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# Performance Evaluation of IoT enabled Green Irrigation System (GIIS) for Agriculture and Gardening Field

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***Abstract: The major problem in the world is the scarcity of water. Being an agriculture centric country, the water resources available in India are exhausting, which is a perilous threat. All over world, agriculture is a demanding field that provides vast number of jobs. Large amount of water is consumed by agriculture field. However, wastage of water in agriculture field is unavoidable. Daily greenhouse operation involves watering the plant which is the important cultural practice and labour-intensive tasks. People enjoy to plant trees, maintain gardening, getting their benefits and feeling related to nurturing them nowadays. Keeping the environment healthy, cleaning air naturally and producing oxygen are the aspects in which plants are helpful to all human beings. These aspects motivate to design smart and effective automatic IoT enabled Green Innovative Irrigation System for farming or gardening. To address the issues related to watering the plants daily for those who cannot water the plant due to their busy schedule or when they go outside for long time, this proposed system is helpful. ATMEGA 328 microcontroller is used in this system to programme to receive the input signal of varying moisture condition of the soil through the sensing arrangement. It also indicates the temperature level of the soil, water tank overflow as well as low water level in the water tank and automatic motor ON/OFF facility and watering the plants along with specified amount of fertilizer additionally. All the activities are monitored and reported to the user mobile using GSM mobile application.***

***Keywords: ATMEGA 328 microcontroller, Plant Irrigation, Humidity/Soil Moisture Sensor, Temperature Sensor.***

## 1. INTRODUCTION

Agriculture is the main living source of majority of the Indians and it also has a countless influence on economy of the country [11]. Watering the plants or garden is the most important daily practice and the most labour-intensive task in farming and gardening [3]. More often water is wasted in large amount while watering with a hose or oscillator. Two important aspects need to be considered while by this way of manual watering: when and how much to water [1]. In order to make the plants grow well, plants need to be watered twice a day, morning and evening. As people are busy with day-to-day activities, they forget to water their plants. It is a challenging task for them to keep their plants healthy and alive [4]. In addition, shortage of water is a main concern for farmers since it is a challenge them to maintain their fields/garden.

Scarcity of water resources is the problem in all over world. Most of the farmers depend on ground water for cultivating crops. As the ground water needs to be pumped with motor, the power supply plays a vital role. Since power cuts are common in villages, cultivation using ground water requires constant human presence to switch on the motor pump and wait until the field is properly watered. This process forces them to stop doing other activities, and results in waste of time and effort. [8]. Though, agriculture field consumes large amount of water, it is a challenging task for farmers/gardeners to maintain their fields properly and manage watering of plants during shortage of water. Appropriate irrigation system needs to be used to achieve maximum yield since the main reason is the deficiency of land reserved water due to lack of rain. Therefore, there is a need of technology in the irrigation system. The proposed Green Innovative Irrigation System aims to implement a simple, smart, effective system, which is automatically irrigate water to the plants or crop with minimal human intervention.

## 2. REVIEW OF LITERATURE

Abhishek Gupta et.al (2016) have proposed Automatic Plant Watering System. The research work is helpful to regulate the water supply and the field to be irrigated using PIC16F877A microcontroller. The moisture level of the soil is detected using the microcontroller and water is supplied if the required moisture is not present using Darlington amplifier[2]. The researchers adopted an incompetent but economic method by measuring the voltage between the conductors. Divani et.al (2016) have propsed Automated Plant Watering System [4]. Here, threshold value is more important for maintaining plant's sustainability. When it goes down than the predicted value,at that point adequate amount of water should be supply to the plants as long as it hits the threshold value.

Bishnu et.al (2017) have proposed Microcontroller Based Automatic Plant Irrigation System [5].This research work has proposed an automatic irrigation system using ATMEGA 328 microcontroller which is helpful to turn ON/OFF the pump depending upon the humidity level of the soil. Additionally, this work used temperature sensor and GSM module, which is very much helpful to indicate moisture level, temperature level through mobile phone using GSM module.Devika et.al (2017) have proposed Automatic Plant Irrigation System using Arduino [7]. The authors havedesigned and constructed automatic plant irrigation system.This system is helpful to monitor moisture level of the soil and meet the water requirement in a fruitful manner. The authors tested this system on two different types soil such as wet and dry, but it worked properly when the soil condition is dry.

