AIIoT-Enabled Soil Irrigation System

Sonu Airen[1],Puja Gupta*[2]
[1,2]*Assistant Professor*
[1,2]Department of Information Technology, SGSITS, Indore, 452001, India,
Email id Sonugoyal24@rediffmail.com[1],pooja1porwal@gmail.com[2*]
[*] Corresponding Author, pooja1porwal@gmail.com

***Abstract*—** The Covid-19 pandemic and consequent nationwide lockdown measures have had an adverse effect on India's agriculture supply chain. Insufficient irrigation infrastructure and inadequate fertilizer application by farmers have had a detrimental impact on several agricultural regions. The implementation of intelligent soil irrigation and monitoring system is needed in order to address the aforementioned situation. The latest developments in precision farming, using the Internet of Things (IoT), are significantly transforming agricultural practices by improving their efficiency and cost-effectiveness for farmers via the reduction of crop losses. The advent of the contemporary age has seen the integration of the Internet of Things (IoT) across several industries, therefore significantly influencing the lives of individuals via its intelligent connectivity capabilities. The system comprises a set of disparate devices that cooperate to establish a network that can autonomously configure itself. The primary goal of the proposed system is to provide a solution that can provide farmers with information pertaining to moisture content and irrigation across many platforms. Farmers stand to benefit economically from the use of this device, as it has the capability to collect precise data pertaining to various environmental factors within the field, such as temperature, humidity, moisture levels, UV index, and infrared radiation. This data can then be utilized to facilitate the implementation of intelligent farming practices, therefore enhancing crop yields while concurrently preserving valuable resources, such as water and fertilizers. The suggested equipment comprises an ESP32s Node board, a breadboard, a DHT11 Temperature and Relative Humidity Sensor, an Electronic Ultraviolet Index/Infrared Sensor, jumper wires, and LEDs. The live data stream is seen via the use of the serial monitor and a Blynk smartphone. Consequently, farmers will have enhanced capabilities in crop management.

Keywords - IoT, Irrigation system, Moisture sensor, Wifi module, Relay board.

I. INTRODUCTION

Farming is the main food source production in India. For Indian, which would be the nation's fastest countries in Europe of population increase, increasing agricultural production is important. The monsoons have a significant impact on output rates, and current meteorological data suggests that monsoon season in India are rather unpredictable. As a result, India's food consumption rate falls short of that of its people. Each year, the amount of water needed for irrigation is insufficient. As a result, a slew of problems develop, including insufficient irrigation, agricultural expansion, and so on. To solve all of these concerns while also protecting water resources, a system that assures effective water resource management while also reducing farmer burden is required.

The Internet of Things will be completely reliant on intelligent computing in the future. It is crucial in the transition from "Traditional Technology" to "Next Generation Everywhere Computing" in homes and organizations. The 'Internet of Things' is gaining pace in global research, notably in the realm of improved wireless communications. Today, IoT is affecting people all over the world, and it is laying the basis for a range of commodities, including intelligent medical care, sustainable communities, smart education in schools, and automation, from the standpoint of the common user. Manufacturing, transportation, agriculture, and corporate management are just a few of the areas where it's utilized commercially. Using moisture detecting sensors and the IoT, We could continuously evaluate soil moisture levels and send out alerts when action is required.

Agricultural is the most studied use of IoT. Because it is a critical business for ensuring food security in light of the world's fast population growth. Researchers first tried ICT-based methods to this issue, which were helpful in certain ways but never completely solved our problem. As just a consequence, they're exploring at IoT as an agriculture alternative to ICT. Agricultural products require applications such as soil water monitoring, ambient condition monitoring including temperature and humidity, operations management, and infrastructure management. Considering 5 billion people anticipated to be participating in smart farming, it is the future. In addition, the information obtained. Data collected by sensors in agricultural areas might be used for data analysis, assisting farmers in boosting crop output. Thus,Smart farming facilitated by the Internet of Things has the potential to tackle a wide range of agricultural issues. The goal of this essay is to show you how to demonstrate a working system that will deliver real-time data to farmers.

