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APPLICATION OF LORAWAN TECHNOLOGY IN FARM FOR IRRIGATION SYSTEM

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Abstract: This paper describes smart agriculture methods using Internet of things Technology, which enhances the yield and ensures the less human intervention for agriculture works. High accuracy and Low power are the prime factors to make any IoT arrange favorable and allowable to the Ranchers. In this paper we have designed the controlling mechanism for the flow of water in to agriculture farm depends on the wetness of the soil which is required for the specific crops. The Humidity and Temperature value will be sensed for the specific action by the farmer. The long range data transmission of the sensed data is possible as projects adopt LoRa technology.

***Index Terms* - Smart Agriculture, Internet of Things, LoRa Technology, Ranchers.**

I. INTRODUCTION

IoT technology provides the interconnection of objects which have built-in computing, communication and sensing capabilities. The advancement of the Internet of Things has highly facilitated its implementation in various industries such as smart agriculture, smart city, smart factory, smart healthcare, etc. As one of the important communication technologies of IoT applications, LoRa is a designed specifically for long- range, low-power communications. It is a proprietary radio modulation technology licensed by Semtech Corporation. It provides long-range connectivity by using the chirp spread spectrum technique and can be operated at the ISM frequency band of 433 MHZ, 868 MHZ, and 915 MHZ.

With the emergence of IoT, agriculture has advanced in the direction of automation and intellectualization. Irrigation system can utilize water efficiently, in the precision place, at the appropriate time and in the right amount. It can also optimize the electricity consumption and labor costs. However, the irrigation system equipped with GPRS has the problems of high power consumption and high cost of maintenance and deployment. On the other hand, the systems use ZigBee or Wi-Fi have the problem of low coverage.

In general, a LoRa Wide Area Network (LoRaWAN) can cover 20 km in rural area and around 8 km in urban area, which can ensure the high coverage of the irrigation system. Because of low power consumption, the LoRa device can operate up to ten years on battery. In the long term, it brings great benefits, such as water-saving, lower costs of maintenance and deployment. Therefore, a irrigation system based on LoRa technology is proposed in this project. It is a great solution to these problems mentioned above. The system is capable of communication between irrigation devices and applications through LoRaWAN. The main intention of the work is to enable applications to control the irrigation system via cloud. Irrigation node will send its Status information to the gateway and this information will be forwarded to cloud to process and store. By using cloud Application Programming Interfaces (APIs), applications can send command to control the irrigation system. Furthermore, solenoid valve in irrigation node can be charged by a hydroelectric generator. In this way, full utilization of energy can be realized.

In previous system LoRa modules to establish reliable radio link has been designed and customized data transfer protocol that stratifies the requirements has been deployed. It is shown that this solution has the advantages over existing LORAWAN protocol in terms of cost complexity for this specific application.

In our system, we used various sensors for Irrigation system. Sensors are monitor the environmental data, such as soil moisture and temperature and develop the control system that is able to take automatic decision based on the collected data.

II. LITREATURE REVIEW

Irrigation is the artificial process of applying controlled amounts of water to land to assist in production of crops. Irrigation helps to grow agricultural crops, maintain landscapes, and revegetate disturbed soils in dry areas and during periods of less than average rainfall. Irrigation also has other uses in crop production, including frost protection, suppressing weed growth in grain fields and preventing soil consolidation. In contrast, agriculture that relies only on direct rainfall is referred to as rain-fed. Irrigation systems are also used for cooling livestock, dust suppression, disposal of sewage, and in mining. Irrigation is often studied together with drainage, which is the removal of surface and sub-surface water from a given location.

