# Solar Based Automatic Irrigation System with GSM Module

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*Abstract*— **In this investigation, the traditional irrigation system of Bangladesh has been modernized using recent technology for the betterment of rural farmers, and its impact upon agricultural development has been discussed. More precisely, user-friendly watering in the field, along with reducing labor cost, standardization of farming system, using technical advancement to meet the peak demand for food, and improving farming methods are the key objectives. ATmega 2560 microcontroller, Sensors, GSM module, LCD, and Solenoid valve has been used as a prime component. Temperature, humidity, and water level corresponding to a particular field has been measured. That information has been sent to its user through a short message service. Finally, the pump has been controlled based on the water requirement. As a result, a certain amount of water and electricity can be saved, which has been calculated. Manual and automatic operation mode also substantiated.**

***Keywords— irrigation system; ATmega 2560 microcontroller; sensors; GSM module;***

## I. INTRODUCTION

Agriculture based economy could lead a country towards an economically independent nation. Undoubtedly, Bangladesh is an agricultural country, and its economy depends on farming. One of the essential elements for successful farming is to make available of enough supply of water in time. Deficiency of rainfall, inadequate surface water, dried of rivers due to the water barricade on the river flow from the sources reduces the availability of the water on the firming land. As a result, expected production is not possible from the cultivating lands, and it requires an alternative water irrigation system.

The traditional water irrigation system uses shallow tubewells, deep tubewells, hand tubewells, and low-lift pumps. Advancement of technology introduces high-quality electric pumps, solar pumps in the water irrigation system. The infrastructure development company of Bangladesh is planning to install around 50,000 solar pumps by 2025 [1].

The traditional water irrigation system is not well planned, which in turn, waste a considerable amount of water. Almost 5% to 13% of water, which is in some cases about 45%, wasted in the traditional water irrigation system reported in [2]

Technological development takes place in every sphere of life. Many developed and developing countries are trying to establish a correlation between technology and agriculture. In this perspective, some previous work done by Prof. Rupali S. Sawant et al. (2015) [3], R. Subalakshmi et al. (2016) [4], M. A. Murtaza et al. (2017) [5] are praiseworthy.

Water supply isn't the only vital factor during farming, as it is also depended upon temperature, humidity, and water level demand for different stages of crops. Staple food like Boro (rice) requires diverse water quantity during its growing period from 1-140 days that varies between 0 cm- 7 cm [6].

Optimizing previous works, it's quite clear that those works depended on soil moisture sensors [3-5]. Practically, most of the cultivators in Bangladesh are watering the lands after watching the waterline of the field.

Addressing the issues stated, a solar-based automatic irrigation system having a GSM module for smart communication is presented in this paper. This project uses renewable sources of energy, could save wasting water, and makes it possible for automatic control of the system. As a result, it is a right candidate for the industry 4.0 revolution.

## II. DESCRIPTION OF THE SYSTEM

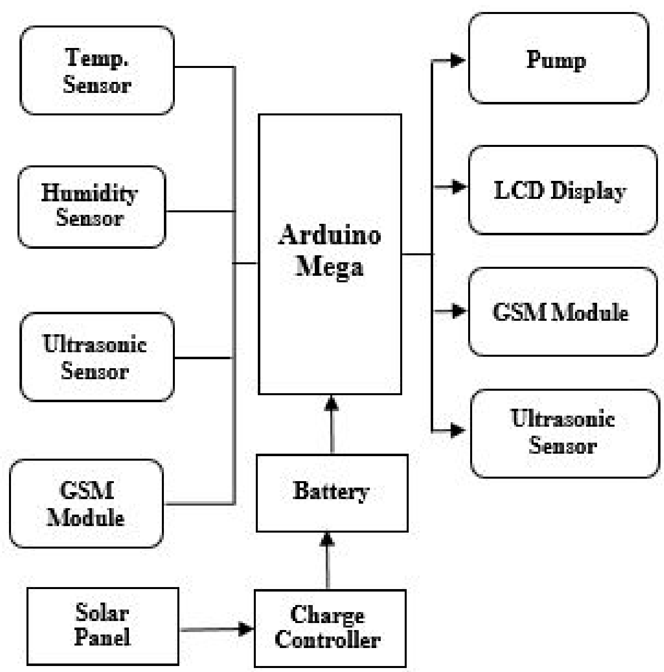


Fig. 1. Block Diagram of the System.

System block diagram represented in Fig. 1 which is divided into two parts. One is an electrical part, and another is mechanical part. Considering renewable growth, polycrystalline solar panel included. Therefore, it is electrical

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part of power supplier. Solar charge controller regulates voltage and current from solar to charge the battery.

