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Real Time Water Monitoring System Using NodeMCU ESMP8266

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Abstract:

Water is one of the most important resource for human beings. In the world, water pollution contributes to almost 1.8 million deaths. In order to ensure that people have access to clean water for drinking and other activities in both cities and villages, certain measures must be taken to monitor the quality of water continuously. The conventional method of assessing the quality of the water involves manually collecting water samples and sending them to a lab for testing and analysis. This method is labor-intensive, time-consuming, and inefficient. However, with the recent development in the fields of IoT and Wireless Sensor Networks, a Real Time Water Quality Monitoring System can be developed which can track the quality of water continuously and efficiently. In this Paper, the proposed system consists of several sensors which measure various parameters such as pH, turbidity and conductivity of water. A Microcontroller Unit NodeMCU ESMP8266 is interfaced with these sensors to collect the data, further processing is performed on a Personal Computer (PC). The obtained data is sent to the cloud by using IoT based ThinkSpeak application to monitor the quality of the water.

1. Introduction:

The five important elements on Earth: soil, water, climate, vegetation, and landforms. One of most important of these for human life is water. Additionally, it is necessary for the survival of other living habitats. Water is also required for many purposes: drinking, domestic use, agriculture, production and recreational purposes. Therefore, it is crucial to maintain the quality of water. Otherwise, it would lead to serious harm to human health while causing significant damage to the ecological balance. The water quality can be monitored by tracking different water parameters like pH, turbidity, conductivity, temperature, etc. pH measures the concentration of hydrogen ions. For pure water the ideal pH value is 7. Turbidity is the measure of suspended particles. Clean water has low turbidity. Conductivity sensor measures the amount of cations and anions present in the water. It should be in the range of 50-150. The system proposed in this paper is a low cost real time water monitoring system which measures different

water parameters, the data is then sent to ThingSpeak (an IoT application) for continuous remote monitoring via NodeMCU ESMP8266 development board.

The paper is structured in a following way: Section 2 presents related work. Section 3 describes our approach using NodeMCU ESMP8266. In Section 4 we present the results of our experiment. Finally Section 5 concludes the study direction and future works.

2. Literature Review:

Omar Faruq et al [1] (2017) developed a water quality monitoring system using microcontrollers for the people living in the outskirts of Bangladesh, where clean drinking water is not available. The device designed has high degree of accuracy and is sensitive to different water parameters like temperature, turbidity, hydrogen potential displayed on LCD.

"QOI-Aware Energy Management in Internet-of-Things Sensory Environments" by Zhanwei Sun, Chi Harold Li, Chatschik Bisdikian, Joel W. Branch, and Bo Yang. This research examines an effective energy management framework for delivering a satisfying QOI experience in IOT sensory environments. Contrary to earlier attempts, it is transparent and compatible with lower protocols, maintaining energy efficiency over time without compromising any QOI levels that have been obtained. In particular, the new idea of "sensor-to-task relevance" that expressly takes into account both the QOI requirements of a task and the sensing capabilities supplied by a sensor to the IOT sensory environments. In choosing the sensors to serve a task over time, the concept "critical covering set" is used. At runtime, a dynamic decision is taken about energy management. This paper proposes an extensive case study of using sensor net to perform water quality monitoring. [2]

The creation and application of a transportable, mobile, affordable, and dependable water level control system were covered by Lambrou et al. [3] (2014). In order to check the water quality, the authors employed two radio frequency (RF) transceivers and a transmitter positioned on the tank and sump. The wireless RF transceivers used to connect to the internet server. Unless the water bottle is empty or overflows, the system is entirely programmed by the user with the aid of a microcontroller. The sensor array is used to measure a variety of factors, including temperature, pH, dissolved oxygen, and tumble. The wireless system lowers installation expenses.

Based on GPRS/GSM, Qiao Tie-Zhn [4] created an online system for tracking water quality. The data was transmitted via the GPRS network, which made it possible to check the water quality parameters remotely.

A low-cost system devised by Vijayakumar et al. [5] for real-time IoT water quality monitoring makes use of sensors to examine numerous significant physical and chemical aspects of water. Water

characteristics like turbidity, temperature, pH, and conductivity of dissolved oxygen can be measured. Also role of ML and advanced microcontrollers [6-33] are becoming important in latest applications and control.