Recently, wireless sensor networks have been deployed in many applications, which includes agriculture data collection, industrial controlling, logistics management, metrological monitoring and so on. LoRa provides new communication solution for wireless underground sensor network. A LoRa propagation testing node is presented in this system. Tests about in-soil LoRa propogation characteristics related to volumetric water content, burial depth and payload are experimentally evaluated with the testing node. Some suggestions are proposed for LoRa- based Wireless Underground Sensor Network (WUSN) which is applied in soil. Deployment of wireless sensors and sensor networks in agriculture can be a great help in monitoring environment and growing crops and having a network to support those devices is necessary to successfully utilize those resources. Recently, LPWAN have been recognized as an appropriate technology for agriculture use. LoRa is a representative network of LPWAN. It can be applied to IoT for agriculture due to its long range and low power capabilities. Currently most studies have shown LoRa communication capabilities in urban, mountains and maritime areas with little focus on agriculture use cases. Tree farming is a long term investment, requiring careful monitoring to mitigate loss; therefore, this system provides an analysis about the impact of variant physical layer parameters on performance of LoRa networks in a tree-farm.

Besides the implementation in the smart city applications IoT has also found significant place in the agricultural and food production process. In this system, an innovative power efficient and highly scalable IoT agricultural system is presented. This system is based on LoRaWAN network for long range and low power consumption data transmission from the sensor nodes to the cloud services.

Sr. No.	Name of the paper	Name of Author	Remarks
1.	Design Implementation of LoRa Based Wireless Control for Drip Irrigation Systems.	Maksudjon Usmonov and Francesco Gregoretti	In this paper, the solution using LoRa technology for cost effective wireless control of drip irrigation systems has been presented. The system which utilizes LoRa modules to establish reliable radio link has been designed and customized data transfer protocol that stratifies the requirements has been deployed. It is shown that this solution has the advantages over existing LORAWAN protocol in terms of cost complexity for this specific application.
2.	Design and Implementation of Smart Irrigation System Based on LoRa.	Wenjo Zhao, Shengwie Lie, Jiwen Han, Rongtao Xu, Lu Hao	This paper proposes a smart irrigation system based on LoRa technology. In order to validate the excellent execution of the proposed irrigation system, experiments have been carried out. Exploratory outcomes approve the materialness of the proposed framework. Simultaneously, the benefits of LoRa innovation received in keen water system framework have been appeared by tests. The system proposed by us facilitates more efficient, also minimizes the cost of deployment and maintenances. According to the experimental results, the irrigation node equipped with hydroelectric generator can operate up to for decades. The communication distance between the irrigation node and gateway is up to 8 km, thus the irrigation system can cover up to 200 hectares. By mobile App, users can control the irrigation system remotely and check the status of system in time. It is believed that adopting LoRa technology to smart irrigation system will significantly simulate development of smart agriculture Of course, we have a lot of follow-up work to do to make the system more intelligent and precise controlling.
3.	Design and Implementation of LPWA- Based Air Quality Monitoring System.	K. Zheng, S. Zhao and Z. Yang,	In this paper, implemented an air quality monitoring system by using the advanced IoT techniques in this paper. With the guide of the LPWA organization, the air detecting information over a huge inclusion region is gathered and sent to the IoT cloud on schedule. The gateway checking hubs are produced for simple organization and can work the entire day with a battery or a sun based board. Every one of the elements of the AP are carried out on a GPP-based SDR stage. The detected information are put away in the data set and dissected in the IoT cloud. A lot of investigations have been completed in the metropolitan conditions to approve the dependability of the proposed framework. Some intriguing realities have been uncovered when contrasting the air quality pattern and other comparable information. It is accepted that long haul and huge scope air observing can significantly assist us with understanding air contamination and figure out how to tackle the

