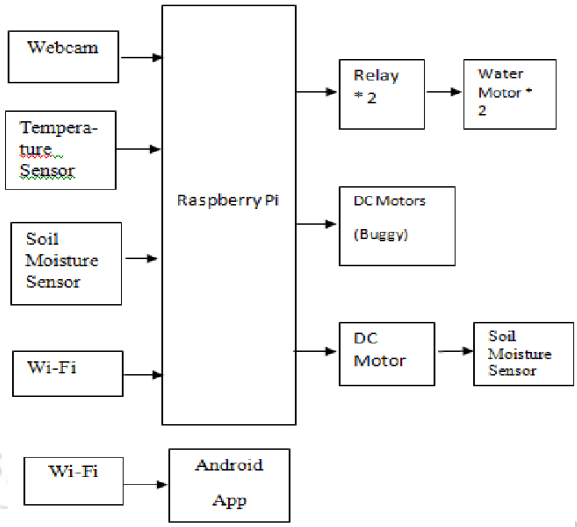

Fig.1 Block diagram of automatic irrigation system.

Client reacts to RPI worker to make an important move. Raspberry-Pi is introduced with Raspbian Jessy which is a LINUX based Working Framework (operating system). This operating system is introduced on a SD card utilizing SD formatter. SD formatter is utilized to arrange the card and win32diskimager to stack the working framework. After this, first boot arrangements are made which incorporates root parcel augmentation, head/headless mode booting, framework update and redesign. All the co-appointment capacities are acted in Raspberry-Pi executed utilizing python programming. Python script gets information esteems from Arduino over sequential port through USB interface. It then, at that point investigations to check whether the information is in allowable cut off points i.e., soil is wet or dry. On the off chance that the information passes as far as possible, it is told to the client utilizing GCM administrations. Google Cloud Informing (GCM) administrations are utilized to send information from worker to client's devices [2]. A block diagram of automatic irrigation system is presented in Figure 1.

Below is the list of sensors that can be directly connected to the Raspberry-Pi GPIO and are supported by the Software.

- AM2302 (hosting the DHT22 sensor) : Air Temperature, Air humidity
- DS18B20 : Temperature
- DS3231 : clock
- BH1750 : light
- BMP180 : Atmospheric pressure, Air temperature
- BME/BMP280 : Air Temperature, Air humidity, Atmospheric pressure
- Digital Soil Moisture Sensor : Soil moisture
- HX711 : Weight sensor

Humidity and temperature sensors (AM2302)
The Hydrosys4 SW is designed to be compatible with the AM2302 board which embed the DHT22 sensor; it provides Air temperature and Humidity readings [7].

I2C sensors – Temperature, Humidity, atmospheric pressure and light.

The I2C sensors use the I2C interface to connect to the Raspberry Pi.I2C Sensors supported by the system:

- BH1750: light
- BMP180: Atmospheric pressure, Air temperature

- BME/BMP280: Air Temperature, Air humidity, Atmospheric pressure

The I2C interface has a common bus made by two wires (SDA, SCL), the I2C devices can be connected in parallel with other I2C devices.

DS18B20 temperature sensor

Recently the support for this type of thermometer has been added to the system (ver 1.11d). The sensor uses the one wire protocol; it has 3 wires that can be connected as follow:

- Red : 5v or 3.3v
- Black : Ground
- Data wire (usually white or yellow) : one of the GPIO pins not involved in I2C or DMI

The GPIO where the data wire will be connected can be set by software. As from the specifications, the data wire should be connected to a resistor (4.7K ohm) in pull-up configuration. Anyway this is not necessary (at least for a single thermometer usage) as the Raspberry GPIO can be set to use internal pull-up configuration [8].

External Hardware Clock

As the Raspberry-Pi does not have a battery protected clock, its clock is reset every time the power is OFF. In case it is connected to internet this is not a problem as it synchronizes automatically with the network (using NTP protocol). If this is not the case, a Hardware clock with battery will be very useful [9].

Relays

Relays are used as switches for the actuators. The compatible relays should work at 5V and should have inputs isolated by optocouplers. In this way they can be directly connected with RPI GPIO pins [10].

V. Result

The dirt dampness edge esteem is set which relies on the sort of harvest i.e. it needs more water or less. This limit esteem is checked each time by Arduino to control up the engine or not. The mugginess and Temperature sensor additionally send their information to Arduino. The harvests require ideal temperature and Mugginess or, more than likely the nature of the yields is settled. The Arduino is additionally associated with the engine drive board and ESP8266. The engine driver board turns on the water siphon at whatever point the dirt dampness content drops the limit esteem. The ESP8266 is dependable to associate the equipment and the product part. The ESP 8266 module interface the Arduino to the thing talk stage and sends the sensor information remotely. The thing talk stage stores the information which can be broke down by the ranchers by looking me at each progression of the undertaking.

By utilizing the proposed framework, there are parcel of advantages to the two ranchers and governments. For the public authority answer for energy emergency and water deficiency is proposed. The proposed procedure is chiefly utilized for water system of agribusiness field. Likewise it is utilized in the farming exploration stations, nurseries, and gardens. The proposed model is completely founded on sunlight based energy so it tends to be utilized in distant regions where power isn't available.

VI. Conclusion

The principle applications for this undertaking are for ranchers and landscapers who don't have bountiful chance to water their harvests/plants. It additionally covers those ranchers who are inefficient of water during water system. The task can be stretched out to nurseries where manual administration is far and not many in the middle. The guideline can be reached out to make totally mechanized nurseries and farmlands. Aggregate with the guideline of downpour water gathering, it could prompt monstrous water investment funds whenever applied in the correct manner. However, the programming is troublesome. Additionally, cost for the setup is high.

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