Varsha et.al (2018) have suggested Smartphone based Automatic Irrigation System [9]. This innovative mechanism detects the plant's necessities and it has a potential to supply sufficient level of liquid to the plants instinctively. It follows the succeeding method to ensure the threshold value conservation. The motor force to turn on when it senses the high threshold value and vice versa. Rajkumar et.al (2018) have generate the mechanism of Arduino- automatic plant watering system, which is act like a complete aid of farmers. Here, the authors machineries notice the lower moisture range than the specified value.As soon as it sense the lesser signal,it activates the Arduino board which stimulates the water pumps (or) motor to start and yield the water to the plant and the motor stops when the expected level is reached.

Sajid et.al (2019) have suggested Automatic Plant Irrigation System [11]. In this research work, authors proposed an automation of farm irrigation. Soil moisture level is identifiedusing Arduino, Soilmoisture sensor and L293D module. This irrigation system senses themoisture level of the soil and automatically switches the pump when thepower is on.Yin Yin Nu et.al (2019) have proposed Automatic Plant Watering System using Arduino UNO for University Park [12]. This proposedresearch work utilized Arduino UNO board, which consists of ATmega328 microcontroller. It is programmed to sense the moisturelevel of the plants and supply the water if required.

Laura et.al (2020) have proposed IoT-Based Smart Irrigation Systems. Authors presented an overview ofrecent trends on sensors and IoT enabled system forirrigation process in precision agriculture [13]. Authors have described the existence implications of smart irrigation system. They mainly concentrated on the constraints of water measurement and its level of superiority, soil features along with climate status. The proposed system presented a four-layer framework for crop irrigation management. They described the implementation of nodes in the strategic framework in wireless technology settings. The author indented to progress the smart irrigation system in order to examine the water quality which is rendering to the proposed work.

Santhana et.al (2020) have suggested Fuzzy Logic based Smart Irrigation System using Internet of Things [14]. The author presented athoroughstudy on the basic needs of the plants. They also cover the parameters such as soil, biological conservational strategies.Significantly,the proposed framework preserves the power supply in the midst ofrain. Theauthors compared their proposed work with some of the existing work such as drip irrigation and manual flooding, among the results, the proposed work gives the better outcome.

There are various plant irrigation systems existing. However, each technique existing in irrigation system has its own advantages and limitations. There is no combined solution existing for plant irrigation system like automatic watering, fertilizer feeding, water tank monitoring, temperature monitoring, etc. Hence, it is motivated us to design smart and effective automatic IoT enabled Green Innovative Irrigation System for farming or gardening.

## 3. PROPOSED GREEN INNOVATIVE IRRIGATION SYSTEM (PGIIS)

This proposed system uses ATMEGA 328 microcontroller which is programmed to receive the input signal based on the fluctuating soil moisture levels by the framework of detection settings. It is very captivating signal transfer occurs while the soil humidity sensor detects the very lower value of soil moisture content. The proposed framework stimulates the microcontroller through its alarm signal, subsequently, the microcontroller stretches its sign to GSM Component. At last, GSM directly communicate the user mobile by text message.

. The user turns the pump/motor ON/OFF using their mobile phone which is located far away from the paddy land or garden. The overall activity is reported to the user mobile using mobile application.Temperature sensor is used in this system to record the atmospheric temperature. The proposed Green Innovative Irrigation System is designed in such a way that it reminds the user to add water to the tank as well as overflow indication. Additionally, this system is designed to watering the plants along with specified amount of fertilizer.This proposed system is helpful to the farmers or gardeners to reduce their work pressure. This system is very much useful to the farmers to save their valuable time and yield more crops. Certainly, it will be helpful to the farmers for improving their economicstatus. Additionally,

this proposed Green Innovative Irrigation System requires the minimum quantity of water for the irrigation work.

