Tarang Wireless Network for Monitoring and Controlling Greenhouse

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Abstract: The increasing demands for crop production and quality have significantly increased the utilization of high quality and productivity green houses. Modern greenhouses are nowadays having great sizes and they are equipped with sophisticated monitoring and controlled actuation systems to assure maximum productivity and provide value-added quality. The aim of this paper is to present a novel wireless sensor network based Trarng technology for monitoring and controlling greenhouse climate. The system consists of a number of local stations and a central station. The local stations are used to measure the environmental parameters and to control the operation of controlled actuators to maintain climate parameters at predefined set points. For each local station a Arduino Microcontroller is used to store the instant values of the environmental parameters, send them to the central station and receive the control signals that are required for the operation of the actuators. The communication between the local stations and the central station is achieved via Tarang wireless modules. This transmitter module will be transmitting sensor values to receiver side. These values will be sent as serial alerts. In the receiver side either serial alert will be received and displayed on LCD. The receiver module is also having relay circuits connected to it. Whenever the serial alert is received the relay will gets ON the subsequent request of serial alert. The below code represents the transmitter and receiver sides implementation functionality.

***Index Terms* – Arduino, Tarang wireless module, LCD.**

I. INTRODUCTION

Antennas are used to transmit and receive information through changes in the electromagnetic fields that surround them. For spacecraft or aircrafts applications based on the specifications such as size, weight, cost, performance, ease of installation, etc. low-profile antennas are preferred. These antennas are known as rectangular microstrip antennas or patch antennas; they only require space for the feed line which is normally placed behind the ground plane. The major disadvantage of using these antennas is their inefficient and very narrow bandwidth, which is typically a fraction of a percent or, at the most, a few percent. A Planar Inverted-F Antenna can be considered as a type of linear Inverted F antenna (IFA) in which the wire radiating element is replaced by a plate to increase the bandwidth. The advantage of these antennas is that they can be hidden into the housing of the mobile when compared to different types of antennas like a whip, rod or helical antennas, etc. The other advantage is that they can reduce the backward radiation towards the top of the antenna by absorbing power, which enhances the efficiency. They provide high gain in both horizontal and vertical states. This feature is most important for any kind of antennas used in wireless communications.

1.1 TARANG Antenna

Tarang-P20 FCC Compliance

This device complies with Part 15 of the FCC rules. Operation is subject to following two conditions:

1. This device may not cause harmful interference and
2. This device must accept any interference received including interference that may cause undesired operation of this device.

The changes or modifications not expressly approved by the party responsible for Compliance could void the user's authority to operate the equipment. To comply with the FCC RF exposure compliance requirements, this device and its antenna must not be co-located or operating to conjunction with any other antenna or transmitter, except if installed in compliance with FCC Multi Transmitter procedures.

To OEM Installer

1. The Original Equipment Manufacturer (OEM) must ensure that FCC labeling requirements aremet. This includes a clearly visible label on the outside of the OEM enclosure specifying "Contains FCC ID: N3Y-TARANG-P20" or "Contains transmitter Module FCC ID: N3Y-TARANG-P20".
2. In the user manual, final system integrator must ensure that there is no instruction provided to install or remove the transmitter module.
3. Transmitter module must be installed and used in strict accordance with the Manufacturer's Instructions as described in the user documentation that comes with the product.The user manual of the final host system must contain the following statements:

This device complies with Part 15 of the FCC rules. Operation is subject to following two conditions:

1. This device may not cause harmful interference and Tarang P User Manual Page 4 of 17.
2. This device must accept any interference received including interference that may cause Undesired operation of this device. The changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Fig. 1 Tarang Module

II. LITERATURE SURVEY

Nowadays, few of the irrigation systems are operated by people manually, few are automatically monitored and operated. So, the present systems mostly depend on Computer based, Low and high technological principles as well as Real time based. These projects are not much cost effective or are not cost-centered. But still some of these techniques are really worth the time been given. In paper[1], the analysis study referred to as "Automatic Irrigation System on Sensing Soil wet Content" is ready to create an automatic irrigation system that manages the motor pump ON and OFF when the detection of the wet content of the soil. Within the field of agriculture, usage of correct suggests that of irrigation is sort of usable and economical.

