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A Machine Learning Perspective to foster Accuracy and Prediction of Urbanization using Automatic Weather Station

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Abstract

Farmingis largely dependent on the climate. Additionally, poor climatic information seriously impairs both the amount and quality of crop production. However, IoT technologies let you know the current weather conditions. The agricultural fields have sensors installed both inside and outside of them. They gather environmental information that is utilized to choose the best crops for specific climatic circumstances. The entire Internet of Things (IoT) ecosystem is made up of sensors that are highly accurate at detecting real-time meteorological conditions like humidity, rainfall, temperature, and more. Numerous sensors are available to detect each of these factors and can be set up to meet your needs for smart farming. These sensors keep an eye on the state of the crops and the surrounding weather. Organizations and communities may create smart surroundings thanks to weather stations powered by LoRa. This weather station is being developed in India for smart agriculture for helping farmers to increase crop productivity. The following modules include the LoRa WAN Outdoor Gateway along with the following sensors CO2/PM2.5/PM10, Wind Direction & Speed, Rain Gauge, Rain and snow Detect sensor, Temperature, Humidity, Illuminance, Pressure, Total Solar Radiation, PAR (Photosynthetically Available Radiation).

Keywords: IoT technologies, LoRa WAN Outdoor Gateway, Photosynthetically Available Radiation

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I. INTRODUCTION:

A weather station can be described as an instrumental device, which provides us with information about the weather in our neighboring environment. For example, it can provide us with details

about the surrounding temperature, pressure, humidity, light intensity, and intensity of rainfall. There are various types of sensors present in the prototype, using which all the parameters can be measured. It can be used to monitor the temperature or humidity of a particular room/place.

The brain of the prototype is based on LoRaWAN Protocol and the DLOS8 is LoRaWAN Outdoor Gateway. It lets you bridge LoRa wireless network to an IP 10 network via Wi-Fi, Ethernet, 3G, or 4G cellular. The LoRa wireless allows users to send data and reach extremely long ranges at low data rates.

1.1MOTIVATION:

Farmers can ensure higher productivity of crops and lower the risk of weather hazards via the IoT weather Station.Weather Station enables organizations and communities to develop a smart environment.Weather Monitoring System helps in the installation of Renewable Energy Plants and are widely used in the Automotive industry and mining industry.It helps tourists to determine drastic changes in the environment, especially in areas prone to Volcanoes and Rain forests.

II. LITERATURE SURVEY:

Li Ting, Mudassir Khan EMAIL logo, Ashutosh Sharma, and Mohd Dilshad Ansari proposed an intelligent climate and watering agriculture system is presented that is controlled with an Android application for smart water consumption considering small and medium ruler agricultural fields.The proposed design consists of various sensors that collect real-time data from the environment and field such as temperature, soil moisture, light intensity, and humidity. The sensed field information is stored in the IoT cloud platform, and after the analysis of entries, watering is scheduled by implementing intelligent fuzzy logic and blockchain [1].

Anshika Gupta, Ankita Tripathi, Reuben Coutinho, Rhea Rodrigues, and Prachi Raut created a clever, self-sustaining tiny weather station with the goal of covering smaller areas. The system senses 6 different weather characteristics and is built on the ESP32 platform. The gathered information is uploaded to an online database and made accessible via a mobile app and website. Weather measurements per minute may be taken, and the device can operate without an external power source for about 11 hours, according to tests conducted under varied situations. [2].

Ravi Kishore Kodali and Snehashish Mandal proposed an instrument or equipment that gives the user knowledge about the weather in their immediate surroundings is referred to as a weather station. In essence, this gadget measures the numbers for pressure, humidity, light intensity, and

rainfall. It can be used to keep track of temperature or humidity. Other data factors, including the dew point, can be calculated using temperature and humidity. In addition to the aforementioned features, we can also keep an eye on the area's lighting levels. We have also made it possible to keep track of the room's air pressure. The worth of the rain can also be tracked. The prototype's central processing unit is the ESP8266-based Wi-fi module Nodemcu (12E). The DHT11 temperature and humidity sensor, the BMP180 pressure sensor, the raindrop module, and a light-dependent resistor are the four sensors attached to the NodeMCU (LDR). An email and a tweet are sent out whenever these values go above a specified threshold limit for each SMS, alerting the appliance's owner to take appropriate action. [3].