Apart from this, the mechanical part consists of ultrasonic sensor, temperature and humidity sensor, GSM module, solenoid valve, etc. These sensors provide information to Arduino mega 2560, their output related to LCD, and responsible for sending sms through GSM module. Both GSM and ultrasonic sensor has two pin receiver and transmitter.That's why interference of both shown in input and output with Arduino. Each step visualized through LCD.

## III. Flow Chart

The flowchart of the whole system shown in Fig. 2. This system starts when supply is given. At first, it initializes all modules, sets GSM module to text mode, and sets the mobile number of the user. Then, the DHT11 measures the temperature and humidity and shown them on display. Ultrasonic sensor stands in a predefined height. It measures distance from that height to surface of water. Arduino compares the level of water with required water level. If the water level is less than required level, the motor will start automatically. Pump will go off when required line is found. If the alignment of water is more than required, then it goes to next step. In which there is a chance of changing water level to user if he thinks that he needs more water for any reason. Otherwise, the system will run automatically and will run in this loop.

## IV. Circuit Diagram

Pulse width modulation (PWM) algorithm implemented in the project because of its feasibility. Typical arrangement of circuit diagram shown in Fig. 3. All the peripherals controlled by ATmega2560. LCD connected to the SDA and SCL pin via I2C connector. On the other hand, ultrasonic sensor related to pin number 6 and 7. Pin number 6 & 7 are relevant with Trig pin & Echo pin respectively.

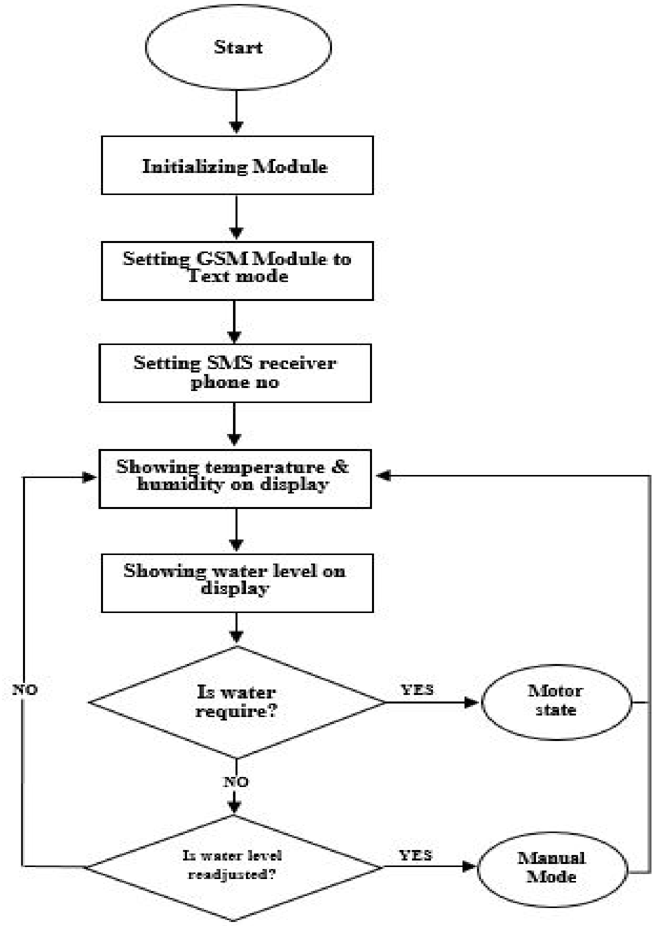


Fig. 2. Flow Chart of the System.

A relation established between data pin of DHT11 & pin no A0. So that, measurement of temperature and humidity can be obtained from selected DHT11. Henceforth, RX & TX pin of