			issue of air contamination at any rate part of the way.
4.	An SMDP-Based Resource Allocation in Vehicular Cloud Computing Systems.	K. Zheng, H. Meng and P. Chatzimisions,	In this paper we have proposed a computation resource allocation scheme for a Vehicular Distributed computing framework, which is detailed as an infinite skyline Semi-Markov Decision Process (SMDP). An ideal dynamic plan is acquired through the emphasis calculation to augment the drawn out anticipated all out remuneration of the VCC framework. Mathematical outcomes show significant expect reward execution acquire over others, e.g., contrast and Greedy Allocation (GA) conspire, almost 7% execution acquire when either λ p is high or K is low. Besides, the intricacy of the SMDP-based plan is lower than that of the SA conspire.
5.	The Internet of Things: a survey, Computer Networks	L. Atzori, A. Iera and G. Morabito	The Internet has changed drastically the way we live, moving interactions between people at a virtual level in several contexts spanning from the professional life to social relationships. The IoT can possibly add another measurement to this interaction by empowering correspondences with and among brilliant articles, consequently prompting the vision of "whenever, anyplace any media, anything" communications In this paper, we have overviewed the main parts of the IoT with accentuation on the thing is being done and what are the issues that require further exploration. In fact, current advances make the IoT idea practical yet don't fit well with the adaptability and effectiveness prerequisites they will confront. We accept that, given the interest appeared by enterprises in the IoT applications, before long resolving such issues will be an incredible driving element for systems administration and correspondence research in both mechanical and scholarly labs.
6.	A Smart Irrigation System in Agriculture with Cloud Support using Internet of Things.	S. Manimurugan	This work was defined with the objectives of helping the farmers through the recent technologies by reducing their burdens, loss and enlarging the yields. In connection with that, the survey of their real problems had been undertaken and listed in the previous sections. The most important problem of the list is considered and it is addressed by the proposed smart water irrigation system for the high yield process. Though many sensors used the installation cost of the developed technology should be less. It is also been addressed. As the outcome of this work, it can support the farmer needs 100%, secure them from the loss, with cost less and gain more.
7.	Sensor Data Management of LoRaWan Technology	Poonam S. Jakhotiya, Dr. N. N. Kasat, Dr. A. D. Gawande, Dr. V. T. Gaikwad	The practice of smart agriculture using LoRa to LoRaWAN network. There are two LSN50 nodes, one at transmitter and the other at receiver. Node at transmitter is equipped with variety of sensors that collect and transmit data to our cloud services, while node at receiver is equipped with actuators for controlling the technology enhances the former methods of collecting and analyzing data in the agro environmental system. By leveraging LoRa technology and LoRaWAN protocol, agribusiness can digitally monitor, analyze and monitor every aspect of their business. LoRa automatic sprinklers, turn on/off the valve, etc... technology provides a solid platform for the When a command is send through TTN network, the LSN50 node gets the data from the sensors which can be seen through TTN and the future of smart agriculture as it is easy to deploy and helps farmers to grow their business.

III. PROPOSED METHODOLOGY

"APPLICATION OF LORAWAN TECHNOLOGY IN FARM FOR IRRIGATION SYSTEM" as the title said the main purpose behind that system. This paper is to design a device that monitors soil moisture, temperature and humidity of field atmosphere, and transmit the information to the remote receiver at the farmhouse or outside the field. The remote receiver (Receiver) is a laptop connected to the LoRa transceiver. In this paper consists of Arduino as processing unit and WSN base station.

