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Solar Powered Smart Irrigation System using GSM

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***Abstract*—This paper describes an irrigation system which is more efficient than the current system. This is beneficial to the farmers in many ways like not having to water the farm being physically present to performing irrigation without the actual use of commercial electricity.**

Unlike the normal irrigation system, here we power the pumping system with the help of a solar panel. Since government of India is providing 90% subsidy under *'PM KUSUM'* scheme to the farmers for installing solar pumps, this also doesn't cost any extra money for installation [1].

In this irrigation system, we are using soil moisture sensors to sense the amount of moisture content in the soil whether to water the soil or not. We also have an Arduino board which takes care of the irrigation. Hence, we don't need any physical body to monitor the system. In addition to automatic Irrigation system, we set up a weather forecast system in the Arduino which helps watering the farm. The water leakage monitoring helps reduce wasting the water.

Here, we use GSM module to communicate with the farmer mentioning the status of the motor and the farm.

Keywords—Solar Panel, GSM, Arduino UNO, Relay Module, LCD, Weather Monitoring System, Leakage Control System.

I. INTRODUCTION

Be it in agriculture or day-to-day life, water plays a vital role. Many of the farmers have been leading a miserable life due to lack of water supply to their farms. While lack of water is a problem, excess water supply to the farm also might kill the crop. Crop destruction can be done either way. To overcome this problem, we have come up with an idea of a smart irrigation system. This agricultural practice uses sensors and solar panels in the field. The sensors we use here are soil moisture sensors which keep track of moisture content in the soil and sending signals to the Arduino UNO board thereby, reducing the wastage of water. The use of solar panels powers up the battery of the motors using solar energy. This practice reduces the power consumption which is being increased every year by the agriculture sector in India. This Smart irrigation system use precise amounts of water minimizing water wastage, saves manpower costs and protects agricultural fields from over watering. This project is one of the ways to step up towards the betterment of the country. Agriculture is the backbone of country like ours. Hence adopting such practices will also improve the economy of the country. We have started this project to bring a new evolution in agriculture.

ELUCIDATING EACH HIGHLIGHT OF THE PROJECT

A. Solar Powered System

One of our aims of this project is replacing the electricity from the sub-stations with solar energy, which is a renewable energy source. In recent years, the solar energy utilization industry has experienced vigorous development and made rapid research or commercial achievements [2]. This irrigation system helps farmers to perform irrigation without the use of power that comes from the electrical power sub-stations which is not very affordable to the farmers. Rather, this system uses power generated by solar panels [3].

The reason why renewable energy usage is affordable even though the hardware is excess is that the Government of India provides 90 percent subsidy to the farmers of the

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country for solar powered irrigation system under '*Pradhan Mantri Kisan Urja Suraksha evem Utthan Mahabhiyan (PM KUSUM)*'. The scheme would ensure that sufficient local solar/ other renewable energy based power is available for feeding rural load centres and agriculture pump-set loads, which require power mostly during the day time [1].

This Solar panel is connected to the Pump set in the farm which powers it up.

B. Soil Moisture Sensor

In this Irrigation system, we use a soil moisture sensor to detect the amount of moisture content in the soil of the farm. One of the most effective ways to improve irrigation efficiency is to implement soil sensor technology in irrigation scheduling [4].

The main aim of this project is to reduce the manpower and finish the irrigation process automatically. When the amount of water content in the soil is decreased, the motor must be turned ON and once the water content becomes adequate, the motor must be turned OFF. This automatic irrigation system is very useful because of various reasons:

- It will reduce the manpower.
- It knows exactly how much water content is required by the soil since it calculates the content present time-to-time.
- Each crop type requires different amounts of water to be fed. So, we give the data of the crop beforehand and the sensor collaboratively with the Arduino UNO, manages to water the plant adequately.
- This reduces the wastage of water. Underwatering and overwatering problems will be reduced by 90 percent.

The amount of water content in the soil is calculated by the formula:

$$VWC = a / (R - b)$$

Where,

VWC -> Volumetric Water content,

R -> electrical resistant measured by the sensor,

A, b -> Calibration constant (Sensor Specific).

$$\%\ Soil\ Water\ Depletion = \left[1 - \left(\frac{Sensor\ VWC(\%) - PWP(\%)}{FC(\%) - PWP(\%)}\right)\right] * 100$$

Fig.1

Where,

PWP -> Permanent Wilting Point

FC -> Field Capacity [4].