The good thing about using these techniques is to decrease human interference and still certify acceptable irrigation. This machine-driven irrigation project brings into play an Arduino board ATmega328 micro-controller, is programmed to gather the signal of changeable wet circumstances of the world via wet moisture investigation system. In paper[2] called "AUTOMATIC IRRIGATION SYSTEM" by Anitha K, the research study aims to create an automatic irrigation system which changes the motor pump ON or OFF on detecting the moisture content of the field. The benefit of using this system is to decrease human intrusion and again make sure that automatic irrigation is carried out. This system takes an 8051 series microcontroller which is programmed to get the incoming data of changing moisture states of the soil through the sensors assembly.

This goal is reached by taking an OP-Amp as a comparator circuit which acts as an interface among the sensing assembly and the micro-controller. Once this arrangement gets this signal, it generates an output that starts a relay for operating the motor pump. An LCD display is interfaced to the microcontroller to show the condition of the soil and motor pump. The sensing assembly is prepared by using two stiff metallic conductor like rods deepen into the field at a distance.

Readings from the metallic rods are interfaced to the main head unit. In paper[3], in this project "AUTOMATED IRRIGATION SYSTEM BASED ON SOIL MOISTURE USING ARDUINO" by Arduino device and L293D module. This automatic irrigation system senses the wet content of the soil and mechanically switches the pump once the ability is on.

A correct usage of irrigation system is incredibly necessary as a result of the most reason is that the shortage of land reserved water, because of lack of rain, spontaneous use of water as a result massive amounts of water goes waste. For this reason, we have a tendency to use this automatic plant watering and soil moisture observation system. This technique is incredibly helpful in all weather conditions. Republic of India is that the agriculture based mostly country. Our most of people's square measure fully relied on the agricultural gathering.

Agriculture may be a supply of employment of majority Indians and has nice impact on the economy of the country. In dry areas or just in case of lacking rain, irrigation becomes tough. So, it has to be machine- driven for correct watering a plant and handled remotely by farmer. In paper[4], "Design And Implementation Of Automatic Irrigation System Using ARM7" the Automatic Irrigation system is designed to optimize the water use for agriculture crop.

The system has represented the wireless sensor network of soil-moisture, temperature and humidity sensor placed into root zone of the plant. The system is designed to find the exact field condition, to control the wastage of water in the field and to provide exact controlling of field by using the automatic irrigation and automating the agricultural environment by using the components and building the necessary hardware.

This system includes the monitoring of the system using ZigBee and GSM. In paper[5], "IOT based Smart Irrigation System (Srishti Rawal-2017)", this proposal discussed about how the water can be efficiently used for agriculture. According to this proposal Real Time Clock (RTC) is used to control the motor in the real time. First the ON time and OFF time of the motor is send from the android application via GPRS modem. Once the ON and OFF timings are reached the controller, the motor continuously starts and stops in that particular time interval in the by using RTC. Temperature and moisture values of the irrigation area are continuously monitored and the values are send to the android application via GPRS modem.

If the temperature and moisture values are beyond the certain limit an alert SMS will be send to the farmer. If the farmer wish to control the motor remotely it is possible by pressing the ON and OFF button given in the android applicationThe idea of use of Wireless sensor Network in agriculture has been proposed in [4]. This paper gave information that how the data collected from various sensors can communicate and can be send it to destination wirelessly. In [5] distributed wireless sensor network system is proposed, that can be used for the efficient water management controlled sprinklers from various GPS systems. In [6] authors presented that there are two types of wireless sensor Networks (WSN) in agriculture, one is terrestrial WSN and another is underground WSN. The underground WSN is not affected by the human intervention, as it lies below the soil. The combination of both types gives more promising results. The framework to operate and deploy hybrid WSN was developed. In [7] Advanced technique to measure soil moisture content based upon automatic pumping is proposed. These papers presented a system based on microcontroller that senses the soil, calculates the moisture content and according to the moisture value, irrigate the fields.

