IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

# RENEWABLE ENERGY INTEGRATION INTO IOT BASED SMART AGRICULTURE

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***Abstract:*** Water is a critical input in agriculture in almost all aspects that have a determining effect on final performance. Good seeds and fertilizers fail to reach their full potential if plants are not optimally watered. Despite the scarcity of water, farmers are also facing an electricity crisis due to the increasing demand for electricity by the growing population. Solar based irrigation system offers the best solution for the above problem by using solar based soil moisture sensor. Solar energy is the best way for irrigation to overcome the problem of energy crisis. The solar panel will extract energy from the sun and convert it into electrical energy which is stored in the battery. Automatic irrigation using solar energy can be used efficiently for proper irrigation management. Proper irrigation increases the fertility rate of the field and can obtain maximum crop production by increasing yields and crop quality through better water management during critical stages of plant growth. The benefit of solar irrigation that uses a soil moisture sensor is that the field receives continuous water and the plants grow quickly. Proper water management helps to overcome the problem of water scarcity

***Index Terms* – Computing, Internet of Things, integration.**

## I. INTRODUCTION

For the development of the country, agriculture plays a fundamental role. Most of the land in the world is cultivated land, but it cannot be used properly due to lack of adequate knowledge or scarcity of water. Many lands depend on monsoon rains and due to the unfavorable season, crops grow late or dry out. Due to the intermittent nature of rainfall, farmers have to invest in water, which ultimately increases the cost of production. As we know, there is a lack of adequate market for agricultural products and it is not feasible to make large investments during production. In some places there is no problem of water scarcity, but due to poor water management, crops are dying and due to excessive flooding, crop production rate or land fertility decreases. Solar-based automatic irrigation, using a soil moisture sensor, helps maintain adequate water supply at equal time intervals, which will eliminate the problem of water shortage and excessive water usage throughout the system. automatic. To solve the water problem, many technologies have created many methods and types of irrigation systems. But in today's world the demand for fossil fuels is high and since they are not renewable, it is preferable to use renewable energy sources. For the problem of energy crisis and load shedding, solar energy is the best solution. In this system, automatic irrigation is carried out by detecting the humidity of the placed soil. The moisture sensor measures the volumetric moisture content or resistivity of the soil present. If the moisture content in the soil is less or the soil is dry, the pump will work and supply water. Here the microcontroller takes care of the controlling action and hence the controller is the heart of this system. In case of failure in the automatic system, the pump can also be operated manually using a switch that will not stop the irrigation system, but the only thing that is required is the presence of the farmer.

## II. LITERATURE SURVEY

Bangladesh's economy mainly depends on agriculture, which requires an innovative and reliable irrigation system. The limitations of conventional systems can be reformed by employing smart irrigation systems that will be IOT (Internet of Things) based and automated. This article offers the idea of smart irrigation and the following research conveys the idea. The smart watering process is done with the help of a soil moisture sensor placed next to the roots of the plants, as the plants need enough water for their roots, not for the surface of the soil, but the conventional system verifies the level of the earth's surface water and makes decisions about it. . Thus, as soon as the water reaches the roots of the plants, excess water reaches the soil in the form of waste. This system is completely based on IOT and solar panels are used for pollution-free power supply. To produce 1 kg of rice, the water savings in conventional irrigation is around 35%; However, this smart irrigation system can increase the water saving rate to 64%.

India has huge lands dedicated to agriculture, around 58% of the population depends directly or indirectly on agriculture; Therefore, agriculture plays an important role in the Indian economy. Now, due to huge climate changes, monsoons do not come on time, so an irrigation system is very necessary for regularity of agriculture. Irrigation increases agricultural efficiency and increases yield. This article focused on improving water management practices in irrigation that suffer from various operational deficiencies such as shadow loading. The conventional irrigation system runs on electricity and diesel, so a lot of conventional energy is wasted which can be easily replaced by solar energy. And automation in irrigation saves time, energy resources and, most importantly, water. The objective of this article is to present the literature review from conventional irrigation methods to recent trends in irrigation and automatic irrigation currently available in the market and some of which are in the research stage. This article will also review the comparison between solar irrigation and other energy based irrigation based on various parameters.

In today's technological world, electrical energy is vital. It is used in all facets of modern life and the global economy. There is an even greater imperative for poor countries to access affordable and reliable energy sources. A hybrid energy system combines different energies from many sources, usually renewable, and only requires a single connection point. This study analyzes a smart irrigation system based on a renewable hybrid energy system powered by off-grid wind and solar energy. An Arduino nano microcontroller controls this smart irrigation system, and this system automatically measures soil and water conditions (Irrigation) with a soil moisture sensor and pump motor. It also provides updates through a GSM-based IoT application. All this energy is stored in a battery for later use. The hybrid power generation system is designed using solar energy (generated by a 360-degree dual-axis solar tracker) and wind energy (generated by a Savonius vertical axis wind turbine). There are several prototypes on the market for the agricultural industry, and their prices were high and low depending on the applications. Therefore, taking into account all these conditions, this system is designed. The main objective of this research is to help the farmer by using this renewable energy based hybrid smart irrigation system and reduce the pressure on the use of commercially generated electricity in agriculture.