1.1 Precision agriculture using IoT:

Precision agriculture is a modern agricultural administration concept that makes use of Internet of Things (IoT) technology to increase agricultural productivity. Precision agriculture enables farmers to make effective use of fertilizer and other supplies in terms of the standard and volume of their crops. In the field, a farmer can be present physically 24 hours a day. Farmers may also lack the knowledge required to use various approaches for finding the best environmental conditions for their crops. They will be equipped with an automatic system that will function without human input and will notify them to take necessary action in terms of a variety of problems that may emerge during farming. It can reach out to farmers and inform them while still there weren't in the fields, allowing them to manage more farms and therefore enhance their production.

By 2050, the world's population is expected to exceed 9 billion people, as according P Prakash's essay [10]. To feed such a large population and to efficiently employ land and other resources, which are scarce in some regions, agriculture requires IoT applications. Unexpected weather occurrences are destroying crops as a result of global warming, and growers are losing a lot of money; an IoT Precision Agriculture software may allow them to take quick action to prevent this. Gorli Ravi [2] explains how Precision Agriculture is important and what the IoT's future responsibilities will be to shape our future. Instead of utilizing an Arduino mega 2560 and then the ESP8266 module to display information on a computer display as N Anand& P Vikram [1] did, we utilized a new ESP32 controller and the Blynk android application to display live data since not every farmers has a PC. Which approach is the quickest and most precise? A sleep mode is also available, which extends the battery life of the self-monitoring device. Every time, human intervention was required in the production of their items.

Furthermore, innovations boost productivity. As S. Jegadeesan [3] points out, IoT allows farmers to control animals including such cows, sheep, as well as other livestock, and also track their health. According to V Roham [8] WSN, which is a subclass of IoT, comprises routing algorithms for networks like these further prototypes.

There are far more expensive systems, including such [5], [10], that might also control the agricultural process, but owing to budgetary constraints, most farmers will be unable to utilize them. Farmers will be able to afford this prototype gadget, which costs around 1,900 Indian rupees. There's also a sleeping mode included. The code establishes a time limit for delivering the measurements after each trigger time to guarantee that the programmer does not get redundant inputs. Additionally, using the proper containers protects against adverse weather. It is more sustainability than the things stated in [4] & [5] due to the use of high-quality sensors, efficient software, routing protocols, and proper design.

IoT systems in precision agriculture include farmer's GPS system, animal monitoring, and storage monitoring, in additional to farm transportation surveillance, animals tracking, warehouse tracking, and other agricultural options. Intelligent Agricultural Production, which is now gaining popularity across the world, offers a diverse set of applications, demonstrating that it is not limited to large-scale farming operations.

1.2 The Advantages of Precision Agriculture:

Farmer monitoring, water and other natural resource conservation, and enhanced food production are all predicted benefits of different IoT-based Smart Farming systems, and the ability to see things that are not visible to the naked eye, resulting in precise agricultural land and agricultural evaluation, good quality, and improved efficacy.

1.3 Advanced Farming's Weaknesses:

• Farming, being a naturally occurring phenomenon, is heavily reliant on nature, which man cannot forecast or control, whether it is rain or sunshine availability. Among other things, pest control thus, agriculture will always use IoT systems.

• Continuous internet connectivity is necessary for smart agriculture. This criteria was not met in rural areas of developing nations. Additionally, the internet is slower than it used to be.

• Defective sensors or information processing engines might result in erroneous judgments, resulting in excessive water, fertilizer, and other resource waste.

• Farmers must comprehend and master the usage of technology in order to employ smart agricultural equipment. This is the primary impediment to widespread adoption of smart agricultural framing.