Zhen Fang, Zhan Zhao, Lidong. Du, Jiangang Zhang, Cheng Pang, and DaoquGengcreated an innovative and useful micro weather station that is portable, tiny in size, and has high precision. It can measure temperature, relative humidity, pressure, and an anemometer. A multi-sensor chip, anemometer, measurement system, display system, and power management system make up the micro weather station. A multi-sensor chip with integrated temperature, relative humidity, and pressure is created using MEMS technology. The development of a drag force wind sensor that measures wind velocity by using the cantilever's torque. By encasing the two-wind sensor perpendicularly, the wind direction may be determined. The procedures we utilized were really straightforward and compatible with different types of micro weather stations. All the outcomes demonstrate our tiny weather station's exceptional performance. [4].

AnangSuryana, Fitra Phila Lismana, Rizky Maulana Rachmat, SeptianDwi Putra, and Marina Artiyasainstalled a weather station to display the weather in the room. An instrument called an Automatic Weather Station can be used to track weather changes (AWS). Temperature, relative humidity, air pressure, wind speed, light intensity, and other meteorological variables are measured by weather stations. a website that offers weather information, among them OpenWeatherMap [5].

High Speed Networks such as WiGig Networks, Cognitive Radio Networks(CRNs) and Machine Learning methods can accelerate data collection and validation from the field[6][7] [8] [9].

III. SYSTEM MODEL:

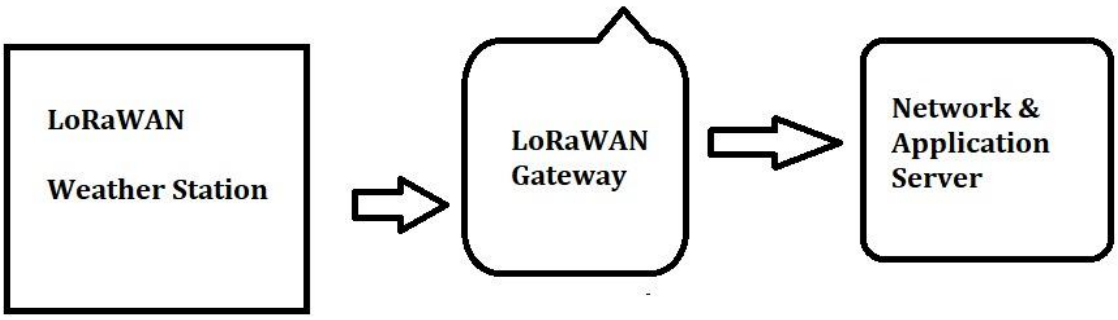

Figure 1.

Figure 1 shows us the basic overview of how the values from the sensors are transmitted to the IoT server via LoRaWAN gateway.

Figure 2.

Figure 2 shows the internal weather station and the connection between the sensors. The data from the sensors send through the RS485 module to the main processing unit. The WSC1-L uploads the data to the IoT server by using a LoRaWAN gateway. The data uploaded in the IoT server is decoded on the network side and displayed the decoded values in the application server.

The DLOS8 is an open-source outdoor LoRaWAN Gateway. It lets you bridge LoRa wireless network to an IP network via Wi-Fi, Ethernet, 3G, or 4G cellular (3G/4G is supported by an optional module).

3.1 DESCRIPTION:

3.1.1 Methodology

The proposed work aims to ease the monitoring of local weather conditions in real-time from anywhere in the world. Storing weather and environmental data for short and long term for studying weather pattern changes and to understand how human-induced climate change affects local weather is significant. The proposed work helps farmers to ensure higher productivity of crops and lower the risk of weather hazards.The proposed smart weather station can be easily deployed for monitoring local atmospheric conditions and microclimates for weather forecasting and prediction.LoRa-based weather station enables organizations and communities to develop smart environments.Many Coal mining industries and high-rise apartments in India are developing this weather station for safe and comfortable living.

3.2.2 Working

Outdoor LoRaWAN RS485 end node. It is powered by external 12v solar power and has a built-in li-on backup battery.MPU reads values from various sensors and uploads these sensor data to the IoT server via LoRaWAN wireless protocol.It is fully compatible with LoRaWAN Class A protocol, it can work with standard LoRaWAN gateway.This is pre-loaded with a set of unique keys for LoRaWAN registration, register these keys to the local LoRaWAN server and it will auto-connect after powering on.Usage of LoRaWAN gateway such as LoRaWAN v 1.0.3 Class A Protocol.It uses RS485/Modbus protocol and Frequency Bands: IN865. It employs both network and application server. It employs various sensors such as LoRaWAN outdoor Gateway along with the following sensors as Wind Speed and Direction, C02/PM 2.5, Rain and Slow detection sensor, Temperature, Humidity and Illuminance, Pressure, Total Solar Radiation, PAR (Photosynthetically Active Radiation).LoRaWAN gateway Covers 5 km in Urban, 20 in rural, and it has a Frequency range between (865-867 MHz).

