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IoT based Novel approach for identification of early detection of Covid-19

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Abstract

Patients diagnosed with Covid-19 often exhibit a range of symptoms including but not limited to dyspnea, irregular cardiac rhythm, and pulmonary dysfunction, which bear resemblance to the clinical manifestations seen in cases of pneumonia. These symptoms indicate abnormal blood oxygen saturation. The Pulse Oximeter is one of several medical devices that measure blood oxygen levels. According to news reports, mass media, and surveys at health facilities (Faskes) in Banyuwangi, many hospitals that treat Covid-19 patients are now unable to independently provide sufficient quick test equipment for early diagnosis. A Covid-19-positive quarantined patient may be hospitalized under medical care. As a responsible traveler from a Covid-19 red zone, they may self-quarantine at home. Such instances need infectious risk evaluation. Covid-19 infection might take 10-14 days or more to show symptoms. Some may stay asymptomatic during the illness. Covid-19 may cause asthma-like and pneumonia-like symptoms. This effort focused on developing bloodstream dissolved oxygen measurement equipment. This was done via medical cooperation and independent experimentation. Healthcare has largely used the Pulse Oximetry Kit. However, the Pulse Oximetry Kit still lacks a real-time monitoring system and the capacity to log measurement findings for Covid-19 patient management. The main goal of this project is to improve pulse oximetry kits using IoT technologies. These kits will use cellphones to remotely monitor covid-19 patients while keeping to physical and social distance rules.

Keywords: Covid-19, oxygen detection, pulse oximetry, IoT, smartphone

1. Introduction

In order to maintain optimal functionality, the human brain requires a consistent and uninterrupted flow of oxygen. Consequently, it is susceptible to settings characterized by a limited presence of this atmospheric gas. At higher elevations, a decline in barometric pressure leads to a reduction in the partial pressure of oxygen in the air that is inhaled, resulting in the occurrence of hypoxia in human beings [1].The use of blood oxygen sensing is prevalent in medical contexts to promptly check the amounts of oxygen in human blood. The measurement of oxygen saturation is a direct indicator of the blood's ability to deliver oxygen. Oxygen plays a crucial role in facilitating the aerobic metabolism of cellular tissue. Hypoxia has detrimental effects on human physiology and has the potential to result in fatality. A normal oxygen saturation percentage is defined as being over 90%. A score of 90% or below [2] suggests an anomaly that necessitates additional examination to ascertain the potential existence of any undiagnosed health issues.Indonesia is now grappling with the repercussions of the COVID-19 pandemic, which has resulted in a significant effect on the nation. As of the latest data, there have been 4,043,736 confirmed cases of COVID-19 throughout Indonesia, accompanied by a total of 13,0182 fatalities [3]. Within the country, the province of Riau has also been significantly affected, with 120,707 positive confirmed cases and 3,559 deaths [3].Patients diagnosed with Covid-19 often exhibit a range of symptoms, including but not limited to dyspnea, irregular cardiac rhythm, and pulmonary dysfunction, which bear resemblance to the

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clinical manifestations seen in cases of pneumonia.The presence of these symptoms suggests that the level of dissolved oxygen concentration in the blood is abnormal [4]. The typical range for oxygen saturation is 75-100 mmHg. When oxygen saturation falls below this range, individuals may need supplemental oxygen. Conversely, if oxygen saturation surpasses the upper limit of normal, it might potentially lead to lung injury [5].The user's text is not clear enough to be rewritten in an academic manner. Certain individuals infected with Covid-19 may exhibit a phenomenon known as joyful hypoxia, characterized by significantly reduced amounts of oxygen in the bloodstream. Remarkably, these individuals remain asymptomatic and are able to engage in their daily activities without any discernible symptoms [6]. One of the factors contributing to the absence of symptoms in individuals with COVID-19 during hypoxia is the delayed response of the brain, which only occurs when oxygen levels reach a very low threshold [7].