II. Literature Survey

The current scenario, which includes diminishing groundwater, drying rivers and tanks, and an unpredictable environment, necessitates competent water management. Temperature and humidity sensors are put in appropriate places for crop monitoring to deal with this. [6][16] To regulate the amount of water used, a microcontroller-based gateway may be programmed with an algorithm temperature and moisture in the soil threshold values. Photovoltaic panels power the system, which also includes a bidirectional communication channel built on a cellular-Internet programmer that allows data examination and irrigation management to be managed via a web page. [7][23] Wireless sensor have progressed to the point that it may now be utilized in precision agriculture to monitor and adjust greenhouse conditions. [24][8] After doing field research, authors found that agricultural productivity is decreasing day by day. In the agricultural industry, however, technology plays a critical role in both increasing production and reducing needless manual effort. Some research is conducted for the advantage of farmers, with the goal of developing systems that use technology to help enhance agricultural productivity. In order to maximize production while consuming the least amount of water, Y. Kim created a remote safeguards and acceleration watering system that uses a dispersed wireless sensor to achieve variable interest rate watering, real-time in-field sensors, and regulation of a destination accurate regression analysis start moving irrigation system. The system addressed the construction and evaluation of fixed rate systems, wireless sensors, and actual field sensing using suitable software. The complete system was built using five in-field sensing stations that collect data and send it to a base station through a GPS, where the system's database was used to perform the necessary irrigation management operations. The technology provides reduced wireless options as well as irrigation management precision via remote control. [9][24][25] In wireless sensor studies, researchers looked at soil-related variables including temperature and humidity. Sensor are implanted inside the soil, and they use an efficient network communication with a low duty cycle to communicate with relay nodes, allowing the soil monitoring to last longer. Data was sampled and buffered hourly, then broadcast and verified for status signals, and the system was created with such a microcontroller, anuniversal asynchronous receiver transmitter (UART) connection, and sensor. The system's drawbacks were its expensive cost and the sensor's underground location that caused Radio waves to be muted. [10][26]

Ranya et al. introduced the Agricultural Landslide Susceptibility Evaluation (ALSE) to analyses multiple kinds of land to identify the right soil for crop production by assessing geo-environmental factor. ALSE used Global Knowledge System abilities to assess land based on the regional climate factors via a computer map and then make decisions based on that data. [11-19]

III. ARCHITECTURE

A. Block schematic of an irrigation system

The system's block diagram is shown in Figure 1.Here Esp8266 Node MCU acts asamicrocontroller which is connected to soil moisture sensor and relay board. The sensor detects the ground water level and sends an analog data to the receiver. Andbased on the threshold value the controller sends signal to relay board, which is connected to Waterpump.

ISSN: 1539-854X
www.newjournalzone.in

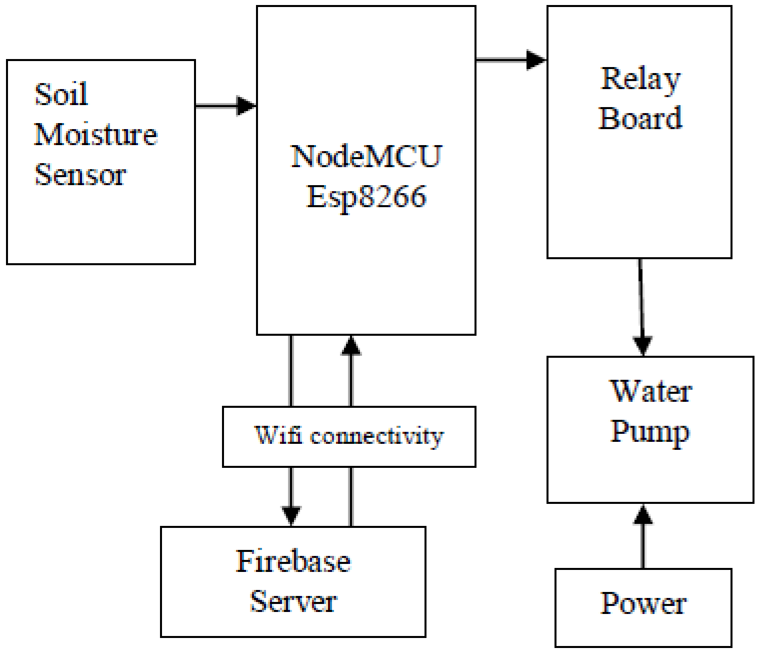


Figure 1 Architecture of Proposed System

Figure 1 depicts the proposed system's architectural block diagram in terms of the various irrigation sub modules and how they are connected with each other's..

A. *Measurement of soil moisture in IrrigationSystem*

The quantity of moisture in the soil around a temperature sensor may be measured. It's a simple sensor, but it's perfect for keeping an eye on an urban garden or a little plant's water level. This sensor works by passing power through the soil with two probes, then reading the resistance to determine the moisture content. More water allows the soil to transmit electricity more freely (with less resistance), but dry soil does not (more resistance). As shown in the diagram, the sensors includes a new potentiometer for adjusting the sensitivity of a digital output (D0), in addition to a powered LED and a digital output LED [20-54]

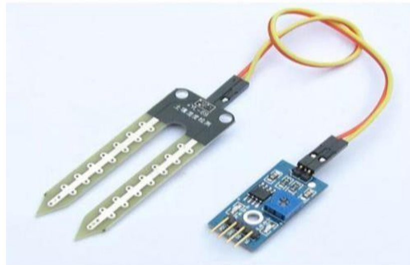


Figure 2 YL-69 Moisture sensor

The moisture sensor shown in Figure 2 is used to monitor soil moisture levels.