3. Proposed System

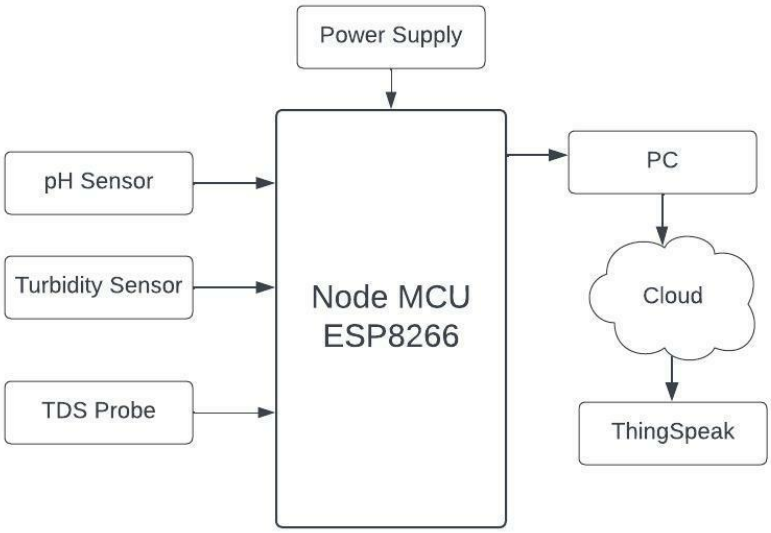

Fig. 1 Block Diagram of Proposed System

The block diagram of proposed system is shown in the Fig.1. The system consist of several sensors like pH sensor, turbidity sensor, TDS probe and a micro-controller unit (Node MCU ESP8266). The values of different water parameters are collected from the sensors and is send to the micro-controller unit for appropriate processing. The processed data is forwarded to ThingSpeak where the water parameters values are displayed in graph format for continuous remote monitoring

pH sensor : pH sensor measures the acidity or alkalinity of water ranging in between 0-14. pH is defined as negative log of hydrogen ion concentration. For acidic solutions the pH value is less than 7 while for alkaline solutions pH value is greater than 7. Pure water has pH 7. pH sensor has measuring electrode and a reference electrode. Battery positive terminal is connected to measuring electrode and reference electrode is connected to negative terminal of battery. The potential of reference electrode is fixed whereas the potential across measuring electrode varies as per the hydrogen ion concentration in water. By mathematically processing the varied potential the pH value is obtained.

Turbidity sensor: Turbidity is the calculation of the water clearness i.e. the number of suspended particles in water. The turbidity sensor makes use of light to detect the suspended particles to evaluate light transmit and dispersion rate. The sensor produces both analog and digital output. NTU (Nephelometric Turbidity Unit) is the unit of turbidity.

Conductivity Sensor (TDS): The total dissolved solid is the sum of cations (positively charged) and anions (negatively charged) ions in the water. The most suitable and acceptable value of TDS lies in the range of 50-150. If the value of TDS is above 1000 ppm, it is considered unfit to use.

Node MCU ESP8266: Node MCU is an open source software and hardware development environment built around ESP8266. The NodeMCU ESP8266 development board comes with the ESP-12 module containing the ESP8266 chip. For other controllers like Arduino separate wifi module is required, here NodeMCU ESP8266 is used as a micro-controller as well as wifi module. The code is written in Embedded-C using Arduino IDE.

Thing Speak: ThingSpeak is an open source IoT application which is used to store and retrieve data from sensors and things using Local Area Network (LAN) or HTTP over Internet. ThingSpeak channel supports 8 data fields, elevation, attitude, longitude and status. It can send sensor data to cloud to store data in channel as cloud provides easy access to stored data.

4. Prototype Testing and Results

The developed prototype shown in Fig.2 is tested under two conditions. First is the indoor test condition where the known water samples are tested for to check proper working of the prototype. Other is the outdoor field testing where the water sample tested is unknown and is a natural water body.