The increasing number of confirmed Covid-19 cases among patients in Indonesia, particularly in Banyuwangi, highlights the severity of the viral epidemic. Based on the available data on the progression of the Covid-19 pandemic in Banyuwangi [8], it is observed that the number of individuals at risk, supervised individuals, and supervised patients has exhibited a gradual increase. However, there is currently no evidence to suggest a decline in Banyuwangi regency's status from the yellow zone to the Green Zone. According to the surveys conducted [9], health facilities in Banyuwangi, including hospitals and Puskesmas, encounter challenges in providing rapid test and swab test services to patients exhibiting symptoms of Covid-19. These challenges arise from the limited availability of equipment, which incurs significant costs if procured independently. Symptoms symptomatic of Covid-19 include shortness of breath, irregular heartbeat, and alterations in lung function like those seen in cases of pneumonia [10]. The symptoms shown by the individual indicate that the oxygen saturation levels in their bloodstream are abnormal. The typical oxygen (O2) concentration in a healthybloodvessel ranges from 75 to 100 mmHg. If the dissolved oxygen level falls below this range, an individual may need supplemental oxygen. Conversely, if the oxygen levels beyond the usual range, it may lead to dysfunction or harm to the lung cells. The Pulse Oximetry (SpO2) technique [11] is often used as a benchmark for assessing the overall well-being of the human body, specifically by quantifying the concentration of oxygen dissolved in the bloodstream. Aberrant levels of dissolved oxygen have been seen in several health conditions, including pneumonia, cardiovascular problems, and asthma. Furthermore, these levels are used as a diagnostic tool to assess potential anomalies in newborn infants.

2. Related works

The first identification of Covid-19 occurred in December 2019 inside Wuhan City, located in the province of China. During this time, many individuals were admitted to hospitals with an initial diagnosis of pneumonia.The individuals in question were first diagnosed with a condition that was shown to have epidemiological connections to both animal and seafood markets. This condition then escalated into a severe epidemic [5]. The first instance of individuals contracting

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COVID-19 was documented on December 18, 2019. Within a span of 10 days, five patients exhibiting symptoms of severe respiratory diseases were identified, and unfortunately, one fatality was reported. In early January 2020, a total of 41 individuals were diagnosed with COVID-19. The majority of these patients had comorbidities, including cardiovascular conditions, hypertension, and diabetes. Several individuals have symptoms such as asthma and pneumonia, seizures, coughing, and a body temperature ranging from 38-39 degrees Celsius [12].

The Novel coronavirus disease 2019, also referred to as Covid-19, is a pathogen that specifically targets the respiratory system in humans. Presently, the global populace is confronted with a significant danger in the form of the Covid-19 pandemic. Covid-19 may be traced back to two earlier outbreaks in the 2000s, namely Middle East Respiratory Syndrome (MERS)-CoV and Severe Acute Respiratory Syndrome (SARS)-CoV. The first identification of Covid-19 occurred in December 2019 inside Wuhan City, located in the province of China. During this time, a group of individuals were admitted to hospitals with preliminary indications of pneumonia. The first claims suggested a potential epidemiological connection between these individuals and livestock and seafood markets, which later developed into a severe epidemic. In December 2019, a research was undertaken by Zhao and Lin [13] to calculate the reproduction rate (Ro) of Covid-19 using exponential growth methodologies. The study determined that the average Ro estimate for COVID-19 was between 2.24 and 3.58, representing an eight-fold increase. If the reproductive number exceeds 1, it is postulated that Covid-19 has the potential to induce a pandemic due to its accelerated progression.