B. *Role ofcontroller*

The system is controlled by a Node MCU microcontroller, which is linked to an esp8266 Wi-Fi module. Microcontroller Unit (MCU) is an abbreviation meaning "computer on a single chip." A microcontroller is a computer with one or more CPUs (processing cores), memory, and input/output peripherals that have been programmed.

Figure 3 Esp8266 NodeMCU

Figure 3 depicts a microcontroller-based development board that was used to process and operate various electrical components.

D. *Water pump on/off through Relay Board*

Relay with four channels Module boards are used to connect any Microcontroller to electrical appliances and loads, and they may also be used to drive high-powered motors. Each channel on the 5V four channels relay interface board requires a 15-20mA driving current. It may be utilized to regulate a variety of large-current appliances and equipment.

Figure 4 RelayBoard and WaterPump

A relay board and water pump components are shown in Figure 4 for regulating water flow for soil irrigation.

E. *Controller Interfacing*

All of the modules communicate with the microcontroller. The moisture content in the soil the moisture content of the soil and sends analog information to the receiver. In addition, the system controller sends digital signals to the relay to convey control orders. Ionic is a mobile app development framework that is open source. It offers products and technologies for creating native-looking mobile interfaces. To operate on mobile devices, the Ionic framework requires a native wrapper. An android app is also being created for this soil watering system, which offers you complete control and monitoring access.

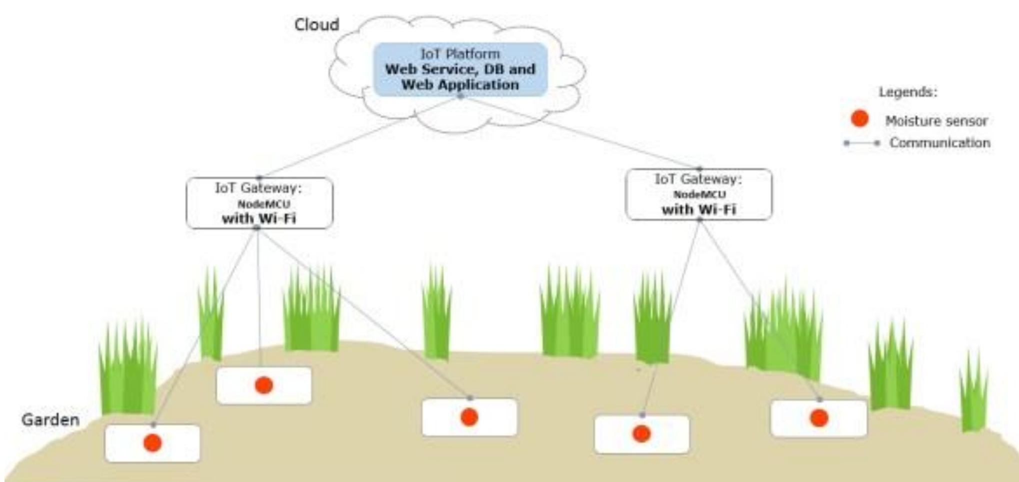


Figure 5 complete controlling interfacing

Figure 5 depicts the interfacing of various components and the communication paradigm for the system's seamless operation.

F. Role ofIoT

IoT uses some web-enabled devices like- Sensors, Antenna, Microcontrollers etc. to emit, accept and process data. The data is further passed down to communication channels where further processing and conversion takes place. Once the data is processed then it is directed for the analysis and projections are sent to remote device (IoT apps of smart phones, PCs etc). Once the data is processed then it is directed for the analysis and projections are sent to remote device (IoT apps of smart phones, PCsetc).