C. GSM Module

We Also use the GSM module to communicate with the farmer. The status of the motor (On / Off) must be updated to the farmer. This is done using a GSM. The GSM is present in the Arduino UNO Board. The Arduino is the one that handles the entire system. Every component on the field is connected to the Arduino and sends signals to it. When the motor in Turned on, the Arduino sends signal to the GSM, then the GSM sends a message to the farmer's phone which the GSM is connected to.

II. LITERATURE SURVEY

This project is introduced to bring new evolution in the irrigation system mainly in India. India has traditionally been vulnerable to natural disasters on account of our unique geoclimatic condition. Due to different climatic and rainfall patterns in different regions, few states are experiencing heavy floods and few other states have been experiencing drought situations. Some parts of the country, mainly coastal regions like Andhra Pradesh, Tamil Nadu, Odisha, West Bengal are experiencing the cyclones along with floods due to heavy rainfalls [6].

In this paper, the soil moisture sensor, temperature sensors placed in the root zone of the plant, and gateway unit handles the sensor information and transmit data to a web application. One algorithm was developed for measuring threshold values of temperature sensor and soil moisture sensor that was programmed into a microcontroller to regulate water quantity. For power, a photovoltaic panel was used. A cellular-Internet interface was used for data inspection and irrigation scheduling which can be programmed through a web page.

The automatic system based on ARM and communication GSM technology was used. An irrigation system provides adequate irrigation in a particular area in real-time. Soil moisture sensor placed in the root zone in the paddy field can sense water level. GSM is an important part of this system. The system communicates using GSM. GSM operates through SMS and is a link between the ARM processor and a centralized unit. This system detects climate conditions and field conditions in real-time. This information is sent to the user in the form of SMS and GSM modem is controlled with the help of a standard set of AT (Attention) commands. These commands are used to control the majority of the functions of the GSM model. In the paper, an automatic irrigation control system was using the GSM module and solar panel technique for irrigation, using wireless sensor network i.e. The idea was developed to improve the irrigation system and reduce the cost of irrigation water. Sensors are placed on farms and sense continuously and collect the information. This information is stored at the center monitor and passes to the data collection interface and then transmits to the wireless sensor node. Using this data system was control automatically using the web. Balu proposed Irrigation is the major role and it can be

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controlled by sensor and Wi-Fi module integrated to android application here the sensor senses the amount of water in the field if the amount of water is low in the field then motor turns ON and if the amount of water is high in the field then motor turns OFF automatically and sends the date to the farmer regarding the information of water so that the farmer can decide to switch ON and OFF the motor. The farmer controls using Wi-Fi module to ON and OFF the motor.

III. Components

- Solar Panel
- Battery
- Arduino
- Moisture Sensor
- GSM Module
- DC Pumping
- LCD

IV. Comparision With Previous Models

Quite a few projects, are based on the concept of automated irrigation systems, where many of them used a battery as a power source, and some used an Ac power supply as a power source that simply ON and OFF the motor. In this case, the farmer must frequently visit the field to check whether the motor is working properly or not.

The automatic irrigation system proposed by us is different from all the existing projects.

Here, we compare our System with the below systems.

Fig.1 Automatic Irrigation system with PV Solar tracking [5].

Fig.2 Modelling and simulation for automatic irrigation system with PV Solar tracking [3].

Fig.3 Our System.

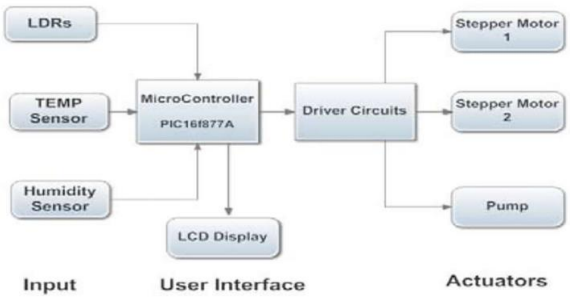

Fig.2

In this System, they use IC's for the Microcontroller PIC16f877A.