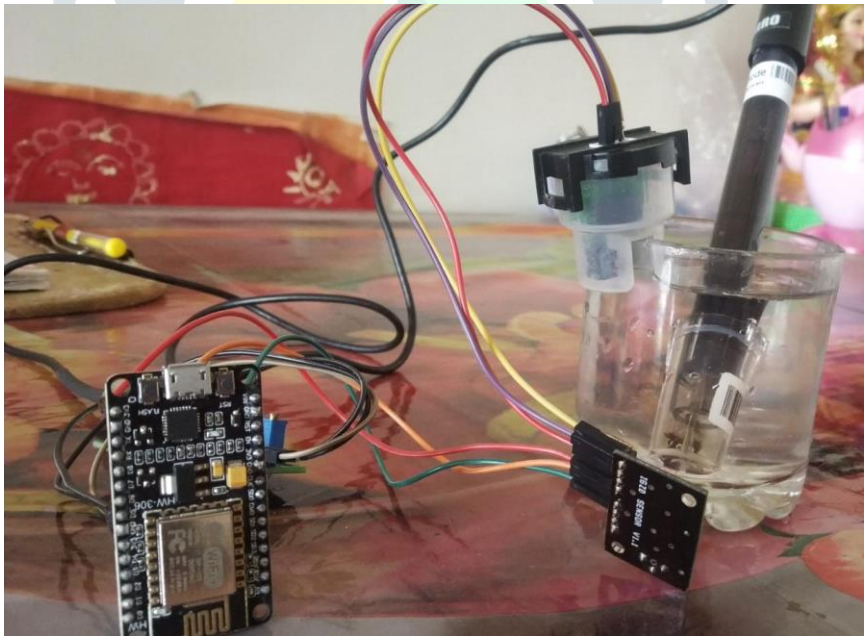

Fig. 2 System design model of water quality monitoring system

Indoor Testing: The water sample taken for test was tap water. The water was taken in a tub and the sensor platform was made to float on it whereas the interface, processor and transmitting module was kept on ground. Both transmitter and receiver were connected to same Wi-Fi network and SSH server client link was established for data transmission.

Output of pH sensor:-

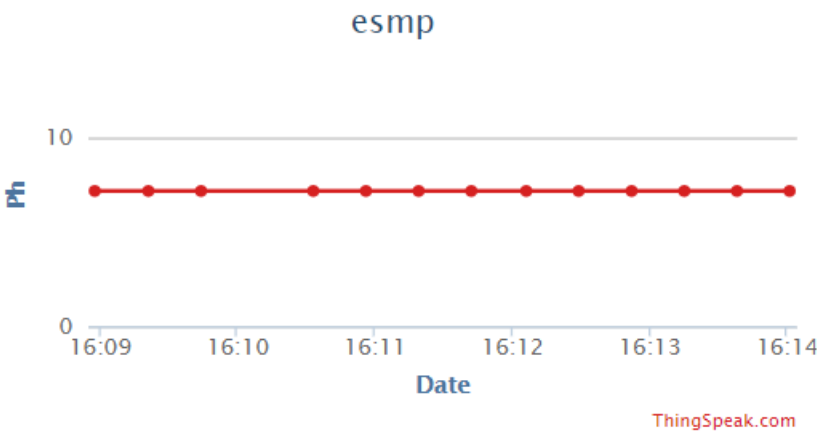

Fig.3 pH Output

In Fig. 3 pH for tap water (fresh water) is measured. The pH value is constant to 7.2 for the measured source. Hence it can conclude that the water is fresh in accordance with pH sensor value.

Output of Turbidity Sensor:-

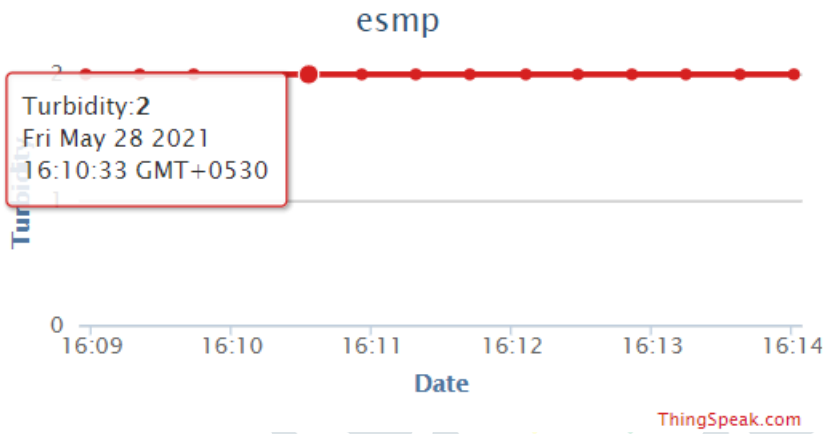

Fig.4 Turbidity Output

The turbidity of fresh water should lie below three and should be as low as possible. In Fig. 4 the turbidity value is 2 which is below three. Hence it can be concluded that the water is clean.