A water flow sensor is used to measure the flow water. In [8] authors investigated a remote monitoring system using Zigbee. The nodes send data wirelessly to a central server, which collets the data, stores it and analyse it and sent to the client mobile. The authors in [9] Proposed an agriculture solution combination of WSN and GSM technology. The PIC microcontroller is used as a heart of the system and Zigbee based low power devices are employed to enable cost saving. Arduino based automatic plant watering system is presented in [10] which uses Arduino board, having ATmega 328 microcontroller. It senses the soil moisture level and supply the water when required. In this paper soil moisture is taken into consideration. In [11] agriculture

monitoring system proposes the use of microcontroller AT89C52 as a heart of the system. The humidity and temperature values are displayed on the LCD and are transmitted to remote station using Zigbee transceiver.

Wireless sensor based crop monitoring system is developed and implemented that is connected to a central station using Global System for Mobile (GSM) technology. The PH value of the soil is send via SMS to mobile phone using GSM [12].

Development of low cost soil moisture sensor for drip irrigation system is proposed in [13]. This automatic system increases the yield of the crop, save water, energy, and labour cost. Soil moisture sensor was calibrated to switch on the motor when soil moisture reaches field capacity. In [14] authors have presented work on the remote automatic irrigation system which was based on the embedded systems. The test for fertilizer requirement, chemical constituents and water content of the field is detected. The proposed system in [15] is automatic irrigation controller is open loop, automatic and adaptive system. A relay controlled microcontroller is used to control all the process management. The system determines soil moisture and according to that applies the amount of water. The proposed model in [16] uses the sensor node consisting JN5121 module, an 802.15.4/Zigbee wireless controller. The sink node for data collection was ARM9 based. The literature review presents that Moisture deficit stress and high temperature are two of the major environmental factors that affect crop production. The amount of water used by a crop always depends on moisture availability in the soil, air temperature, and soil temperature. Microcontrollers and solid-state sensors can be found in many commercial, industrial, and consumer applications. There are many advantages in developing microcontroller based circuits and incorporating new sensor technologies into agricultural applications.

III. EXITING SYSTEM

In recent scenario of climate change and its effect on the environment has motivated the farmers to install greenhouses in their fields. But maintaining a greenhouse and its plantation is very labour intensive and majority of them perform vital operations intuitively. Also agricultural researchers are facing shortage of good quality of data which is crucial for crop development. Thus we have developed such a cost effective system using Bluetooth , which is focused on solving these particular problems, our system automates the greenhouse maintenance operations and monitor the growth conditions inside the greenhouse closely.The existing system is an embedded system which will closely monitor and control the microclimatic parameters of a greenhouse on a regular basis round the clock for cultivation of crops or specific plant species which could maximize their production over the whole crop growth season and to eliminate the difficulties involved in the system by reducing human intervention to the best possible extent. Transmitting section of existing system is shown in Fig. 2.