F. Ionic Framework

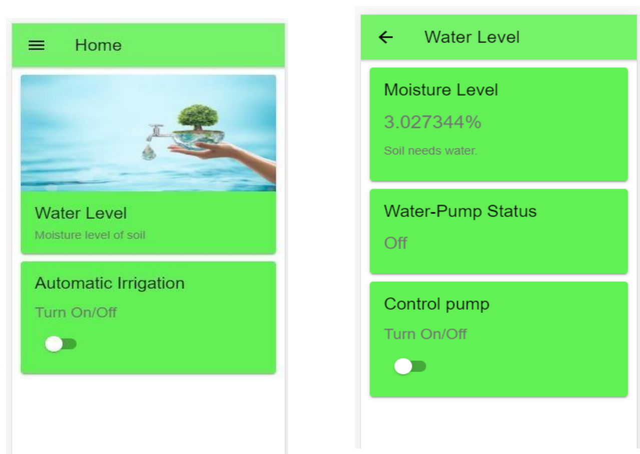
Ionic is a mobile app development framework that is open source. It offers products and technologies for creating native-looking mobile interfaces. To operate on mobile devices, the Ionic framework requires a native wrapper. An android app is also being created for this soil watering system, which offers you complete control and monitoring access.

IV IMPLEMENTATION

The implementation of the system comprises of the following steps:

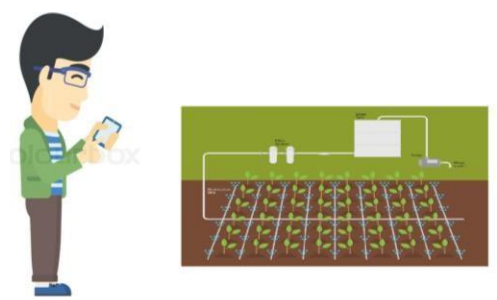
1. A soil moisture sensor detects moisture levels and provides an analogue signal to a Node MCU controller.
2. The Node MCU controller is connected to the relay board and also with the firebase server through which the data is displayed on the application aswell.

3. The moisture level then is compared to the program's threshold value, which is set at 40.
4. The water pump is started through relay board if the soil moisture is below threshold value, and the water pump is shut off automatically if the soil moisture exceeds the threshold value.



5. Turning the water pump on and off can also be controlled manually by toggling off the automaticmode.

6. The application also shows real-time monitor of the water content and pump status.



V. EXPERIMENT AND RESULTANALYSIS

The system records ambient temperature, relative humidity, soil moisture, light levels, CO2, O3, O2, & NO2. The system employs intelligent monitoring and automated planning and control strategies as a result of the data analysis. For improved user interactions, artificial intelligence and machine learning approaches are utilized. Six phases comprise the installation of a smart home:

1. Device installation
2. Equipment enrollment
3. User registration
4. Authorization assignment
5. Equipment configuration

Configuration of the automatic planning strategy experiments with their respective results are shown in the following table

S. no.	**Experiments**			
	Scenerios	***Expected result***	***Actual result***	***Status***
1	Check whether NodeMCU esp8266 is working or not	Successful	Successful	Success
2	Check whether YL-69 Soil Moisture sensor is	Successfu	Successful	Success
3	Check whether NodeMCU esp8266 Wifi Module	Successfu	Successful	Success

Date and Time	Temperature	Humidity	Soil Moisture Percentage
2020-05-23 05:15:00	28.35	85	89
2020-05-23 05:30:00	28.35	85	89
2020-05-23 05:45:00	28.84	85	89
2020-05-23 06:00:00	27.86	85	89
2020-05-23 06:15:00	27.37	86	90
2020-05-23 06:30:00	27.37	86	90
2020-05-23 06:45:00	27.37	86	90

VI. CONCLUSION

The propose system offers an alternate user interface for operating the irrigation system in the most effective way possible. It proposes the notion of monitoring the soil moisture level in an agricultural region and controlling the irrigation system with an Android handset. As a result, the entire implementation cost is low and accessible to the average individual. In light of the current scenario, the team has chosen the Android application so that the majority of people may profit. To validate the framework, an experiment investigating the development of a Korean Ginseng plant is planned and implemented in a prototypes smart home system. The experiment's intelligent cultivating approach is meant to regulate the growing of Korean Ginseng by adjusting the major environmental variables. The experiment's results confirm the expectation. The security and privacy concerns associated with smart homes are advised to be handled in the future, as is the assessment of the user's quality of life.