Monitoring of climate conditions: Probably the most popular smart agriculture gadgets are weather stations, combining various smart farming sensors. Located across the field, they collect various data from the environment and send it to the cloud. The provided measurements can be used to map the climate conditions, choose the appropriate crops, and take the required measures to improve their capacity (i.e precision farming).

Weather Forecasting: Farmers employ satellite weather forecasts to decide when it is appropriate to plant or harvest during the season. Weather stations with smart sensors can collect data and send valuable information to a farmer.Furthermore, complex software analyzes the data, providing ready-made analysis that helps farmers gain an accurate forecast helping avoid crop failure.

Agility: One of the benefits of using IoT in agriculture is the increased agility of the processes. Thanks to real-time monitoring and prediction systems, farmers can quickly respond to any significant change in weather, humidity, air quality as well as the health of each crop or soil in the field. In the conditions of extreme weather changes, new capabilities help agriculture professionals save crops.

Drought Monitoring: A big challenge for many farmers is dealing with drought conditions. IoT solutions can help farmers detect water shortages before they become a problem. Some systems can even provide information on when and where to irrigate in order to maximize crop watering.

The available features of weather conditions monitoring IoT technology. In your smart weather monitoring dashboard, we can easily configure the number of samples per day, track historical measurements over a set date range, view where sensors are in your fields, view smart dashboards with monitored metrics, utilize better sensor fleet management tools, set alarms and thresholds when data shows action is needed, set open data or secure data options.

By monitoring the data and metrics mentioned above, farmers find a wealth of benefits, including higher production quality and quantity. Other benefits includeSave costs: smart farming leaders to lower costs on labor, water, and nutrients for crops, save water resources: knowing the exact rainfall for each crop can help optimize watering, thus preventing overwatering, which can impact not only crop health, but the environment, save time and be more organized: being able to view water levels and weather conditions remotely saves the time it takes to physically go out to the fields. In addition, by knowing weather patterns, you are able to better plan out what needs done during the day while avoiding rain or other weather, Easier to make decisions: Everything from pesticides, seeding, irrigation, and labor can be done more accurately with precise data. You can better predict spraying times by tracking historical weather patterns for the exact area and better anticipate disease risks through weather patterns and conditions.More efficient crop monitoring with less human error: automatic monitoring will lead to more accurate data in less time and with less labor.

IV. RESULTS

Our network and application servers are both hosted on the things mate server. The data on the network server is unstable. Between the gateway and the application server, the network server serves as a medium. The data is erased from the network server as it is saved in the application server.