Previous researchers have conducted several instances of pulse oximetry based on the Internet of Things [14-19] to monitor various health concerns, including heart health conditions, asthma patients, and lung health. Furthermore, amidst the ongoing covid-19 pandemic, several researchers are engaged in investigations using pulse oximetry as a means to identify and track the condition of individuals afflicted with covid-19, as shown by the studies conducted by [20-21]. These studies specifically explore the use of an android-based SPO2Max30100 device for the purpose of monitoring oxygen saturation levels. The test results of the Max 30100 sensor can accurately identify oxygen levels, as seen by the values obtained from each sample. These findings are then sent to an Android device and displayed on the LCD screen using the Blynk application. Another study that examines computer-based pulse oximetry is undertaken by Firda Ryan et al., in a paper titled "Computer-Based Wireless SpO2 Monitoring for Patient Monitoring of Chronic Obstructive Pulmonary Disease (COPD)." During the monitoring process, an oxygen level detection is performed using a finger sensor. The data obtained from this sensor is then processed on the ATmega328P microcontroller. Subsequently, the processed data is sent to a personal computer (PC) using Bluetooth HC-05 technology. The received data is displayed in an Excel format on the PC. One limitation of this research is the lack of integration between the input device for the oxygen level sensor and the monitoring device for the patient's status [21]. The aforementioned article [22] examines a comprehensive healthcare system designed to

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monitor oxygen saturation via the use of pulse oximetry. The research only used SMS alerts to remind individuals to engage in preventative measures, while physicians got SMS notifications about a patient's status if their oxygen saturation level fell below 50. This allowed doctors to promptly provide necessary therapy to patients.

3. Materials and Methods

The functioning of the system is dependent on the use of ESPDUINO-32 as a receiver or Bluetooth Low Energy receiver, which will be linked with Pulse Oximetry BLE. The ESPDUINO-32 and NEO-6M GPS devices are interconnected with the Node MCU in a serial manner, enabling real-time monitoring of data from these devices on server databases. Fingerprints serve as a means of identification or verification of a patient's identity when using this particular technology. The system architecture will be shown in Figure 1 and Figure 2.

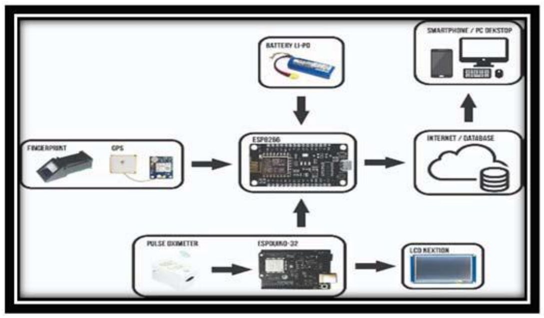

Figure 1. System model

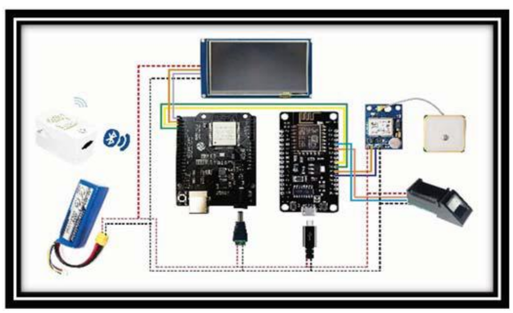

Figure 2. System connections

Pulse Oximetry Kit BLE : Pulse oximetry is a noninvasive technique used to measure an individual's blood oxygen saturation levels. The accuracy of peripheral oxygen saturation (SpO2) measurements is generally within a range of 2%, with 95% of cases falling within a 4% accuracy range when compared to the more precise and intrusive measurement of arterial oxygen saturation (SaO2) obtained from arterial blood gas analysis. However, there exists a strong correlation between the two variables, indicating that the pulse oximetry approach, which is safe, easy, noninvasive, and cost-effective, has significant value in the clinical setting for assessing

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oxygen saturation levels [23-25]. The pulse oximetry kit is a medical device used to measure the oxygen saturation level in a person's blood. It consists of a sensor that is often placed on a Bluetooth Low Energy (BLE) is a technological instrument used for the quantification of oxygen saturation levels inside the bloodstream. This device is often referred to as a saturation monitor. Pulse oximetry is a commonly used medical technique utilized by healthcare professionals, such as physicians and nurses, to assess the well-being of patients, particularly those afflicted with respiratory tract ailments [26]. The Pulse Oximetry Kit, which formerly relied on wires for monitoring, has undergone a transformation. It now incorporates Bluetooth Low Energy (BLE) technology and a compact LCD display to visualize the monitoring outcomes, as seen in Figure 3.