Competing of Interest: The authors declare that they have no conflicts of interest to report regarding the present study.

Author contribution: All authors have accepted responsibility for the entire content of this manuscript and approved its submission.

Ethical and informed consent for data used: The research conducted research is not related to either human or animals use

Data Availability Statement: The data that support the findings of this study are available on request from the corresponding author.

Funding Statement*:* The author(s) received no specific funding for this study.

Acknowledgement: Thanks to the reviewing committee for their valuable points and notes.

REFERENCES

[1] Nayyar, A. and Puri, V., 2016, September. Smart farming: IoT based smart sensors agriculture stick for live temperature and moisture monitoring using Arduino, cloud computing & solar technology. In Proc. of The International Conference on Communication and Computing Systems (ICCCS-2016) (pp. 9781315364094-121).

[2] Gorli, R. and Yamini, G., 2017. Future of smart farming with Internet of things. Journal of Information Technology and Its Applications, 2(1).

[3] S. jegadeesan, dr. g. k. d. Prasannavenkatesan Smart cow health monitoring, farm environmental monitoring and control system using wireless sensor networks, International journal of advanced engineering technology, Jan-March 2016, page 334-339

[4] IoT based agriculture monitoring and smart irrigation system using raspberry pi, International Research Journal of Engineering and Technology (IRJET), Volume: 05(01), Jan-2018, Page 1417

[5] S. R. Nandurkar, V. R. Thool, R. C. Thool, “Design and Development of Precision Agriculture System Using Wireless Sensor Network”, IEEE International Conference on Automation, Control, Energy and Systems (ACES), 2014

[6] JoaquínGutiérrez, Juan Francisco Villa-Medina, Alejandra Nieto-Garibay, and Miguel ÁngelPorta-Gándara, “Automated Irrigation System Using a Wireless Sensor Network and GPRS Module”,IEEE TRANSACTIONS ON INSTRUMENTATION AND MEASUREMENT, 0018-9456,2013

[7] Dr. V .VidyaDevi,G. MeenaKumari, “Real- Time Automation and Monitoring System for Modernized Agriculture” ,International Journal of Review and Research in Applied

Sciences and Engineering (IJRRASE) Vol3 No.1. PP 7-12, 2013

[8] Y. Kim, R. Evans and W. Iversen, "Remote Sensing and Control of an Irrigation System Using a Distributed Wireless Sensor Network", IEEE Transactions on Instrumentation and Measurement, pp. 1379–1387, 2008

[9] Q. Wang, A. Terzis and A. Szalay, "A Novel Soil Measuring Wireless Sensor Network", IEEE Transactions on Instrumentation and Measurement, pp. 412–415, 2010

[10] Elsheikh, R., Shariff, A.R.B.M., Amiri, F., Ahmad, N.B., Balasundram, S.K. and Soom, M.A.M., 2013. Agriculture Land Suitability Evaluator (ALSE): A decision and planning support tool for tropical and subtropical crops. Computers and electronics in agriculture, 93, pp.98-110.

[11] Gupta, P. and Kulkarni, N., 2013. An introduction of soft computing approach over hard computing. International Journal of Latest Trends in Engineering and Technology (IJLTET), 3(1), pp.254-258.

[12] Farooq, O. and Gupta, P., 2020, March. Machine learning approaches for IoT-data classification. In Proceedings of the International Conference on Innovative Computing & Communications (ICICC).

[13] Gupta, P., Kumar, S., Singh, Y.B., Singh, P., Sharma, S.K. and Rathore, N.K., 2019. The impact of artificial intelligence on renewable energy systems. NeuroQuantology, 20(16), pp.5012-5029.

[14] Ashraf, M.; Waheed, A. Responses of some local/exotic accessions of lentil (Lens culinaris Medic.) to salinity stress. J. Agron. Crop. Sci. 1993, 170, 103112

[15] Habtamu, A.A. Impact of salinity on tolerance, vigor, and seedling relative water content of haricot bean (Phaseolus vulgaris L.)cultivars. J. Plant Sci. 2013, 1, 22–27

[16] Jayawardane, N.; Chan, K. The management of soil physical properties limiting crop production in Australian sodic soils: Areview.Soil Res. 1994, 32, 13–44