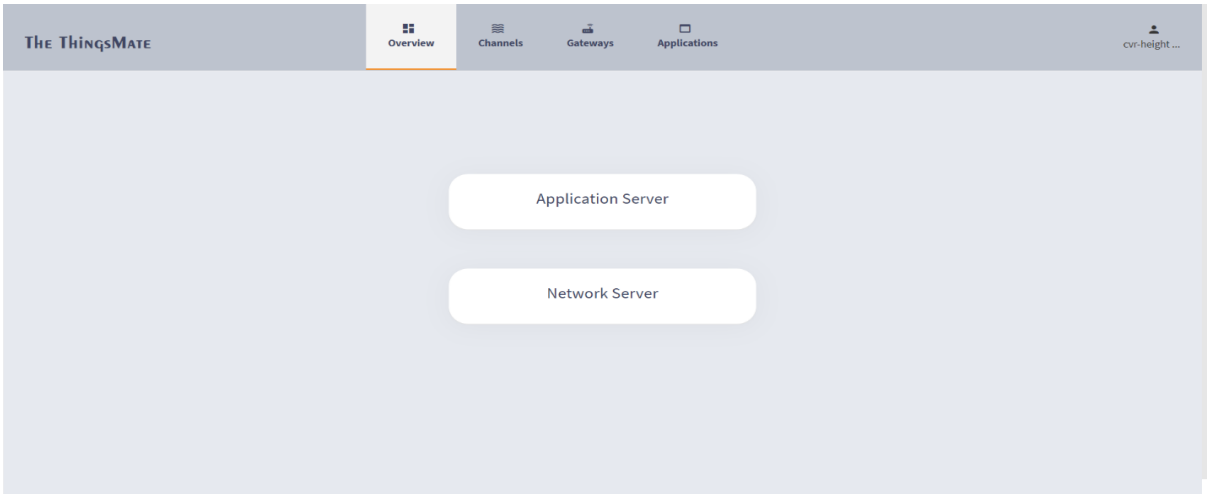

Figure 3. Things mate server

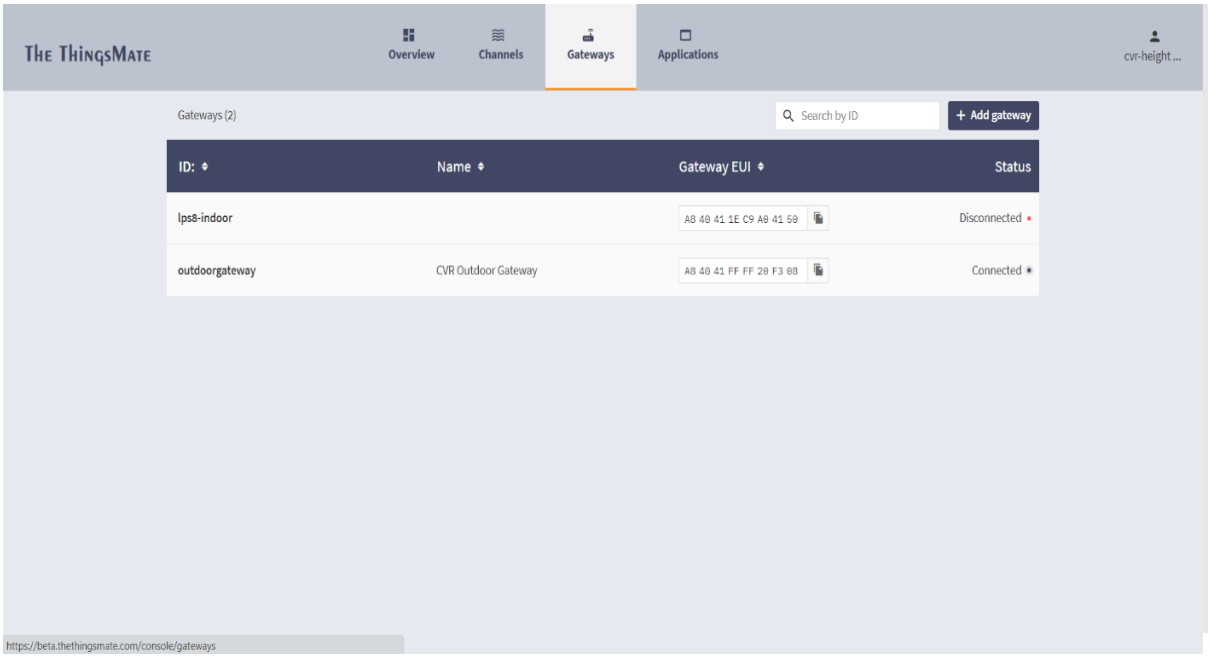

Figure 4. Connected Gateway

```
In [56]: print(dataframe)
       Rain on Tomorrow Rain prediction tomorrow
0                   Yes                       No
1                   Yes                       No
2                    No                       No
3                    No                      Yes
4                    No                       No
...                 ...                      ...
29087                No                      Yes
29088                No                       No
29089               Yes                       No
29090                No                       No
29091                No                       No

[29092 rows x 2 columns]

In [65]: dataframe.to_csv('ouput.csv')

         accuracy

In [64]: from sklearn.metrics import accuracy_score
         accuracy_score(Y_test,y_pred)

Out[64]: 0.8521930427608965
```

Figure 5. We have Built this model using ML with help of random classifier and we have predicted the rainfall and itsAccuracy is 85%