For the same water sample the conductivity value around 70-75. The ideal conductivity value ranges in between 50-150. Hence it can be deduced that water is suitable for drinking in accordance with conductivity

In this way by measuring different water parameters the quality of water can determined.

Serial No	pH value	Turbidity value	TDS value	Water Quality
1	7.2	2	70	Good
2	6.5	3.4	120	Moderate
3	8.6	10.5	180	Not Suitable
4	5.5	23	200	Not Suitable

Table 1

Table 1 shows the result of various indoor test done by taking various samples of water.

The samples were:

a. Fresh drinking water: Here we observed that the pH, turbidity and tds are in given range. pH is between 6.5 - 8.5, turbidity is below 3 and conductivity between 50-150. Hence, this water sample is appropriate for drinking.
b. Slightly Acidic water sample: The pH of this source is 6.5, conductivity is 80 and turbidity is 3.4. Therefore, quality this source can be considered as moderate.
c. Slightly Basic water sample: This water cannot be used for drinking as it has high turbidity value, pH value is above 7.
d. Muddy Water: This sample has a very high turbidity and consumption of this source of water can lead to various diseases.

5. Conclusion and Future Scope

The designed water quality monitoring system is highly efficient and reliable with 98% accuracy in real time. The results in the indoor tests show that system is almost accurate and reliable whereas the outdoor test results attests the systems efficiency for a broad spectrum of water bodies. This system is economical compared to other existing systems due to use of low cost micro-controller. As the system provides remote monitoring, there is no need for the user to visit the site, the user can monitor different water parameters anywhere on phone or PC by logging into ThingSpeak.

Future Scope:

- Measuring more parameters using different sensors to obtain more accurate and secure results.
- An alert message can be send to the user if the parameter values exceed certain limit using advance ThingSpeak functions.
- A mechanism can be created for water purification by interfacing actuators to micro-controller to maintain water quality

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6. References

[1] Faruq, M.O., Emu, I.H., Haque, M.N., Dey, M., Das, N.K. and Dey, M., 2017, December. Design and implementation of cost effective water quality evaluation system. In 2017 IEEE Region 10 Humanitarian Technology Conference (R10-HTC) (pp. 860-863). IEEE.
[2] Sun, Z., Liu, C.H., Bisdikia_, C., Branch, J.W. and Yang, B., 2012. 9th Annual IEEE Communications Society Conference on Sensor. Mesh and Ad Hoc Communications and Networks.
[3] Lambrou, T.P., Anastasiou, C.C., Panayiotou, C.G. and Polycarpou, M.M., 2014. A low-cost sensor network for real-time monitoring and contamination detection in drinking water distribution systems. IEEE sensors journal, 14(8), pp.2765-2772.

[4] Qiao, T.Z. and Song, L., 2010, October. The design of multi-parameter online monitoring system of water quality based on GPRS. In 2010 International Conference on Multimedia Technology (pp. 1-3). IEEE.

[5] Vijayakumar, N. and Ramya, A.R., 2015, March. The real time monitoring of water quality in IoT environment. In 2015 International Conference on Innovations in Information, Embedded and Communication Systems (ICIIECS) (pp. 1-5). IEEE.

[6] Cloete, N.A., Malekian, R. and Nair, L., 2016. Design of smart sensors for real-time water quality monitoring. IEEE access, 4, pp.3975-3990.

[7] Andersson, K. and Hossain, M.S., 2015, April. Heterogeneous wireless sensor networks for flood prediction decision support systems. In 2015 IEEE Conference on Computer Communications Workshops (INFOCOM WKSHPS) (pp. 133-137). IEEE.

[8] Maier, H.R. and Dandy, G.C., 1996. The use of artificial neural networks for the prediction of water quality parameters. Water resources research, 32(4), pp.1013-1022.

[9] Adu-Manu, K.S., Tapparello, C., Heinzelman, W., Katsriku, F.A. and Abdulai, J.D., 2017. Water quality monitoring using wireless sensor networks: Current trends and future research directions. ACM Transactions on Sensor Networks (TOSN), 13(1), pp.1-41.

[10] Jaiswal R.C. and Onkar Gagare, "Head Mounted Display", International Journal for Research in Applied Science & Engineering Technology (IJRASET), Open Access, Peer Reviewed and refereed Journal, ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:7.177, Volume 7 Issue XI, pp. 535-541, Nov 2019.