[17] Daba, A.W.; Qureshi, A.S.; Nisaren, B.N. Evaluation of Some Rhodes Grass (Chlorisgayana) Genotypes for Their Salt Tolerance,Biomass Yield and Nutrient Composition. Appl. Sci. 2019, 9, 143

[18] Siyal, A.A.; Siyal, A.G.; Abro, Z.A. Salt affected soils their identification and

reclamation. Pak. J. Appl. Sci. 2002, 2, 537–540

[19] Katembe, W.J.; Ungar, I.A.; Mitchell, J.P. Effect of salinity on germination and seedling growth of two Atriplex species (Chenopodiaceae). Ann. Bot. 1998, 82, 167–175

[20] Girma, T.; Endale, B. Saline and saline-sodic soils of the Middle Awash Valley of Ethiopia. In Proceedings of the 3rd Conference of Ethiopian Society of Soil Science, Addis Ababa, Ethiopia, 28–29 February 1996

[21] FAO (Food and Agricultural Organization). Salinity Affected Soils and Their Management; FAO Soils Bulletin 39; FAO: Rome, Italy, 1988.

[22] Kidane, G.; Abebe, F.; Heluf, G.; Fentaw, A.; Wondimagegne, C.; Hibstu, A.; Asegid, A.; Messele, F.; Mohammed, B. Report of the National Task Force on assessment of salinity affected soils and recommendations on Management Options for Sustainable Utilization. 2006

[23] Mohamed, S.; Tessema, G. Evaluation of soil and water salinity for irrigation in North-eastern Ethiopia: Case study of Fursa small scale irrigation system in Awash River Basin

[24] Zewdie, E. Selected physical, chemical and mineralogical characteristics of major soils occurring in Character Highlands, Eastern Ethiopia. Ethiop. J. Nat. Resour. 2001, 1, 173–185.

[25] Rathore, Neeraj, and Inderveer Chana. "Load balancing and job migration techniques in grid: a survey of recent trends." Wireless Personal Communications 79.3 (2014): 2089-2125.

[26] Vishal Sharma, Rajesh Kumar & Neeraj Kumar Rathore, "Topological Broadcasting Using Parameter Sensitivity Based Logical Proximity Graphs in Coordinated Ground-Flying Ad Hoc Networks", Journal of Wireless Mobile Networks Ubiquitous Computing and Dependable Applications (JoWUA), SCOPUS indexed, volume: 6, number: 3, pp. 54-72, September 2015

[27] N Kumar Rathore and I Chana, "A Cognitative Analysis of Load Balancing Technique with Job Migration in Grid Environment", World Congress on Information and Communication Technology (WICT), Mumbai, IEEE proceedings paper, ISBN -978-1-4673-0127-5 pp- 77-82, December 2011

[28] Rathore, Neeraj, and Inderveer Chana. "Variable threshold-based hierarchical load balancing technique in Grid." Engineering with computers 31.3 (2015): 597-615.

[29] Rathore NK and I Chana, “A Sender Initiate Based Hierarchical Load Balancing Technique for Grid Using Variable Threshold Value" in International conference IEEE-ISPC, ISBN- 978-1-4673-6188- 0, pp.1-6, 26-28 Sept. 2013.

[30] Rathore, Neeraj, and Inderveer Chana. "Job migration with fault tolerance based QoS scheduling using hash table functionality in social Grid computing." Journal of Intelligent & Fuzzy Systems 27.6 (2014): 2821-2833.

[31] N Rathore and I Chana, “Job Migration Policies for Grid Environment", Wireless Personal Communication, Springer Publication-New-York (USA), volume: 89 (1), pp. 241-269, IF -0.979, July-2016.

[32] NeerajRathore and Inderveer Chana, “Report on Hierarchal Load Balancing Technique in Grid Environment", Journal on Information Technology (JIT), vol. 2, No. 4, ISSN Print: 2277-5110, pp-21-35, Sep - Nov 2013.

[33] Inderveer Chana and RathoreNeeraj Kumar, “Checkpointing Algorithm in Alchemi.NET", Annual conference of VijnanaParishad of Iindia and National Symposium Recent Development in Applied Mathematics & Information Technology , JUET, Guna, M.P., Dec 2009.

[34] N Rathore, “Dynamic Threshold Based Load Balancing Algorithms", Wireless Personal Communication, Springer Publication-New-York (USA), vol: 91 (1), pp. 151-185, Nov 2016.