CVR Weather Station Report

CVR - Weather Station Report

Refresh

time	hum	tem	pressure	co2	pm2_5	pm10	wind_speed	wind_direction	wind_direction_angle	rain_gauge	illumination	tsr	par
04/01/23 11:24	76.8	28.8	957.8	614	55	68	0.6	SE	132.8	0	86420	252	657
04/01/23 11:19	76.8	28.2	957.9	613	53	68	0.9	SE	132.8	0	83540	245.8	638
04/01/23 11:14	77.8	28.2	957.9	600	56	73	0.9	SE	132.8	0	83510	245.1	635
04/01/23 11:09	78.6	28.2	958.1	590	57	73	0.7	SE	132.8	0	82890	242.9	629
04/01/23 11:04	78	28.1	958.1	603	55	71	1.6	SE	132.8	0	81410	241.8	623
04/01/23 10:59	78.6	27.7	958.1	595	55	73	0.5	SE	132.8	0	80170	238.3	613
04/01/23 10:54	79.8	27.5	958.2	594	57	72	0.9	SE	132.8	0	79730	235.8	606
04/01/23 10:49	80.1	27.4	958.2	576	57	73	0.9	SE	132.8	0	80360	237.6	610
04/01/23 10:44	81.1	27.4	958.3	598	55	71	0.6	SE	132.8	0	77910	232.1	593
04/01/23 10:39	81.3	27.1	958.4	599	56	73	1.9	SE	132.8	0	74510	222.9	569
04/01/23 10:34	81.7	27.2	958.4	577	58	73	3	SE	132.8	0	74620	225.5	573
04/01/23 10:29	82.5	26.7	958.4	592	57	73	1.4	SE	132.8	0	73480	220.4	559
04/01/23 10:24	83.1	26.7	958.4	557	59	77	1.3	SE	132.8	0	72120	218.4	552
04/01/23 10:19	84.1	26.2	958.5	525	58	77	1.1	SE	132.8	0	70100	215.3	543