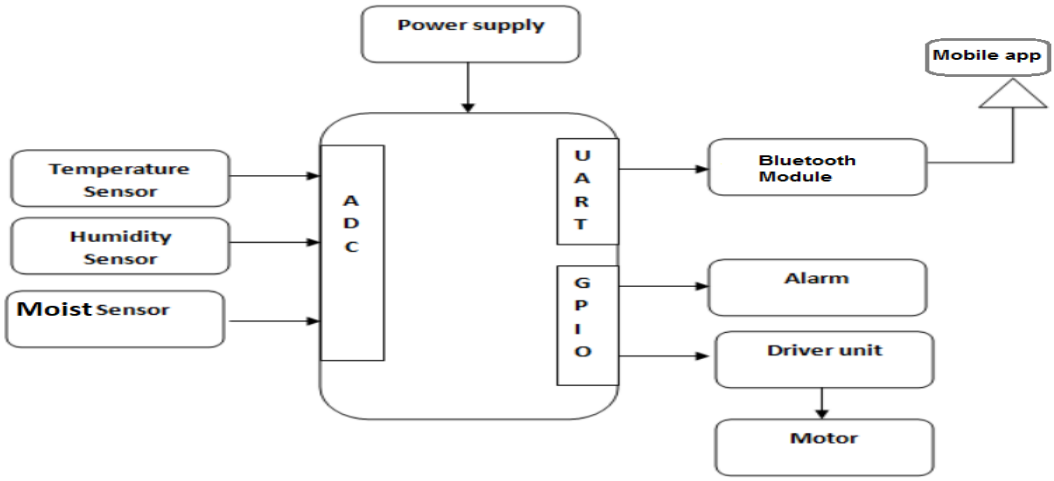

Fig. 2 transmitting section

The Arduino board can be supplied with power either from the DC power jack (7 - 12V), the USB connector (5V), or the VIN pin of the board (7-12V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage your board. We don't advise it.

2.1.Temperature Sensor

A temperature sensor plays an important role in many applications.A simple temperature sensor is a device, to measure the temperature through an electrical signal it requires a thermocouple or RTD (Resistance Temperature Detectors) . The thermocouple is prepared by two dissimilar metals which generate the electrical voltage indirectly proportional to change the temperature.

2.2.Humidity Sensor

A humidity sensor (or hygrometer) senses, measures and reports both moisture and air temperature. Relative humidity becomes an important factor, when looking for comfort. A sample humidity sensor. Humidity sensors work by detecting changes that alter electrical currents or temperature in the air.

2.3.Soil Moist Sensor

The soil moisture sensor consists of two probes which are used to measure the volumetric content of water. The two probes allow the current to pass through the soil and then it gets the resistance value to measure the moisture value.

2.4.Bluetooth module

Bluetooth module HC-06 is used for wireless communication between Arduino Uno and smartphone. HC-06 is a slave device and it can operates at power 3.6 to 6 volts. It has 6 pins: State, RXD, TXD, GND, VCC and EN. For serial communication connect TXD pin of Blue tooth module HC-06 with RX (pin 0) of Arduino Uno and RXD pin with TX (pin 1) of Arduino Uno. Connection diagram of Adriano and Bluetooth (BT) module is illustrated in Fig. 3.

Fig. 3 HC-06 Bluetooth Transceiver

2.5 HC-06 Bluetooth module configuration with Arduino

Connecting HC-06 Bluetooth module to the Arduino

- Connect the HC-06 Ground (GND) pin to ground (duh!).
- Connect the HC-06 VCC pin to 5v.
- Connect the HC-06 TX/TXD pin to Arduino digital pin 4.
- Connect the HC-06 RX/RXD pin to Arduino digital pin 2.

Use a level shifter, voltage regulator (or a voltage divider, like in my set-up below) to protect the Bluetooth module RX pin. It is designed for 3.3v operation, while the Arduino digital pins work on 5 volts. You do not need the LED on the Arduino pin 13 that I have on my set-up below Fig. 4.

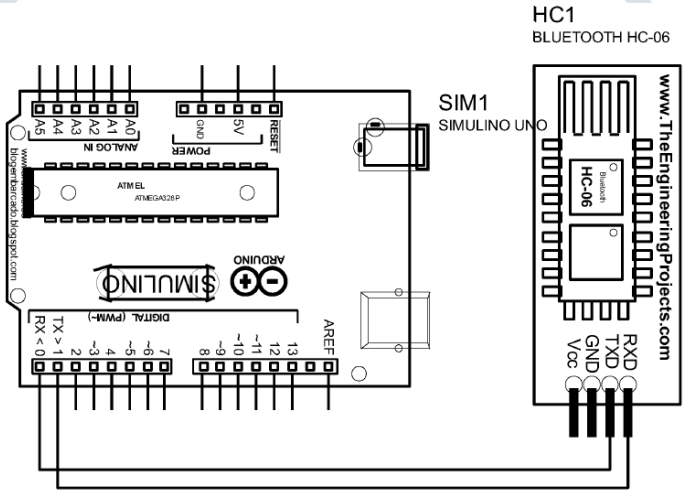

Fig. 4 Connection diagram of Arduino and BT module

Existing system consists of Bluetooth based irrigation system where all the input modules such as temperature, soil sensor are connected to controller and the output modules Bluetooth based serial communication. Greenhouse monitoring system using Bluetooth deals with a simple, easy to construct, Arduino based system to monitor, control and record values of temperature, humidity, soil moisture of the natural environment that are continuously modified and controlled in order optimize them to achieve maximum plant growth and yield. The controller communicates with the various sensor modules in real-time in order to control the light, aeration and drainage process efficiently inside a greenhouse by actuating a motor, dripper and lights respectively according to the necessary condition of the crops. The Existing system also consists of some drawbacks is given below.