[35] Inderveer Chana and NK Rathore, “Comparative Analysis of Checkpointing", PIMR Third National IT conference, IT Enabled Practices and Emerging Management Paradigm book and category is Communication Technologies and Security Issues, pp no.-32-35, Topic No/Name-46, Prestige Management and Research, Indore, (MP)India, 2008.

[36] Neeraj Kumar Rathore, “Efficient Agent Based Priority Scheduling and Load Balancing Using Fuzzy Logic In Grid Computing", Journal on Computer Science (JCOM), vol-3, number-3, pp. 11-22, September-November 2015.

[37] Neeraj Kumar Rathore and Inderveer Chana, “Fault Tolerance Algorithm in Alchemi.NET Middleware", National Conference on Education & Research (ConFR10), Third CSI National Conference of CSI Division V, Bhopal Chapter, IEEE Bombay, and MPCST Bhopal, organized by JUIT, India, 6-7th Mar 2010.

[38] N Rathore, “Performance of Hybrid Load Balancing Algorithm in Distributed Web Server

System", Wireless Personal Communication, Springer Publication-New-York (USA), pp. 1233-1246, vol:101 (4), IF -1.200, 2018.

[39] Neeraj Kumar Rathore, "Ethical Hacking & Security Against Cyber Crime", Journal on Information Technology (JIT), vol-5, number-1, pp. 7-11 December 2015-February 2016.

[40] Neeraj Kumar Rathore and Anuradha Sharma, "Efficient Dynamic Distributed Load Balancing Technique", in Lambert Academic Publication House, Germany , Project ID: 127478, ISBN no-978-3-659-78288-6, 19-Oct-2015.

[41] Neeraj Kumar Rathore, "Efficient Hierarchical Load Balancing Technique based on Grid" in 29th M.P. Young Scientist congress, Bhopal, M.P., pp.55, Feb 28, 2014.

[42] Neeraj Kumar Rathore, "Faults in Grid", International Journal of Software and Computer Science Engineering, MANTECH PUBLIATIONS, vol-1, number-1, pp. 1-19, 2016.

[43] Neeraj Kumar Rathore, "Map Reduce Architecture for Grid", Journal on Software Engineering (JSE), vol-10, issue-1, pp 21-30, July-September, 2015.

[44] Neeraj Kumar Rathore, "Efficient Load Balancing Algorithm in Grid" in 30th M.P. Young Scientist congress, Bhopal, M.P., pp-56, Feb 28, 2015.

[45] RohiniChouhan and Neeraj Kumar Rathore, "Comparison of Load Balancing Technique Grid", 17th Annual conference of Gwalior Acadmy of mathematical science and Natoı symposium on computational mathamatics& Information Technology , JUET, Guna, M.P., 9, Dec 2012.

[46] Neeraj Kumar Rathore and RohiniChohan, "An Enhancement of Gridsim Architecture w Load Balancing" in Scholar's Press, Project id: 4900, ISBN: 978-3-639-76989-0, 23-O 2016.

[47] Neeraj Kumar Rathore, "Installation of Alchemi.NET in Computational Grid", Journal Computer Science (JCOM), vol-4, number-2,pp.1-5, June-August 2016.

[48] Neeraj Kumar Rathore and Pramod Singh, "An Efficient Load Balancing Algorithm Distributed Networks" Lambert Academic Publication House (LBA), Germany, ISBN: 978- 659-78892-5, 2016.

[49] Neeraj Kumar Rathore, "GridSim Installation and Implementation Process", Journal on Clo Computing (JCC), vol-2, number-4, pp.29-40 August- October 2015.

[50] N Jain, N Rathore and A Mishra "An Efficient Image Forgery Detection Using Biorthogoı Wavelet Transform and Improved Relevance Vector Machine with Some Attacks

Interciencia Journal, volume: 42 (11), pp. 95-120, 2017.

[51] Neeraj Kumar Rathore and Pramod Kumar Singh, "A Comparative Analysis of Fuzzy bas Load Balancing Algorithm", Journal of Computer Science (JCS), vol-5, No-2, pp. 23-3 June-August 2017.

[52] Neeraj Kumar Rathore "Implementing Checkpointing Algorithm in Alchemi. NET", Mas of Engineering Thesis in CSE, Thapar University, June 2008.