Figure 6. Weather Report

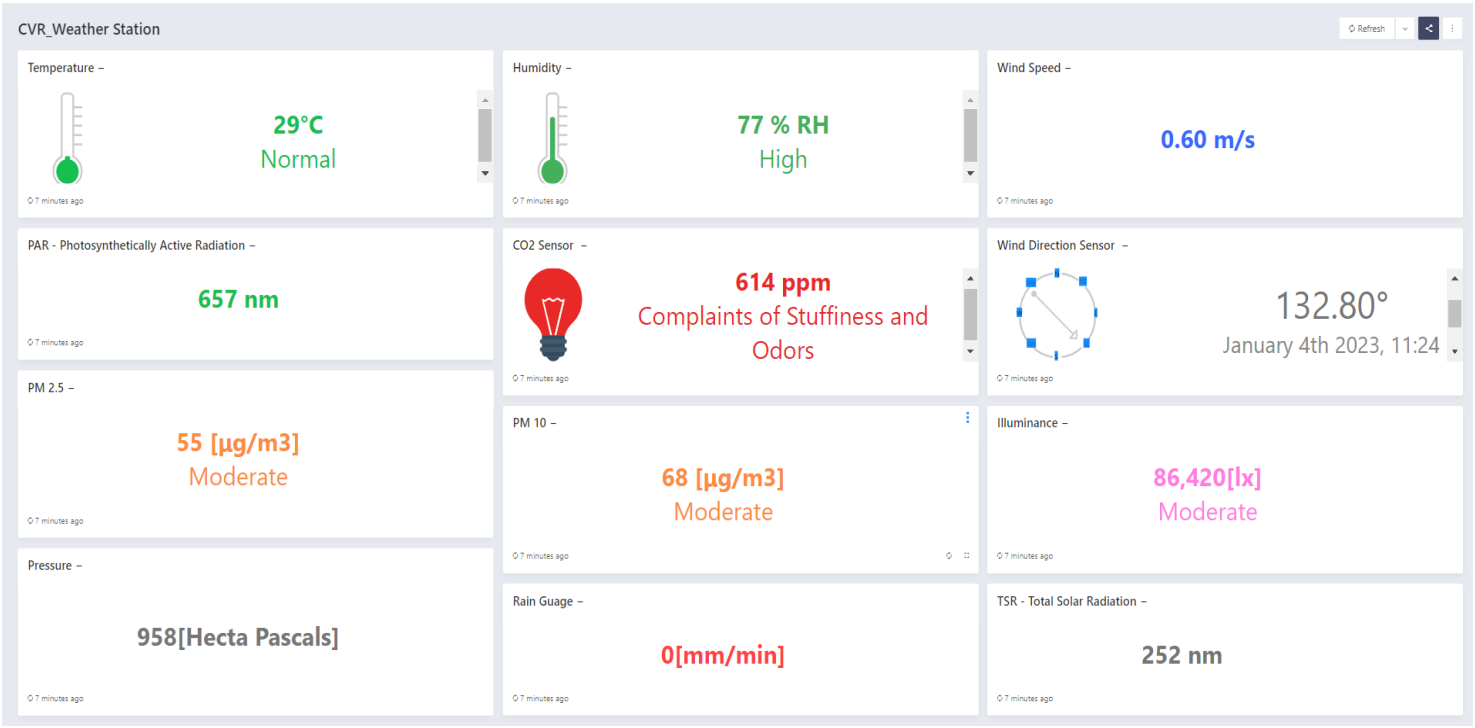

Figure 6. Dashboard Displaying the Various Parameters of Weather Station

V. CONCLUSION

Smart Environment is created by deploying Solar-Powered IoT Weather Station. Crop yield can be increased, and weather hazards can be avoided, by farmers.The model offers a practical method for ongoing environmental monitoring, safeguarding the public's health, and improving the accuracy of weather forecasts in general.

VI. FUTURE SCOPE

There is a wide application for this real-time system in the aviation, navigation, and military industries. It can also be used in hospitals or other medical facilities for research and studies on the "Effect of Weather on Health and Diseases," improving warnings for precautions. It doesn't need any physical data centres because we are constructing a data server in the cloud, negating the requirement for any additional data centres. As a result, it lowers equipment costs. The Internet of Things weather station is useful for tracking the weather in regions like volcanoes and rainforests.Any area can be transformed into a smart environment for data collection and environment analysis with real-time monitoring with the aid of embedded devices and sensors.

REFERENCES

[1] Ting, Li, Khan, Mudassir, Sharma, Ashutosh and Ansari, Mohd Dilshad. "A secure framework for IoT-based smart climate agriculture system: Toward blockchain and edge computing" Journal of Intelligent Systems, vol. 31, no. 1, 2022, pp. 221-236. https://doi.org/10.1515/jisys-2022-0012

[2] A. Gupta, A. Tripathi, R. Coutinho, R. Rodrigues and P. Raut, "Smart Sustainable Mini Weather Station," 2021 IEEE 9th Region 10 Humanitarian Technology Conference (R10-HTC), 2021, pp. 01-05, doi: 10.1109/R10-HTC53172.2021.9641672.

[3] R. K. Kodali and S. Mandal, "IoT based weather station," 2016 International Conference on Control, Instrumentation, Communication and Computational Technologies (ICCICCT), 2016, pp. 680-683, doi: 10.1109/ICCICCT.2016.7988038.

[4] Z. Fang, Z. Zhao, L. Du, J. Zhang, C. Pang and D. Geng, "A new portable micro weather station," 2010 IEEE 5th International Conference on Nano/Micro Engineered and Molecular Systems, 2010, pp. 379-382, doi: 10.1109/NEMS.2010.5592239.

[5] A. Suryana, F. P. Lismana, R. M. Rachmat, S. D. Putra and M. Artiyasa, "Implementation of Weather Station for The Weather Reality In A Room," 2020 6th International Conference on Computing Engineering and Design (ICCED), 2020, pp. 1-6, doi: 10.1109/ICCED51276.2020.9415799.

[6] S. Praveen Chakkravarthy, V. Arthi, Leeban Moses "Performance Analysis of 60 GHz Wireless Communications for Wigig Networks" Vol.8, Issue 10, International Journal of Innovative Technology and Exploring Engineering, pp. 4213 – 4216, August 2019.

[7] S. Praveen Chakkravarthy, V. Arthi, Leeban Moses "A machine learning perspective to foster the next generation 5g networks" Vol.8, Issue 11, pp 3598-3603, November 2019.

[8] V.Arthi, S. Praveen Chakkravarthy ,2017 'Performance analysis of Multicarrier CDMA Transceiver system using a novel dynamic decoding and scheduling procedure' CVR Journal of Science and Technology, pp.21-24

[9] Dr.V. Arthi, Dr. S. Praveen Chakkravarthy, Ms.R. Ramya, 2016, 'Threshold optimization based on Energy detection in Cognitive Radio Networks', Australian Journal of Basic and Applied Sciences, vol.10, no.1, pp.586-591.