- The transmission range of the greenhouse monitoring system using Bluetooth module is less.
- Transmission speed is less compared to the antennas.

IV. PROPOSED SYSTEM

In the proposed system we are using a transmitter and receiver modules of tarang antenna instead of Bluetooth module to increase the range of the transmission. Tarang antenna is radio frequency based antenna. Where each module will have there own subsequent transmitter and receiver modules. Transmitting module is connected with sensor network, and receiver modules are connected with LCD, relay, motor. It has more greenhouse monitoring parameter over the Bluetooth module based monitoring system used in existing method. The proposed system Transmitting section block diagram is shown in Fig. 5.

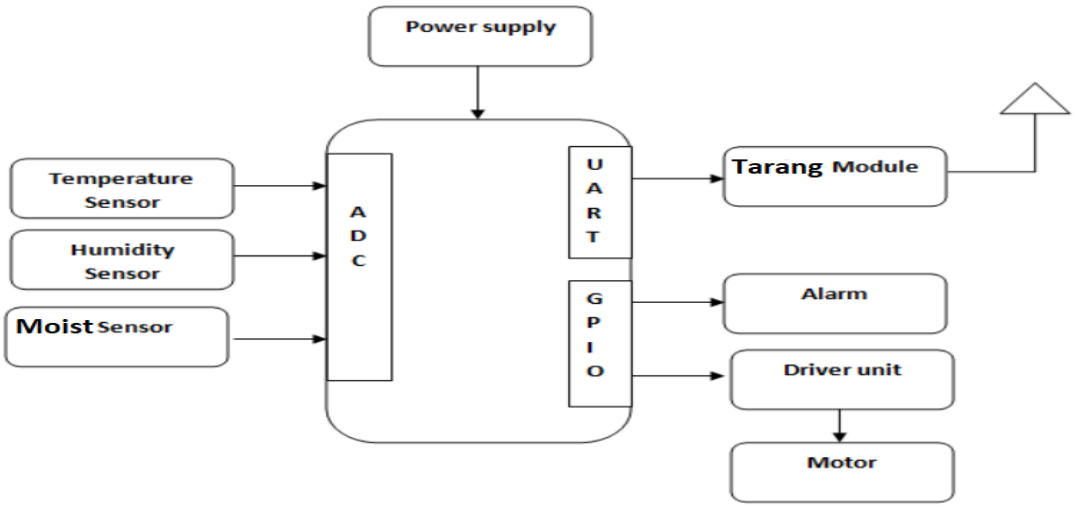

Fig. 5 Transmitting Section

In the transmitting section of the system we have use the Tarang P20 antenna module to the Arduino instead of Bluetooth sensor and the temperature sensor, humidity sensor, moist sensor are the inputs to the Arduino. Where each module will have their own subsequent transmitter and receiver modules. The transmitter module is connected with sensor network, and receiver module is connected with LCD, relay, motor. The Receiver section of proposed system is shown in Fig. 6.