[11] Jaiswal R.C. and Samruddhi Sonare, "Multiple Camera Based Surveillance System Using Raspberry Pi", International Journal of Research and Analytical Reviews (IJRAR), ISSN-2348-1269, Volume 6, Issue 1, pp. 1635-1637, February 2019.

[12] Jaiswal R.C. and Samruddhi Sonare, "Smart Supervision Security system Using Raspberry Pi ", Journal of Emerging Technologies and Innovative Research (JETIR), ISSN-2349-5162, Volume 6, Issue 4, pp. 574-579, April 2019.

[13] Jaiswal R.C. and Manasi Jagtap, "Automatic Car Fragrance Dispensing System", International Journal of Research and Analytical Reviews (IJRAR), ISSN-2349-5138, Volume 6, Issue 1, pp. 315-319, March 2019.

[14] Jaiswal R.C. and Himanshu Mithawala, "Automatic Gate Monitoring System", Journal of Emerging Technologies and Innovative Research (JETIR), ISSN-2349-5162, Volume 6, Issue 1,pp. 88-94, January 2019.

[15] Jaiswal R.C. and Yash Govilkar, " A Gesture Based Home Automation System", International Journal for Research in Applied Science & Engineering Technology (IJRASET), Open Access, Peer Reviewed and refereed Journal , ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:7.177, Volume 7 Issue XI, pp. 501-503, Nov 2019.

[16] Jaiswal R. C. and Shreyas Nazare, " IoT Based Home Automation System", Journal of Emerging Technologies and Innovative Research (JETIR), Open Access, Peer Reviewed and refereed Journal, ISSN-2349-5162, Impact Factor:7.95, Volume 8, Issue 11 pp. 151-153, November 2021.

[17] Jaiswal R.C. and Lokhande S.D, "A Novel Approach for Real Time Internet Traffic Classification", ICTACT Journal on Communication Technology, September 2015, volume: 06, issue: 03, pp. 1160-1166.(Print: ISSN: 0976-0091, Online ISSN:2229-6948 (Impact Factor: 0.789 in 2015).

[18] Jaiswal R.C. and Lokhande S.D "Measurement, Modeling and Analysis of HTTP Web Traffic", IMCIET-International Multi Conference on Innovations in Engineering and Technology-ICCC-International Conference on Communication and Computing -2014, PP-242-258, ISBN:9789351072690, VVIT, Bangalore.

[19] Jaiswal R.C. and Lokhande S.D, "Comparative Analysis using Bagging, LogitBoost and Rotation Forest Machine Learning Algorithms for Real Time Internet Traffic Classification", IMCIP-International Multi Conference on Information Processing –ICDMW- International Conference on Data Mining and Warehousing-2014, PP113-124, ISBN: 9789351072539, University Visvesvaraya College of Engg. Department of Computer Science and Engineering Bangalore University, Bangalore.

[20] Jaiswal R.C. and Lokhande S.D, "Statistical Features Processing Based Real Time Internet Traffic Recognition and Comparative Study of Six Machine Learning Techniques", IMCIP- International Multi Conference on Information Processing-(ICCN- International Conference on Communication Networks-2014, PP-120-129, ISBN: 9789351072515, University Visvesvaraya College of Engg. Department of Computer Science and Engineering Bangalore University, Bangalore.

[21] Jaiswal R.C. and Lokhande S.D, "Analysis of Early Traffic Processing and Comparison of Machine Learning Algorithms for Real Time Internet Traffic Identification Using Statistical Approach ", ICACNI-2014-International Conference on Advanced Computing, Networking, and Informatics),Kolkata, India,DOI: 10.1007/978-3-319-07350-7_64, Volume 28 of the book series Smart Innovation, Systems and Technologies (SIST),Page:577-587.

[22] Jaiswal R.C. and Lokhande S.D, "Machine Learning Based Internet Traffic Recognition with Statistical Approach", INDICON-2013-IIT BOMBAY IEEE CONFERENCE. INSPEC Accession Number: 14062512, DOI: 10.1109/INDCON.2013.6726074.

[23] Jaiswal R. C. and Prajwal Pitlehra, "Credit Analysis Using K-Nearest Neighbours' Model", Journal of Emerging Technologies and Innovative Research (JETIR), Open Access, Peer Reviewed and refereed Journal, ISSN-2349-5162, Impact Factor:7.95, Volume 8, Issue 5, pp. 504-511, May 2021.