## III. DESIGN AND IMPLEMENTATION

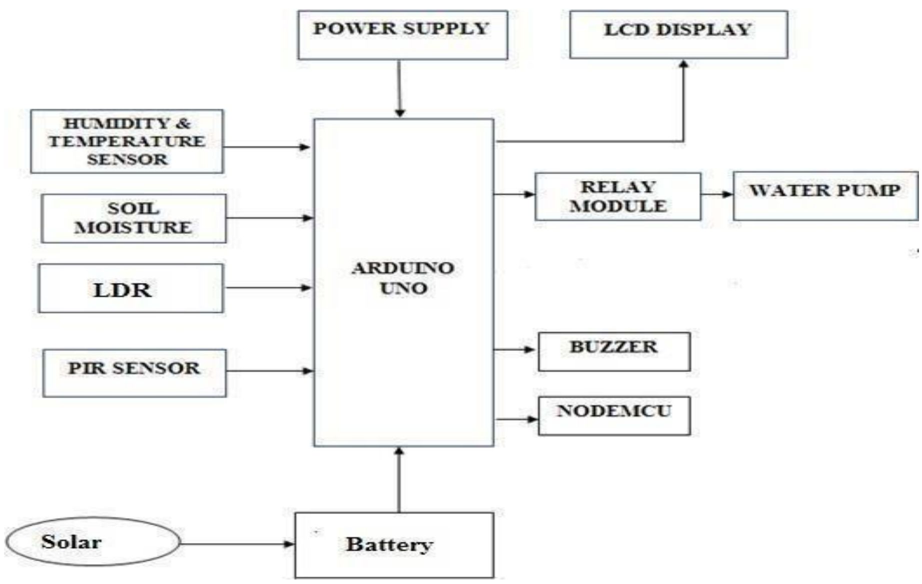


Figure.1: Block diagram of proposed system

To implement the proposed work, we require proper system planning. The implementation of automated systems in agriculture has successfully helped reduce costs. The implementation of the automated system helped revolutionize irrigation. Therefore, this project has been a method based on field observation systems for the detection of dryness, both for experts and non-experts. Furthermore, the final beneficiaries of the project are the farmers who are the backbone of our country. The operation of this system includes the use of the device in an automatic and controlled manner through the mobile application. For this type of classic design and knowing the requirements is the first step. We need to know the advantages and disadvantages of previous studies on automatic plant irrigation systems, we will begin to implement the design and automation methodology to make it viable.

System Design: Define the requirements and specifications of the smart irrigation system. Design the system architecture, considering the integration of Arduino, sensors, relay, water pump, Node MCU, and other components. Sensor Calibration: Calibration of soil moisture sensors, humidity sensors, and LDR sensors to ensure accurate the readings based on specific environmental conditions of the target agricultural area. Arduino Programming: Develop Arduino code to read the data from sensors and make the decisions based on predefined algorithms. Implement control logic for the water pump and relay to regulate irrigation based on sensor inputs. Intruder Detection Logic: Implement logic for the IR sensor to detect the intruders. Define actions to be taken upon intruder detection, such as activating alarms or sending notifications. LCD Display Integration: Interface the LCD display with Arduino to provide the real-time information on soil moisture levels, humidity, system status, and other relevant data. Communication with Node MCU: Program the Node MCU to establish a Wi-Fi connection and enable communication with the central server or cloud platform. Develop logic for sending messages and alerts to the farmers based on system events, such as low battery levels or irrigation completion. Solar Panel and Battery Integration: Connect the solar panel to a charge controller and battery to manage the charging and discharging cycles. Develop power management logic to ensure the efficient use of energy and prevent overcharging or deep discharge of the battery. Relay and Water Pump Control: Interface the relay with Arduino to control the water pump based on soil moisture levels and other environmental parameters. Implement fail-safe mechanisms to prevent the over-irrigation or pump damage. Remote Monitoring Setup: Establish a secure and reliable connection between Node MCU and a central server for remote monitoring and control. Implement the encryption and authentication protocols to ensure data security. User Interface Design: Design a user-friendly interface for the LCD display and Node MCU, providing farmers with a easy access to essential information and control options. Deployment: Install the Solar-Based Smart Irrigation System in the target agricultural area. Provide training to the farmers on system operation, maintenance, and troubleshooting. Monitoring and Maintenance: Implement a monitoring system to track the performance of the smart irrigation system remotely. Establish a maintenance schedule for regular cleaning, sensor calibration, and the software updates.