But in our System, we use Arduino as a microcontroller. The reasons for using Arduino as microcontroller are:

- Arduino provide easiest debugging system which is a cross platform.
- We can't import our required program to an IC. But we can import our program to an Arduino easily.

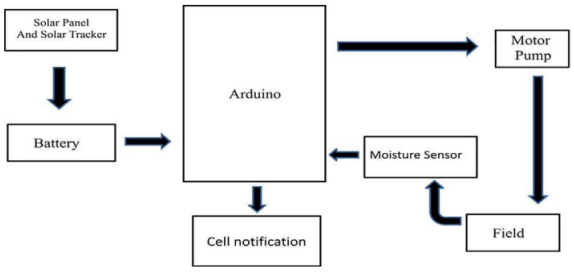

Fig.3

Along with the existing features we have added numerous amounts of new features which include leak and flow control, weather forecasting, we are using solar panels for power supply which saves a lot of energy and also we need not worry about power cuts as we have a backup.

By using the proposed model farmer need not worry about being physically present at the farm during irrigation. With one click on his phone, he can ON the motor without being present.

The weather forecast module takes care of the weather and waters the plants based on the weather and the crop requirements.

The leak and flow control module makes sure that there is no leakage of water which in turn saves a lot of water. Thereby providing enough water to the crops.

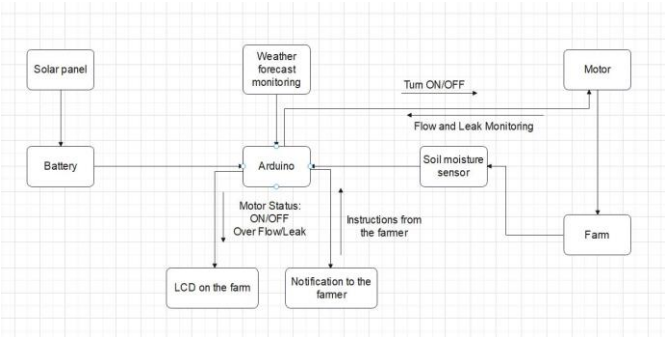

Fig.4

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V. Applications

Smart Irrigation systems find applications in various domains where efficient water management is crucial. Here are some applications for Smart Irrigation systems:

A. Agriculture:
Smart irrigation systems are widely used in agriculture to optimize water use and conserve water. They help far mers provide the right amount of water to their crops ba sed on timely soil moisture, weather and crop water nee ds data. This increases crop yields, reduces water waste, and improves the overall profitability of agriculture.

B. Landscaping and Turf management:
Parks, golf courses, residential developments and sports facilities use smart water systems to maintain healthy pl ants while reducing water use. These systems adjust irrig ation times according to soil moisture, weather conditions and evapotranspiration rates, making water q uality for beauty and safety.

C. Urban Green Spaces:
Smart irrigation systems are used to irrigate plants and landscaping effectively in public gardens, city parks an d green areas. They help cities and urban planners reduc e water use, conserve resources, and maintain attractive urban green spaces.

D. Commercial and Industrial landscapes: Large-scale businesses, office buildings and offices can benefi t from smart water use. These systems provide precise irrigation schedules, remote monitoring and water-saving features to enable efficient and effective mainten ance of outdoor areas.

VI. Conclusion

The main target of our project is to bring a new evolution in the irrigation system which is more efficient than the current system. This system helps farmers with an automatic system which reduces the manpower. This system also reduces the electricity and water bills overall. The reduction of bills varies in different locations. According to a study, in India, irrigation water wastage is reduced about 70% [7].

This system is finally made into a prototype helping solve the problems faced by the farmers in the process of irrigation. This can be installed across the world to multiple types of crops to cultivate. This system helps farmers earn more money during cultivation.

This project can be considered for further modifications and updates. This can be taken as a learning platform for researchers to build new projects with this base.

Acknowledgment

We would like to express our sincere appreciation and gratitude to all our teachers and guides who have contributed to the development and implementation of the smart irrigation system. Their invaluable support, expertise, and dedication have been instrumental in making this project a reality.

We would also like to express gratitude towards our family and friends for their support throughout this project work.

This project is open for any future enhancements. This project can be referred to as a learning module and freely can update the project.

The main aim of this project is to help the farmers of India without whom the nation cannot be developed.

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