Solar Based Smart Irrigation System

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***Abstract*—Automation of farm activities can transform agricultural domain from being manual and static to intelligent and dynamic leading to higher production with lesser human supervision. Internet Of Things (IOT) is a shared network of objects or things which can interact with each other and provide the internet connectivity. IOT plays an important role in agriculture industry. Smart agriculture helps to reduce wastage, effective usage of fertilizer and thereby increase the crop yield. In this work, a system is developed to monitor crop-field using sensors (soil moisture) and automate the irrigation system. These sensors are connected to Arduino UNO which can receive the sensor data and transmit it. The micro controller will analysis the sensor data and determine the amount of water needed for irrigation. The amount of water required for the _eld is based on the type of crop, duty and delta. It also sends control signal to the Relays. The micro controller can also transmit the data to web server. By using web application, the data can be read from the web server and analyzed and then control commands can be sent to the micro controller through internet.**

***Index Terms*—Battery, sensor, Soil moisture, Solar panel, Solenoid valve, PIC microcontroller, Water level indicator.**

I. INTRODUCTION

Agriculture is the unquestionably the largest livelihood provider in India. With rising population, there is a need for increased agricultural production. In order to support greater production in farms, the requirement of the amount of fresh water used in irrigation also rises. Currently, agriculture accounts 83% of the total water consumption in India. Unplanned use of water inadvertently results in wastage of water. This suggests that there is an urgent need to develop systems that prevent water wastage without imposing pressure on farmers.

Over the past 15 years, farmers started using computers and software systems to organize their financial data and keep track of their transactions with third parties and also monitor their crops more effectively. to collect and evaluate a huge amount of information from a diverse number of devices (e.g. sensors, faming machinery etc.) in order to become more efficient in production and communicating appropriate information. With the advent of open-source Arduino boards along with cheap moisture sensors, it is viable to create devices that can monitor the soil moisture content and accordingly irrigating the fields or the landscape as a when needed. making the farmers' work much easier as they can concentrate on other farm activities.

II. LITERATURE REVIEW

1.In A Remote Measurement and Control System for Greenhouse Based on GSM-SMS [4] the proposed system introduced a GSM-SMS remote measurement and control system for greenhouse based on PC-based database system connected with base station. Base station is developed by using a microcontroller, GSM module, sensors and actuators. In practical operation, the central station receives and sends messages through GSM module. Criterion value of parameters to be measured in every base station is set by central station, and then in base stations parameters including the air temperature, the air humidity.

2.Indu et al. (2013) [5] mainly focuses on reviews in the field of remote monitoring and control, the technology used and their potential advantages. The paper proposes an innovative GSM/Bluetooth based remote controlled embedded system for irrigation. The system sets the irrigation time depending on the temperature and humidity reading from sensors and type of crop and can automatically irrigate the field when unattended. Information is exchanged between far end and designed system via SMS on GSM network. A Bluetooth module is also interfaced with the main microcontroller chip which eliminates the SMS charges when the user is within the limited range of few meters to the designated system. The system informs users about many conditions like status of electricity, dry running motor, increased temperature, water content in soil and smoke via SMS on GSM network or by Bluetooth.

3.In [6], R.Suresh et al. (2014) mentioned about using automatic microcontroller based rain gun irrigation system in which the irrigation will take place only when there will be intense requirement of water that save a large quantity of water. These systems bring a change to management of field resource where they developed a software stack called Android is used for devices that include an operating system, middleware and key applications. The Android SDK provides the tools and APIs necessary to begin developing applications on the Android platform using the Java programming language. Mobile phones have almost become an integral part of us serving multiple needs of humans. This application makes use of the GPRS feature of mobile phone as a solution for irrigation control system. This system covered lower range of agriculture land and not economically affordable.

4.In IOT SMS alarm system based on SIM900A [7], an IOT alarm system based on SIM900A module of SIMCOM Company was designed for greenhouse. The system can gather environmental parameters such as air temperature and air humidity. Meanwhile, with the use of AT command, this system can also realize SMS automatic sending and receiving, environmental parameters overrun alarm and insufficient balance alarm. Through the system setting, the alarm message can be sent to the user-specified mobile phone automatically no matter what the users' location is. This system as a typical application of IOT in the agriculture has got some satisfactory results in the actual operation.

III. Existing System

A solar-based smart irrigation system integrates solar energy with intelligent technologies to automate and optimize the process of irrigation for agriculture, landscaping, or gardening. This system aims to reduce water wastage, improve crop yield, and lower operational costs by using renewable energy and real-time data to control irrigation.

IV PROPOSED SYSTEM

The system is a combination of hardware and software components. The hardware part consists of embedded system and software. Data received from sensor is in analogy format and converted in to the digital format. Once 1st sensor provides the signal then depends on that the signal is generated and according to that the motor is operated. The system is interfaced with the Arduino and Wi-Fi module to operate the system in the specific area. Block diagram of the proposed system is displaying bellow.