## IV. RESULTS AND DISCUSSION

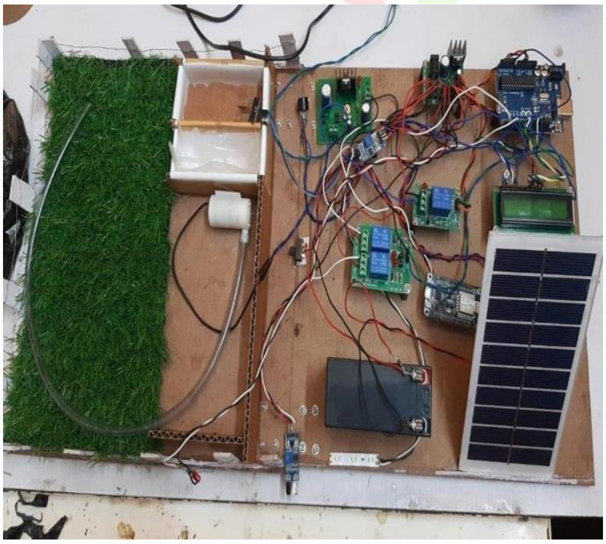

Figure 2: Hardware of the project

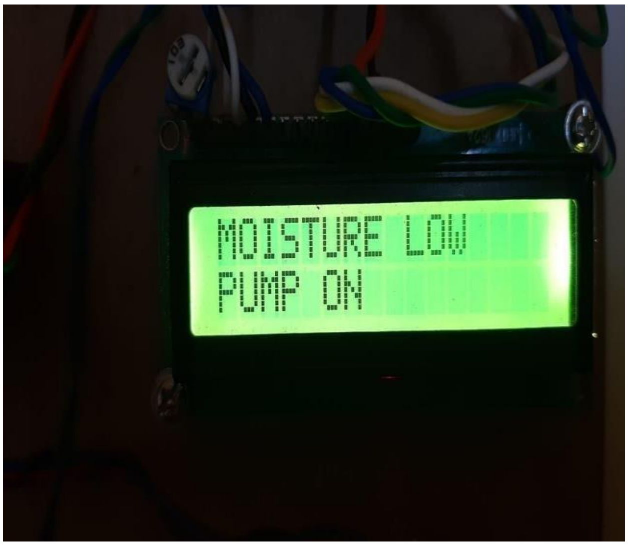


Figure 3:Moisture and pump status

In our work, numerous studies on smart agriculture have been made. From a big data perspective, the authors of covered the state of the art in SA systems. His efforts were aimed at bringing big data processing to SA. Besides, The authors provided a detailed history of the various agricultural systems. He demonstrated how SA could use a variety of data sources to fully utilize the information and communication technology (ICT). Smart Relays (Sonoff with Built-in ESP8266 Wi-Fi Method Maximizes Crop Yield by Conserving Water and Energy The card is the wireless actuator nodes that we used to operate. the water pumps. These are WiFi based wireless smart devices switches that can work with a variety of appliances. They They operate with an AC voltage range of 90 to 250 volts and a 2.4GHz wireless frequency. We choose to use this smart switch as it is affordable, reliable and has a Integrated Wi-Fi module. Additionally, as the Wi-Fi connection may not be available, ensuring contact with the BDAP. Us improved the control and data collection unit by replacing a normal 5V relay coupled to an Arduino Nano Microcontroller equipped with a GSM/GPRS module or a Zigbee Module for Sonoff Smart Relay Module

## V. CONCLUSION

The implemented smart irrigation system is profitable to optimize water resources for agricultural production. The proposed system can be used to turn the water sprinkler on/off depending on the soil moisture levels, thus simplifying the use of the process. Through this project it can be concluded that there can be considerable development in irrigation. Thus, this system is a solution to the problems faced by the existing irrigation process. Therefore, by implementing the automatic irrigation system, adequate irrigation is carried out that maximizes crop productivity. The scarcity or deficiency of water in the field is controlled and regular irrigation is carried out. When implementing manual switching, we use the pump to supply water. The pump is also used to fill the tank and during soil cultivation. Additionally, it helps operate the irrigation system if any short circuit or failure occurs in the automation system. The solar panel used here helps to overcome the problem of energy crisis and is used by the user as an alternative subsidy in case of damage to the battery or on cloudy days, where the battery is not charged enough. Our idea works successfully.

## VI. ACKNOWLEDGMENT

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