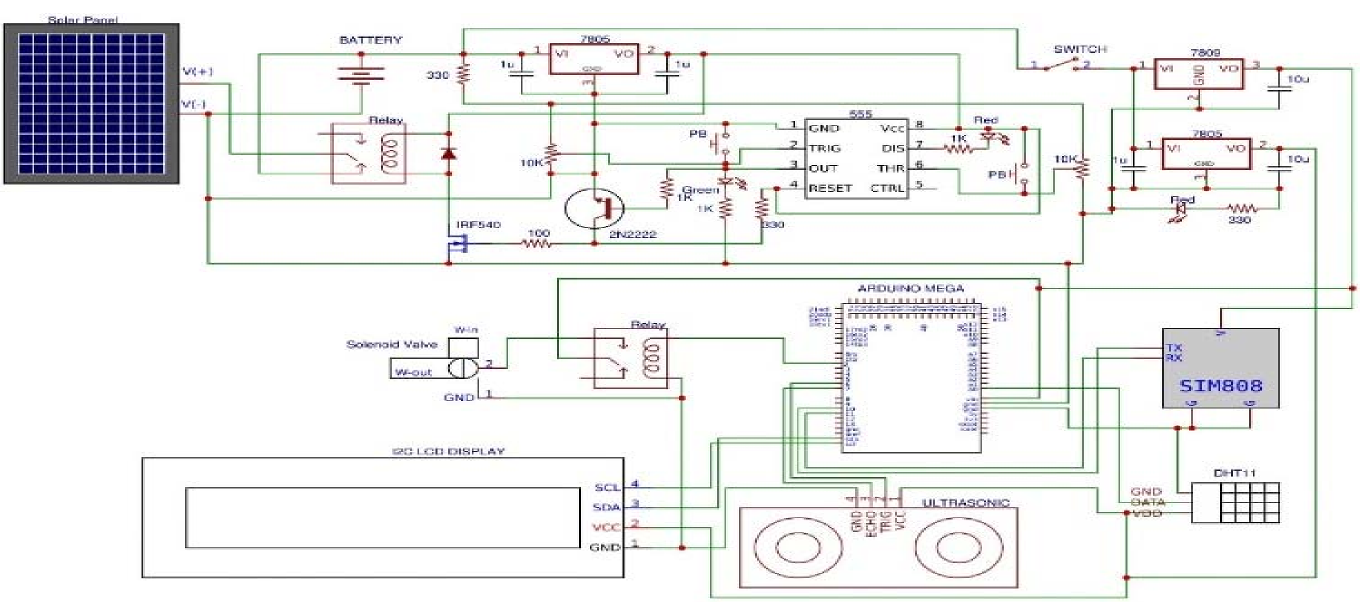


Fig. 3. Schematic Diagram of the System.

GSM module SIM808 is related to pin no 11 and 10 respectively. The transmit pin of GSM module is wired between receiver pin of Arduino and vice versa. Solenoid valve is connected with pin no 2 through a transistor 2N2222. This transistor acts as a switch. Charge controller 7805 and 7809 responsible for fixed dc supply based on particular demand such as 5 $V$ and 9 $V$ respectively. Solar charge controller consists of 555 timer, transistor, MOSFET and relay coil. 555 timer operates in "Astable mode" for continuous low and high output. When output goes low, transistor and MOSFET are open, charging starts. Conversely, transistor and MOSFET become closed, and relay coil operates if output goes high.

## V. Result & Analysis

### A. Figures & Table

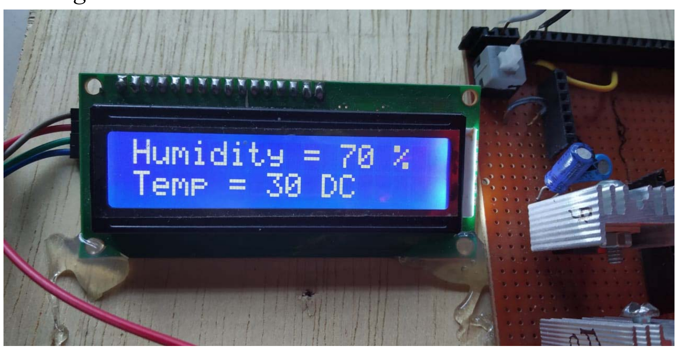


Fig.4.1 Humidity and temperature value.

Firstly, installed program shows a brief introduction of university, department, and project. DHT11 measures temperature and humidity, and their measurement is shown in Fig. 4.1.

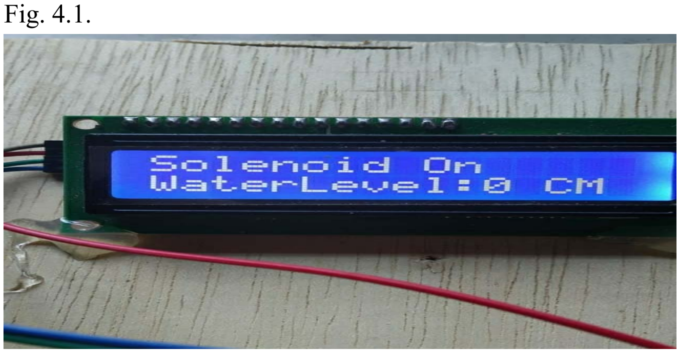


Fig.4.2 Initial water level and motor condition.