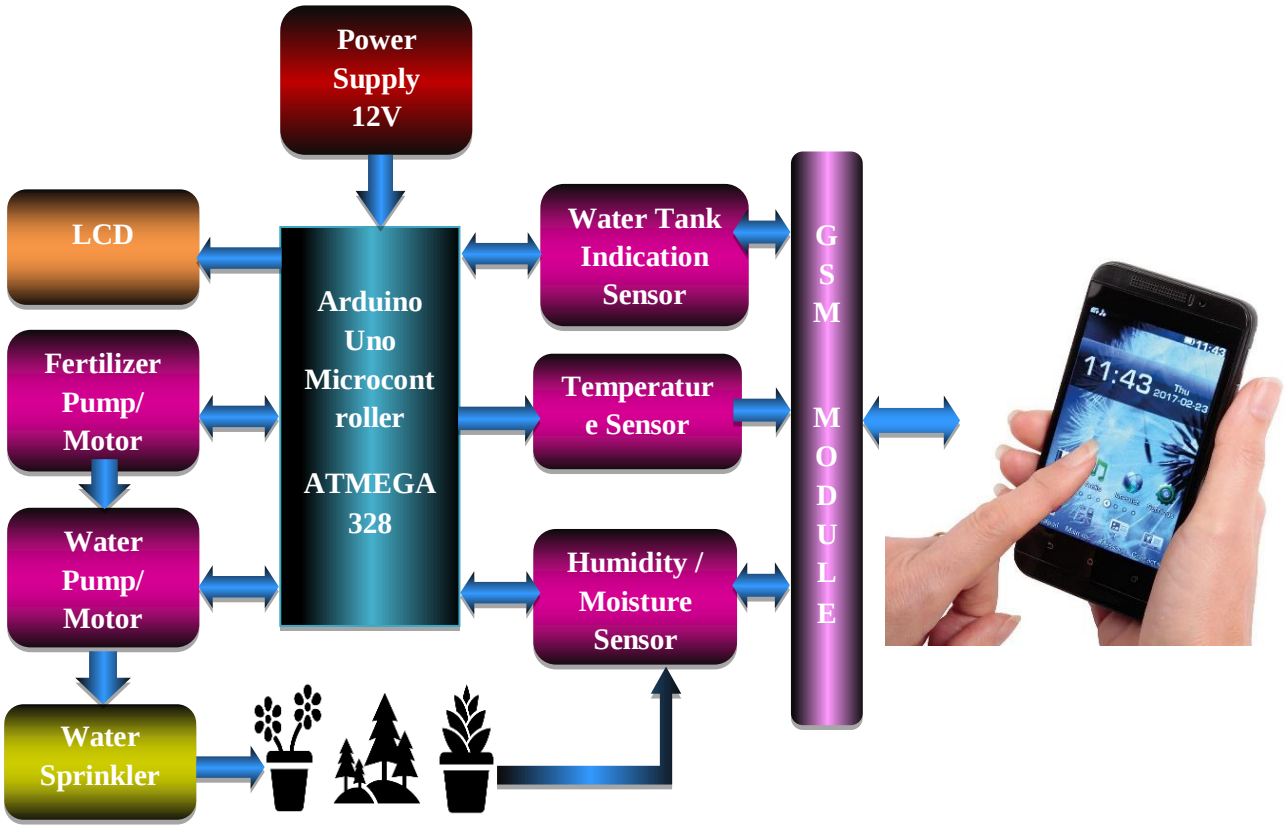


Figure 1. Proposed Architecture for Green Innovative Irrigation System

## 4. PROPOSED METHODOLOGY

There are sevenfunctional components existing in the proposed IoT enabled Green Innovative Irrigation System. They are:

### 4.1. FUNCTIONAL COMPONENTS OF PGIIS

#### *4.1.1. Arduino Uno (Atmega328)*

Arduino board is programmed with the Arduino IDE software. ATmega328 microcontroller plays a vital role in the proposed system. Here, the framework is designed by connecting microcontroller's input pin directly tothe Humidity/soil moisture sensor, temperature sensor and water tank indication sensors, on the other side, the output pin is connected to the multiplexed Pump and fertilizer.