[24] Jaiswal R. C. and Danish khan, "Arduino based Weather Monitoring and Forecasting System using SARIMA Time-Series Forecasting", Journal of Emerging Technologies and Innovative Research (JETIR), Open Access, Peer Reviewed and refereed Journal, ISSN-2349-5162, Impact Factor:5.87, Volume 7, Issue 11, pp. 1149-1154, November 2020.

[25] Jaiswal R.C. and Aashay Pawar, "Stock Market Study Using Supervised Machine Learning", International Journal of Innovative Science and Research Technology (IJISRT), Open Access, Peer Reviewed and refereed Journal , ISSN: 2456-2165; IC Value: 45.98; SJ Impact Factor:6.253, Volume 5 Issue I, pp. 190-193, Jan 2020.

[26] Jaiswal R.C. and Shreya Mondhe, "Stock Market Prediction Using Machine Learning & Robotic Process Automation", Journal of Emerging Technologies and Innovative Research (JETIR), Open Access, Peer Reviewed and refereed Journal, ISSN-2349-5162, Volume 6, Issue 6, pp. 926-929, February 2019.

[27] Jaiswal R.C. and Lokhande S.D., A. Ahmed, P. Mahajan, "Performance Evaluation of Clustering Algorithms for IP Traffic Recognition", International Journal of Science and Research (IJSR), volume-4, Issue-5, May-2015, pp. 2786-2792.(ISSN (Online): 2319-7064, Index Copernicus Value (2013): 6.14|Impact Factor (2013):4.438

[28] Jaiswal R.C. and Lokhande S.D., Gulavani Aditya "Implementation and Analysis of DoS Attack Detection Algorithms", International Journal of Science and Research (IJSR), volume-4, Issue-5, May-2015, pp. 2085-2089. (ISSN (Online): 2319-7064, Index Copernicus Value (2013): 6.14 | Impact Factor (2013):4.438.

[29] Jaiswal R. C. and Sahil Nahar, "Recognition and Selection of Learning Styles to Personalize Courses for Students", Journal of Emerging Technologies and Innovative Research (JETIR), Open Access, Peer Reviewed and refereed Journal, Indexed in Google Scholar, Microsoft Academic, CiteSeerX, Thomson Reuters, Mendeley : reference manager, ISSN-2349-5162, Impact Factor:7.95, Volume 9, Issue 2 pp. b235-b252, February 2022.

[30] Jaiswal R. C. and Firoz Saherawala, " Smart Glasses ", Journal of Emerging Technologies and Innovative Research (JETIR), Open Access, Peer Reviewed and refereed Journal, Indexed in Google Scholar, Microsoft Academic, CiteSeerX, Thomson Reuters, Mendeley : reference manager, ISSN-2349-5162, Impact Factor:7.95, Volume 9, Issue 8 pp. f393-f401, August 2022.

[31] Jaiswal R. C. and Asawari Walkade, " Denial of Service Detection and Mitigation ", Journal of Emerging Technologies and Innovative Research (JETIR), Open Access, Peer Reviewed and refereed Journal, Indexed in Google Scholar, Microsoft Academic, CiteSeerX, Thomson Reuters, Mendeley : reference manager, ISSN-2349-5162, Impact Factor:7.95, Volume 9, Issue 5 pp. f108-f116, May 2022.

[32] Jaiswal R. C. and Fiza Shaikh, " Augmented Reality based Car Manual System ", Journal of Emerging Technologies and Innovative Research (JETIR), Open Access, Peer Reviewed and refereed Journal, Indexed in Google Scholar, Microsoft Academic, CiteSeerX, Thomson Reuters, Mendeley : reference manager, ISSN-2349-5162, Impact Factor:7.95, Volume 9, Issue 5 pp. c326-c332, May 2022.

[33] Jaiswal R. C. and Tejveer Pratap, " Multiparametric Monitoring of Vital Signs in Clinical and Home Settings for Patients ", Journal of Emerging Technologies and Innovative Research (JETIR), Open Access, Peer Reviewed and refereed Journal, Indexed in Google Scholar, Microsoft Academic, CiteSeerX, Thomson Reuters, Mendeley : reference manager, ISSN-2349-5162, Impact Factor:7.95, Volume 9, Issue 5 pp. a701-a705, May 2022.s