3.1 Basic block diagram

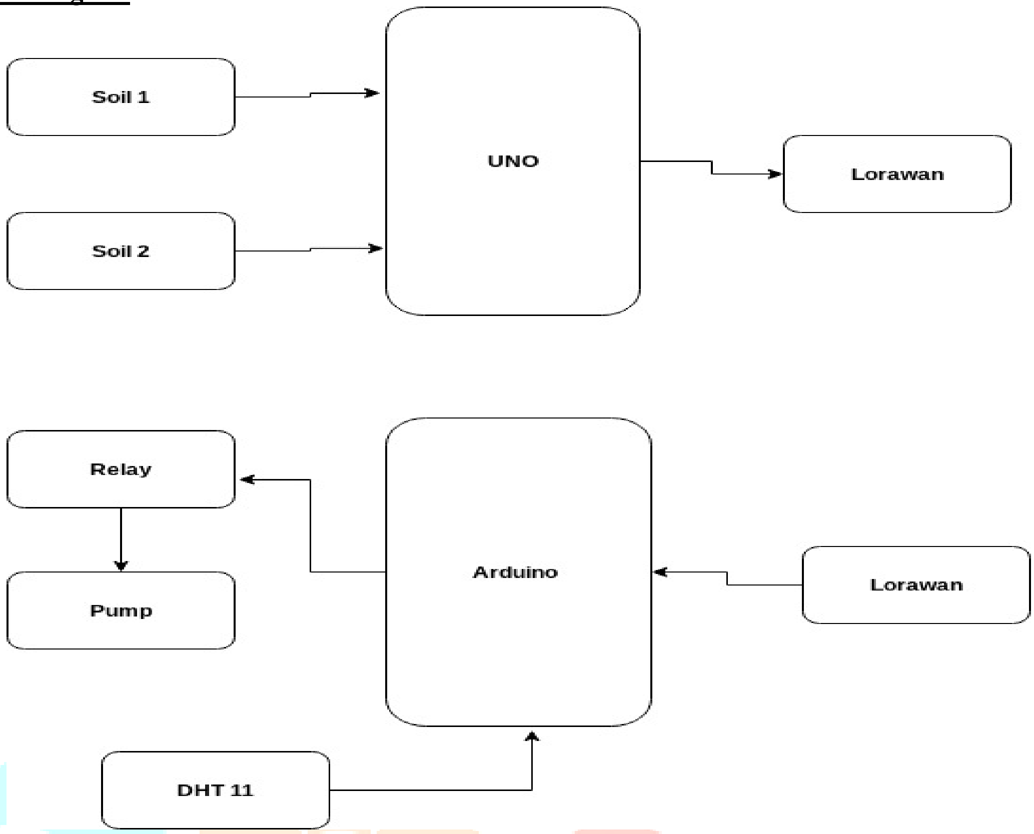

Fig.3.1 :Basic Block Diagram of System

A soil moisture and temperature humidity sensor is fetched to the WSN data collection node. The sensor node also consists of a LCD module, where the sensor output is shown in real time. The sensor node is building unit of the WSN. The duty of sensor node is to achieve the perception, collection, processing and wireless transmission. The sensor node converts the physical quantity to the voltage signal and Arduino UNO board controls the processing, and manages the we utilized different types of sensors for Automatic Smart irrigation system. Sensors like LDR, Soil moisture sensor, DHT Sensor, water pumping Motor and we are using Relay circuit model at transmitter LoRa device. Here Relay interacts with all sensors which are fabricated on LoRa device. In this system we are mainly concentrated on controlling the flow of water by checking the temperature, Humidity, and Soil moisture. Thus, it helps to set the land parameters for specific crops. If the values from all sensors exceeds there Threshold voltage set in program it's automatically Water pump turns Off. At the Receiver End User can get all desired sensed values through Lora WAN Gateway. we are using soil moisture sensors to sense the moisture of soil continuously. According to data from soil moisture sensors, water motors will work automatically. Water motor will operate with the help of a relay. We are using a relay as an automatic switch. DHT11 sensor will monitor the temperature and humidity of our surrounding continuously. Data of soil moisture sensor and DHT11 will be sent to receiver module of LoRaWAN module to farmer. LoRaWAN transmitter module will collect all this data and will send it to receiver module which will be with farmer so that he can get instant update of farm. The Fig.4.3 depicted shows that the flow charts of the process. Where the sensed value is analog in nature is received by Master controller that will be converted to digital by slave controller. If the value is greater than the threshold value then necessary action will be initiated.