Ultrasonic sensor determines water level. During the experiment, water level was 0 *cm* and observed motor condition shown in Fig. 4.2.


Fig. 4.3 Confirmation of sending sms.

Fig. 4.3 shows short message sent to user when solenoid was ON.


Fig.4.4 Increasing water level.

Since there was no water. Consequently, solenoid switched ON and water level had been stepping up from 0 *cm* to 2 *cm* gradually.


Fig.4.5 Water level is reached to 7 *cm*.

After a while, water level was reached to the peak.


Fig.4.6 Solenoid turned OFF when required water level acquired.

Thus, Solenoid turned OFF represented in Fig.4.6


Fig.4.7 message sent to user.

It's quite obvious that user has to know when the motor turns ON & OFF. So, short message sending takes place one more time shown in Fig. 4.7


Fig. 4.8 when water level is 5 *cm*, solenoid will turn on again.

Practically, the amount of water will curtail due to absorption. Let's assume, lands water becomes 5 *cm* after a single day. In such case, watering requires one more time. Moreover, solenoid turned on automatically shown in Fig.4.8.

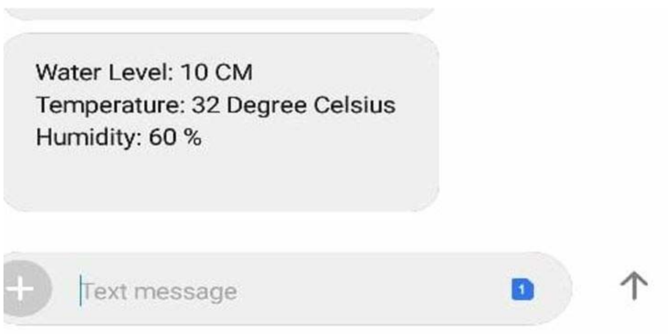


Fig. 4.9 example of short message service.

A typical text message received by a user would be like that shown in Fig. 4.9.

TABLE I. REQUIRED WATER PER DAY FOR RICE (BORO) [6]

| Day No | Required water Level |
|---|---|
| 1-40 | No water |
| 41-50/55 | 2-3 CM |
| 55-85 | 2-3 CM |
| 85-115 | 3-4 CM |
| 115-130 | 5-7 CM |
| 130-150 | No water |

Among diverse rice species, 'Boro' considered here for calculation purpose.

### *B. Calculation*

Let, an area is 42 Decimal whose length=168 *ft.*, width=108 *ft.*
If watering takes place once within two days,
Single day water requirement (3 *cm*, 5 *cm*) = 50569 *l*, 84270 *l*
According to water level demand, quantity of water required within the period 41 to 115 (75 days) and 115 to 130 (15days) should be 1921622 *l*, 1264050 *l* respectively
Total demand = (1921622 + 1264050) *l* = 3185672 *l*
Assume a pump namely Gazi water pump (THF-6C) which ratings 1.50 *hp* 1.12 *kw*, capacity 900 *l/min*.
Energy requirement = (1.12*59) *kWh* =66.08 *kWh*

In traditional system,
4000 *l* water requires per kg production of rice.
After calculation, energy demand 87.36 *kWh.*
Thus, 21.28 *kWh* energy, 1014328 *l* of water won't waste.

## VI. LIMITATIONS

A possibility may arise to include 'Solar tracking system'. Unfortunately, it'll make project complex. Hence, it's devoid. Solenoid valve in place of motor and use a reserve source of water. Initial installation costs relatively high, though it has no maintenance cost. Lack of alternative power sources except 'Solar panel' appeared. So far, watering procedure will stop if the panel damage or broken, or, cannot charge the battery during cloudy, foggy weather conditions except Dye-Sensitized Solar Cell (DSSC). Considering rainy season, an invention of a new type panel may introduce in international market which can produce electricity using the motion of raindrops. The maintenance of sensors and other equipment's are sensitive.

## VII. FUTURE WORK

Solar tracking system can generate more electricity. Implementation of such feature into circuit could be a good choice. This project is useful in every type of land. Due to that reason, required day can be known for that crop and those days can be counted through coding. After ending of a season, the whole coding system can be reset, and usable more than once. After all, our country is developing in ICT sector. If any organization is forwarding with the collaboration of ICT and Ministry of Agriculture, then it can be very helpful to run system.

## VIII. CONCLUSION

The main purpose of this project is to maintain a well-planned irrigation system and save water. The aim of using solar panel is to ensure a farmer not to depend on grid electricity for his pump. It is flexible for a farmer to monitor, control and operate. Project aims have been successfully fulfilled with the implementation of the prototype.

## IX. REFERENCES


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