#### *4.1.2. Humidity/Soil Moisture Sensor*

The humidity moisture sensor is useful for sensing the moisture level of the soil and indicate the signal to the microcontroller. Using GSM module this signal sends to the user mobile.

#### *4.1.3. Temperature Sensor*

Temperature sensor is helpful to record the atmospheric temperature and send the detail to user mobile.

#### *4.1.4. Automatic Water Irrigation*

The plant growth is estimated by moisture level in the soil. Automatic water irrigation system helps the farmers to sustain the fluidity in the land. It gives an alarm to the user when soil moisture value goes down than the predefined limit. Most of the plants grow best with relative humidity of over 50% [16]. If the user tries toclickthe ON button water irrigation process started automaticallyuntil the sensor meets its threshold value.

#### *4.1.5. Water Tank Indication Sensor*

This sensor is used to gives the safety precautions message to the userwhich is intended to water level in the tank. User can use these mobile notifications for the Tank water level maintenance to avoid the excess water flow.

#### *4.1.6. Fertilizer*

Fertilizer component in the proposed system plays a vital role to feed fertilizer to the plants automatically when the user switch on the button. In this process fertilizer directly addedspecified amount along with water irrigation pump and feed fertilizer to the plants.

#### *4.1.7. GSM Component*

The proposed system is directly associated to a communication device namely called GSM component. Some of them are like mobiles, satellite devices, modemsto activate the remotedata or symbolize the status of moisture level, climate condition, water tank level, adding fertilizer and water irrigation.

## 5. SYSTEM IMPLEMENTATION AND PERFORMANCE EVALUATION

The proposed research work has been implemented using ATMEGA 328 microcontroller, Arduino programming, Humidity sensor, Temperature sensor and Android supported GSM module. Figure 2 shows proposed green innovative irrigation system's hardware setup.

Figure 2. PGIIS Setup

System implementation of PGIIS is shown in figure3. The results are obtained from the user's Android mobile phone.

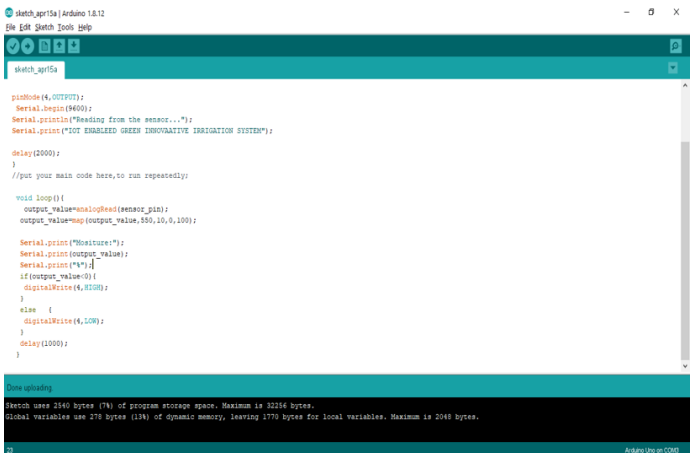


Figure 3. System Implementation

Figure 4. shows that humidity measurement level recorded within 10 days. The obtained result shows that the proposed GII system effectively sends the moisture level of the soil to the user mobile consistently. Figure 5. represents that temperature level of the atmosphere within 10 days. This result shows that the proposed GII system consistently generates accurate result as compared with Tiruchirappalli weather report [15]. Figure 6. Demonstrated that the water consumption level of different irrigation systems like Manual Irrigation, Drip Irrigation and Proposed GII system. The result shows that the proposed GII system requires less amount of water than existing irrigation systems.