IV. SYSTEM ARCHITECTURE AND FLOWCHART

4.1 LoRaWAN Transmitter Module :

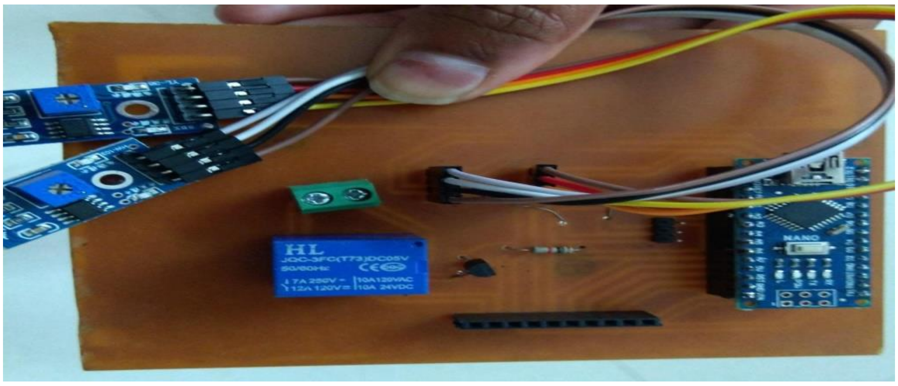

Fig 4.1 : LoRaWAN transmitter Module

Above Figure 4.1 Shows the block diagram of LoRaWAN Transmitter Module. This sections consisting blocks are Soil sensor 1, LoRaWAN Transmitter module, Soil sensor 2, Arduino, Temperature and Humidity Sensor, Relay, Solenoid Valve. In Input side 2 soil sensor and LoRawan Transmitter module are connected of Ardunino they check water level, Temperature and Humidity of the farm. According to data relay will ON/OFF Solenoid Valve.

4.2 LoRaWAN Receiver Module :

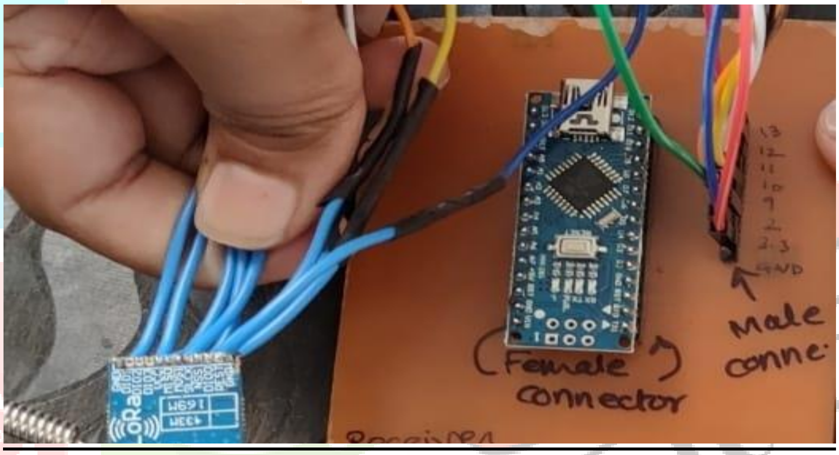

Fig 4.2 : LoRaWAN Receiver Module

Above Figure 4.2 Shows LoRaWAN Receiver Module. This Receiving section consists of blocks like Arduino, and LoRaWAN Receiver Module. In the Receiver side Arduino Module are connected to LoRaWAN Receiver Module. LoRaWAN Transmitting module collect all data of the farm and send to the receiver module which will be with farmer so that he can get instant update of farm.