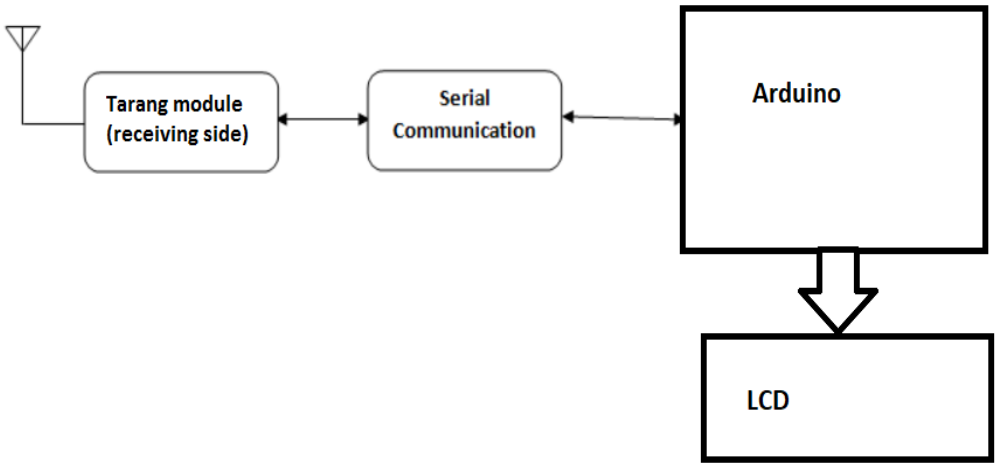

Fig. 6 Receiving section

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4.3.Soil Moist Sensor

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4.4.Tarang P20 Module

Tarang-P series modules are designed with low to medium transmit power and for high reliability wireless networks. The modules require minimal power and provide reliable delivery of data between devices. The interfaces provided with the module

help to directly fit into many industrial applications. The modules operate within the ISM 2.4-2.4835 GHz frequency band switch IEEE 802.15.4 baseband.

4.5.Tarang P20 Specifications

TABULARFORM 1 TARANG P20 SPECIFICATIONS

Power:

Supply Voltage (VCC)	3.3 to 3.6V
Transmit Current	165 mA (typical)
Idle/Receive Current	35mA
Power-down Current	<60µA

General:

Operating Frequency	ISM 2.4 GHz
Transmit Power Output	19dbm (typical)
RF Data Rate	250 Kbps
Receiver Sensitivity	-105 dBm
Serial Interface Data Rate	1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 baud
Operating Temperature	-40 to 85 degree C
Antenna Options	Wire Antenna

4.6.Tarang P20 Interface

The Tarang module interface to a host device through a logic levelAsynchronous serial port. Through its serial port, the module can communicate with any logic and voltage compatible UART or through a level transistor to any serial device. Tarang can be interface with a microcontroller or a PC using serial port with the help of appropriate level conversion.

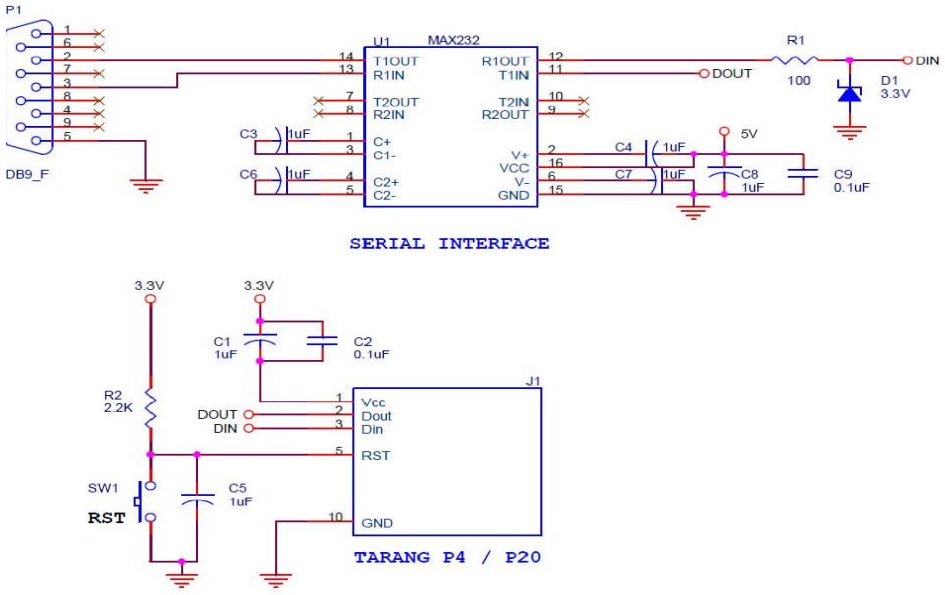

Fig. 7 interface

V. RESULTS AND DISCUSSIONS

Initially, the kit remains off condition as observed in Fig. 8 even after the power supply passes through. When an object is placed after the humidity sensor it shows that device2 is on condition as we can see on display screen. As a result, the motor runs and the water are spread throughout the green house. Whereas, an object is placed after the temperature sensor the LED bulb glows. This indicates the acquirement of light energy required for the green house.