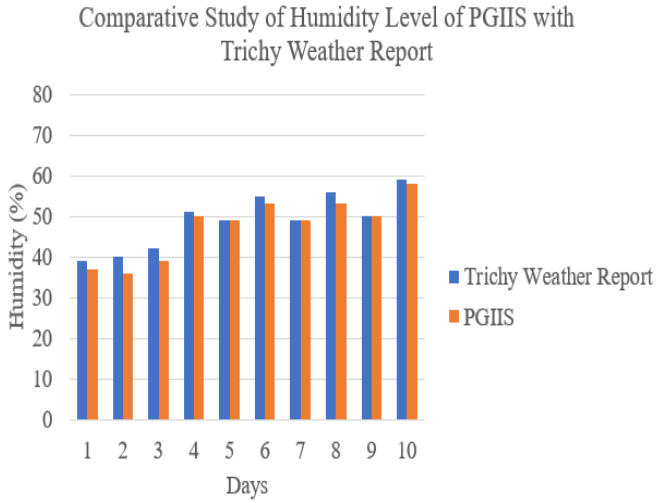


Figure 4. Humidity Level of the Soil within 10 days

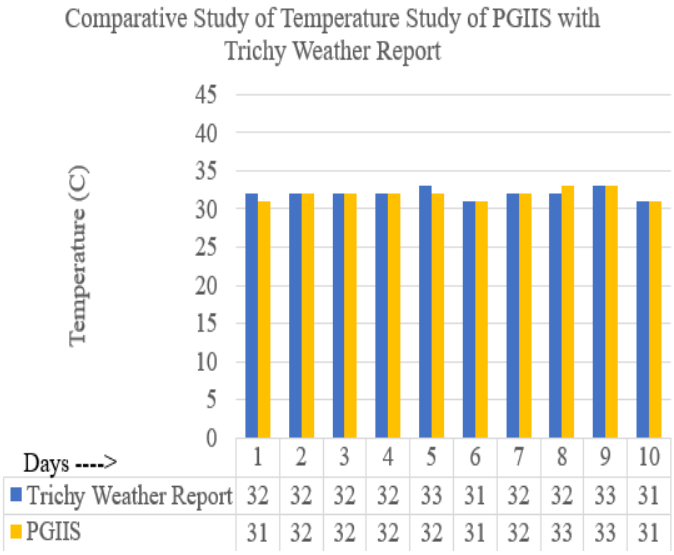


Figure 5. Temperature Study of PGIIS with Trichy Weather Report

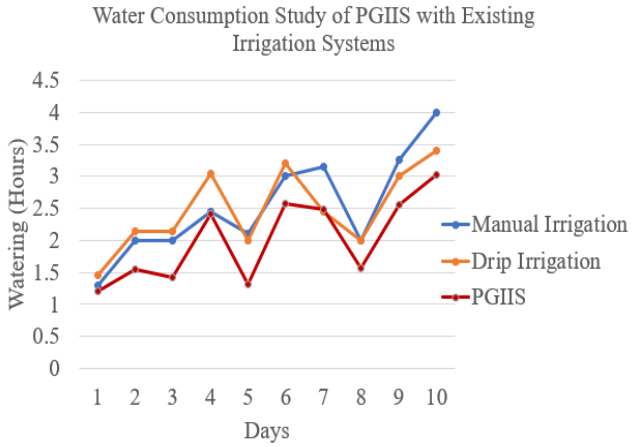


Figure 6. Water Consumption Study of PGIIS with Existing Irrigation Systems

## 6. CONCLUSION

This proposed system uses ATMEGA 328 microcontroller which is programmed to receive the input signal of varying moisture condition, temperature condition and water level of the water tank through the sensing arrangement. The proposed GII system will check again and again about the humidity/soil moisture and temperature in a periodic interval to indicate the user related to water irrigation, fertilization, etc. when the humidity/soil moisture value goes low than the specified threshold value GII system will send the information to the to mobile of the user. Now the user can press ON button to start water irrigation process. When the threshold value is met the irrigation process will end. The proposed system automatically identifies low water tank level, and switches on the motor to pump water to the tank. When the water tank is filled, the motor is turned off automatically. The fertilizer component can be used if there is a need to fertilize the plants. The overall activity is reported to the user mobile using mobile application. The obtained result represents that PGIIS provides consistently & effectively sends the signals about Humidity level, Temperature level. Additionally, it consumes less amount of water during irrigation work.

This project can be extended to test performance, effectiveness based on water tank indication and fertilizer monitoring. Further, PGIIS can be implemented in a large area with a greater number of moist sensors, temperature sensors and powerful motor.

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