4.3 Flowchart :

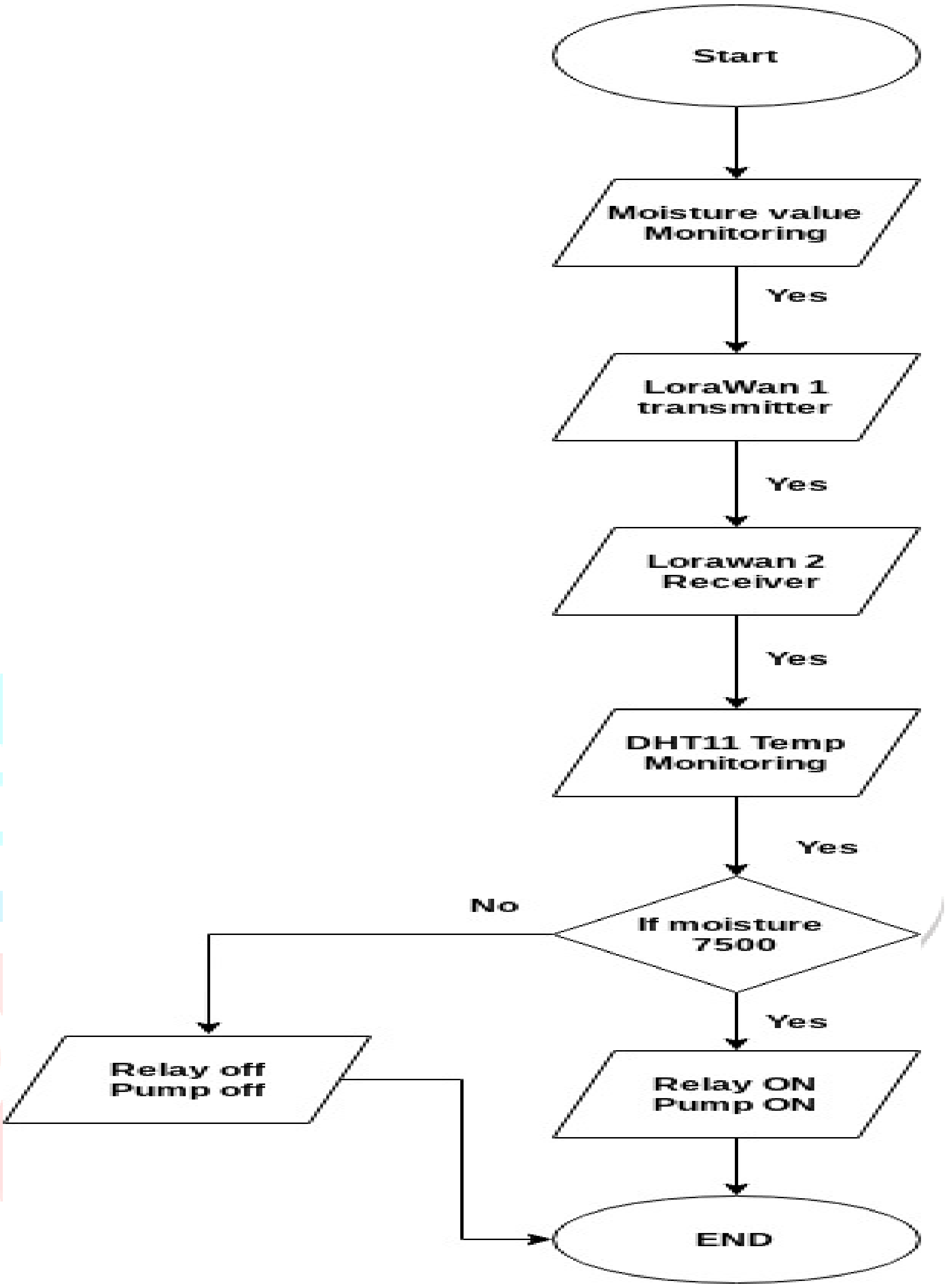

Fig. 4.3 : System Flow Chart

Above Figure 4.3 shows the flowchart of system. The procedure and flow of execution of the system of the system is explained and given with the help of above figure.

V. DESIGN TOOLS

5.1 ARDIUNO IDE

Arduino IDE is open source software that is mainly used for writing and compiling the code into the Arduino Module. It is official Arduino software, making code compilation too easy that even a common person with no prior technical knowledge can get their feet wet with the learning process. A range of Arduino modules available including Arduino Uno, Arduino Mega, Arduino Leonardo, Arduino Micro and many more. Each of them contains a microcontroller on the board that is actually programmed and accepts the information in the form of code.

The main code, also known as a sketch, created on the IDE platform will ultimately generate a Hex File which is then transferred and uploaded in the controller on the board.

The IDE environment mainly contains two basic parts: Editor and Compiler where former is used for writing the required code and later is used for compiling and uploading the code into the given Arduino Module

Tool Used :

IDE:

The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. It runs on Windows, Mac OS X, and Linux. The environment is written in Java and based on Processing and other open-source software. This software can be used with any Arduino board. The Arduino language is merely a set of C/C++ functions that can be called from your code. Your sketch undergoes minor changes (e.g. automatic generation of function prototypes) and then is passed directly to a C/C++ compiler (avr-g++).