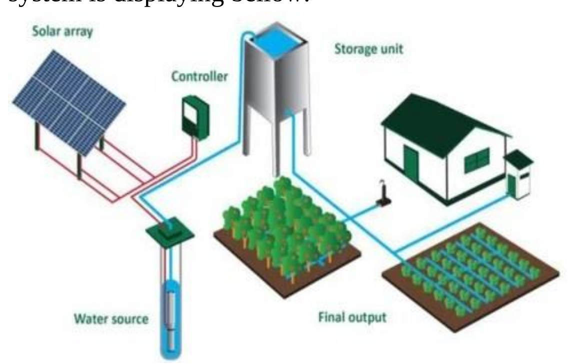

Fig1: Proposed Methodology

V. BLOCK DIAGRAM

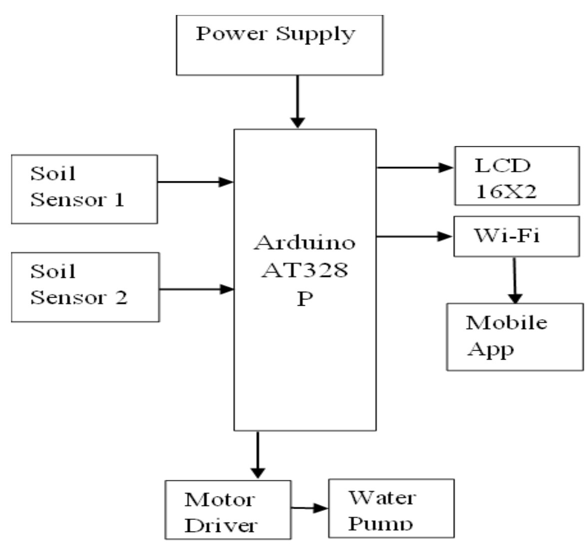

Fig2: Block dig of solar based smart irrigation system

VI. HARDWARE AND DESCRIPTION

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1. Solar panel

Fig3: Solar panel

In a smart irrigation system, solar panels play a crucial role by providing a renewable and sustainable energy source to power the system a smart irrigation system, solar panels play a crucial role by providing a renewable and sustainable energy source to power the system. If the system includes pumps to draw water from a well, reservoir, or other sources, solar panels can power these pumps. Solar panels often charge batteries that store excess energy. This stored energy can be used to run the system during cloudy days or at night, ensuring continuous operation. Solar-powered irrigation systems help conserve water by optimizing usage based on data-driven insights. This reduces waste and promotes sustainable farming or landscaping practices, while minimizing dependence on grid electricity. This is especially beneficial in off-grid areas where electricity access is limited.

2. Soil Moisture Sensor

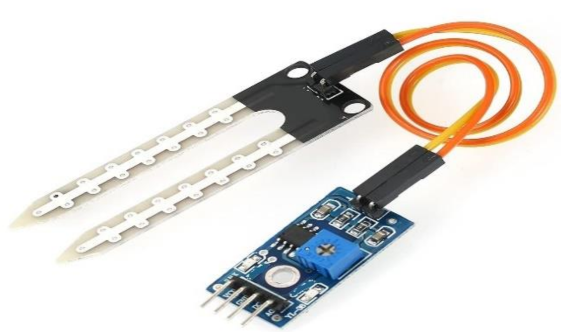

Fig4: Soil Moisture Sensor

A soil moisture sensor plays a crucial role in a smart irrigation system by measuring the moisture level in the soil. This data is used to determine when and how much water is needed to keep plants healthy, making irrigation more efficient. The sensor is placed in the soil to detect the water content The sensor sends real-time data to a central controller or cloud-based system. In some setups, it can even communicate directly with the irrigation system. Based on the moisture readings, the system compares them to preset thresholds or user-defined moisture levels. If the soil is too dry, the irrigation system is triggered to water the plants. If the moisture level is sufficient, irrigation is paused. Some smart systems can automatically adjust irrigation schedules based on weather forecasts, soil conditions, and plant needs, further improving water conservation. The system can continuously monitor the soil and make adjustments in real-time, ensuring that plants receive just the right amount of water.

3. Humidity Sensor

Fig5: Humidity Sensor

A humidity sensor in a smart irrigation system plays a vital role by measuring the ambient air humidity, which influences the rate of evaporation and plant water needs. Here's how it works within the system The sensor measures the relative humidity in the surrounding environment. It can use various technologies like capacitive, resistive, or thermal methods to detect moisture in the air. The humidity is recorded as a percentage, indicating how much moisture is present in the air compared to the maximum amount it can hold at a given temperature. The humidity readings are sent to the smart irrigation system, often through a central controller or cloud-based platform. The system integrates the humidity data with other environmental factors like soil moisture, temperature, and weather forecasts. If the humidity is high, the system may delay or reduce watering since the air's moisture levels suggest that evaporation from the soil is lower, reducing the need for irrigation. On the other hand, if humidity is low, evaporation increases, which means the plants may need more water. The system can then trigger irrigation based on this feedback. By factoring in air humidity along with soil moisture levels and temperature, the system can make more accurate and efficient decisions, conserving water while ensuring the plants are properly hydrated. In some systems, the humidity sensor can also work alongside weather forecasts to anticipate changes in humidity levels and adjust the irrigation schedule preemptively. Continuous monitoring of humidity allows the smart irrigation system to adapt and optimize watering in real-time, considering both the environment and the plant's needs.