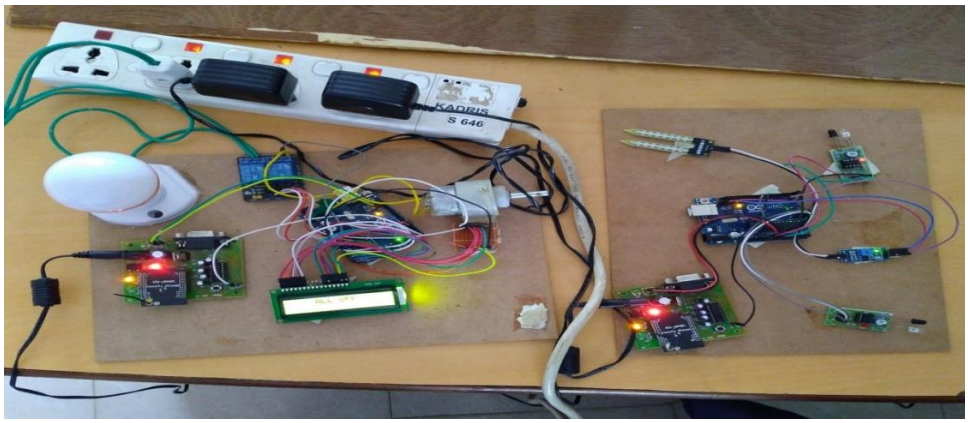

Fig. 8 Proposed system

Fig. 9 Proposed system output

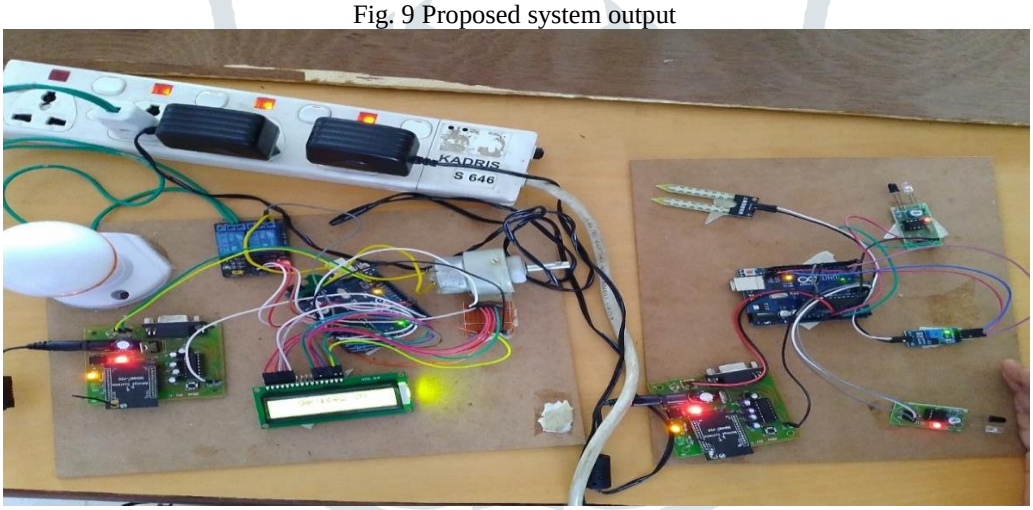

Fig. 10 Proposed system setup

Fig. 11 Proposed system output

VI. CONCLUSION

In this paper, successfully implemented the communication links that exist between transmitter and receiver modules of tarang based green house irrigation system. We have success fully implemented the communication between transmit and receivers and triggers the motor. Receiver side promoting ones understanding on farming methodology.

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