The Arduino integrated development environment (IDE) is a cross-platform application (for Windows, macOS, Linux) that is written in the programming language Java. It originated from the IDE for the languages Processing and Wiring. It includes a code editor with features such as text cutting and pasting, searching and replacing text, automatic indenting, brace matching, and syntax highlighting, and provides simple one-click mechanisms to compile and upload programs to an Arduino board. It also contains a message area, a text console, a toolbar with buttons for common functions and a hierarchy of operation menus. The source code for the IDE is released under the GNU General Public License, version 2. The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub main() into an executable cyclic executive program with the GNU tool chain, also included with the IDE distribution. The Arduino IDE employs the program avrdude to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware.

VI. RESULT AND DISCUSSION

The water system hub sends information to cloud through LoRa doors by means of remote transmission. The framework can be controlled distantly by versatile applications. Exploratory outcomes show that both transmission distance and energy utilization in the proposed framework are dependable.

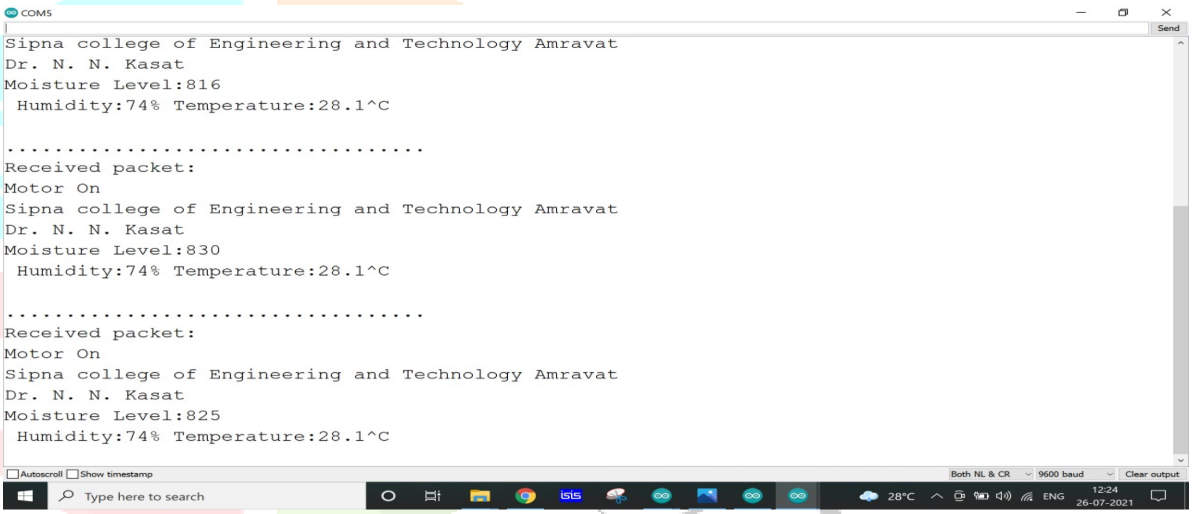

Fig. 6.1 Output of the system

6.1 APPLICATION

By using the APIs provided by Cloud server, diverse applications can be offered in application part, i.e., web applications, mobile applications developed in Android or iOS platforms. Users can obtain the status of irrigation nodes in the field via application, and can also control the irrigation system by sending control commands through applications.

VII. CONCLUSION

The project leads as the model and the successful arrangement over the issue of irrigation management. The Temperature, Humidity, Light Intensity, Soil Moisture values are obtained at the remote site using the LoRa technology. So this cost effective project ensures the great yield production and Less Human Intervention

The practice of smart agriculture using LoRa to LoRaWAN network. There are two LSN50 nodes, one at transmitter and the other at receiver. Node at transmitter is equipped with variety of sensors that collect and transmit data to our cloud services, while node at receiver is equipped with actuators for controlling the technology enhances the former methods of collecting and analyzing data in the agro environmental system. By leveraging LoRa technology and LoRaWAN protocol, agribusiness can digitally monitor, analyze and monitor every aspect of their business. LoRa automatic sprinklers, turn on/off the valve, etc. technology provides a solid platform for the When a command is send through TTN network, the LSN50 node gets the data from the sensors which can be seen through TTN and the future of smart agriculture as it is easy to deploy and helps farmers to grow their business.

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