4.Motor

Fig6: Motor

In a solar-based smart irrigation system, a 5V DC motor is often used to power the irrigation pump or control the flow of water, providing an efficient way to irrigate plants while relying on renewable energy. The solar panel collects sunlight and converts it into electrical energy. This energy is stored in a battery or directly used to power the system. Since most solar systems for irrigation are designed to work off-grid, the solar panel will charge the battery during the day, and the battery will supply power to the 5V DC motor when needed, typically during irrigation cycles. The 5V DC motor is controlled by a central controller or microcontroller (such as an Arduino or Raspberry Pi). The controller receives data from sensors (like soil moisture or humidity sensors) or timers, determining when irrigation is needed. Once the controller determines irrigation is necessary, it sends a signal to activate the 5V DC motor, allowing it to pump water to the irrigation system (e.g., drip lines or sprinklers). The 5V DC motor is typically part of a water pump, which is responsible for moving water from a water source (such as a tank or reservoir) to the plants. The motor helps create the pressure needed for water distribution. In some cases, the motor may directly control a valve that regulates the flow of water to the irrigation system.

5. LCD

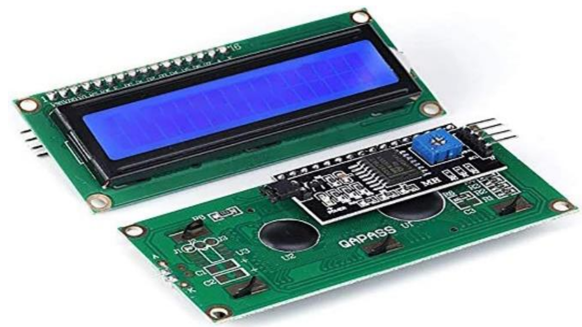

Fig7: LCD

In a solar-based smart irrigation system, an LCD (Liquid Crystal Display) the LCD provides a user-friendly interface for monitoring system performance and controlling settings. It is powered by the solar panel and displays real-time data such as soil moisture, battery status, and irrigation activity. This allows users to track the system's efficiency and make adjustments as necessary, ensuring optimal irrigation and water conservation.

VII. MODEL DESIGN

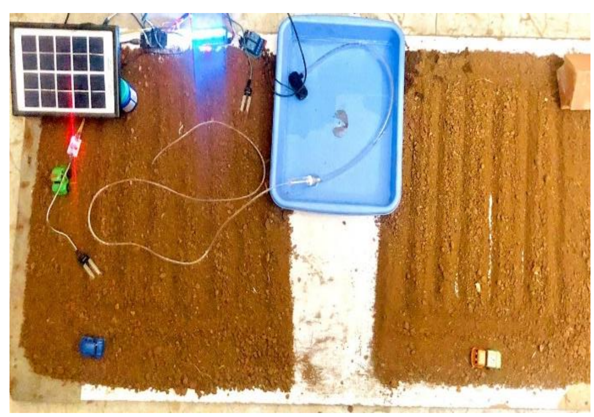

Fig 8: Model design

VIII FUTURE SCOPE

The future scope of smart irrigation systems is rooted in their ability to address water scarcity challenges, boost agricultural efficiency, and contribute to a more sustainable planet.

IX. ADVANTAGES

1. Low maintenance
2. Reliable water access
3. Increased water efficiency
4. Noise-free
5. Easy to install

X. CONCLUSION

In conclusion, the solar-based smart irrigation system project demonstrates significant benefits in terms of efficiency, cost-effectiveness, and environmental impact. By harnessing solar energy, the system reduces reliance on traditional power sources, thus lowering operational costs and minimizing carbon footprint. The integration of smart technology allows for precise water management, ultimately conserving water resources and optimizing crop field. This approach not only enhances agricultural productivity but also contributes to sustainable.

REFERENCE

[1] Dr. Narayan G. Hegde, “Water Scarcity and Security in India”, BAIF Development Research Foundation, Pune.
[2] Marvin T. Batte, “Changing computer use in agriculture: evidence from Ohio”, Computers and Electronics in Agriculture, Elsevier science publishers, vol. 47, 1–13, 2005
[3] Csótó, Magyar, “Information flow in agriculture – through new channels for improved effectiveness”, Journal of Agricultural Informatics 1 (2), 25–34, 2010
[4] Jin Shen, Song Jingling, Han Quian and Yang Yan, “A Remote Measurement and Control System for Greenhouse Based on GSM-SMS”, Electronic Measurement and Instruments, 2007. ICEMI '07. 8th International Conference
[5] Indu Gautam and S.R.N Reddy, “Innovative GSM based Remote Controlled Embedded System for Irrigation”, International Journal of Computer Applications Vol. 47 – No.13, June 2012