Figure 3. Pulse Oximtery BLE

ESPDUINO-32 : Th ESPDUINO-32 is a microcontroller designed to function as an electronic network controller, with integrated Wi-Fi and Bluetooth Low Energy (BLE) capabilities. The ESPDUINO-32 gadget may be interconnected with other devices that use Bluetooth Low Energy technology, as seen in Figure 4. This development board integrates the architectural features of an Arduino Uno with the widely-used ESP32 Wifi module. Consequently, the pin-outs are designed based on the ESP32 form rather than the UNO's. The result is a compact and portable board that facilitates the implementation of your future Internet of Things (IoT) projects. The development board, which is built upon the ESP32 microcontroller, adopts the primary design of the Arduino Uno rev.3. Programming may be conducted using the Arduino or PlatformIO Integrated Development Environment (IDE) by utilizing the micro-USB interface [27]. The card has the capability to receive power either via its micro-USB connection or via an external power source with a voltage range of 5-12V DC.

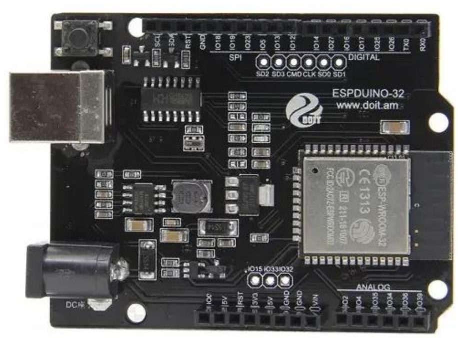

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Figure 4. ESPDUINO-32

NodeMCU : The NodeMCU firmware is an open source software that is accompanied with open source designs for prototype boards. The nomenclature "NodeMCU" is derived from the amalgamation of the terms "node" and "MCU," which stands for micro-controller unit.The user's text is already academic and does not need to be rewritten. From a technical standpoint, it is important to note that the name "NodeMCU" mostly pertains to the firmware itself, rather than the development kits that are often associated with it. The inclusion of a reference is necessary to support the claims made in the preceding statement. Both the designs for the firmware and prototype board are available as open source.According to the source provided. The firmware employs the Lua programming language. The firmware used in this context is derived from the eLua project and built upon the Espressif Non-OS SDK for ESP8266. The use of several open source projects, like lua-cjson and SPIFFS. The user did not provide any text to rewrite. In light of limited resources, it is necessary for users to carefully choose the modules that are pertinent to their project and construct a firmware that is customized to meet their specific requirements. Furthermore, the implementation of support for the 32-bit ESP32 has been accomplished. The often used hardware for prototype purposes consists of a circuit board that serves as a dual in-line package (DIP). This DIP incorporates a USB controller with a smaller surface-mounted board that houses the microcontroller unit (MCU) and antenna. The use of the Dual In-line Package (DIP) format facilitates convenient prototyping on breadboards. The basic architecture of the system was derived from the ESP-12 module of the ESP8266, which is a System-on-a-Chip (SoC) that combines Wi-Fi capabilities with a TensilicaXtensa LX106 core. This core is extensively used in IoT applications [28].

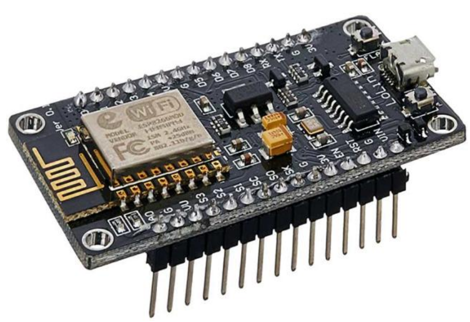

Figure 5. NodeMCU

Finger Print sensor : The primary purpose of this fingerprint is to authenticate the identification information by capturing and storing the fingerprint pattern in a database. The fingerprint sensor under consideration is the AS608, as seen in the image provided. Communication is facilitated by the use of a 4-pin configuration. Serial TTL is employed in instances when a connection is established with the Arduino or similar controllers, including VCC, GND, TX, and RX, as seen in Figure 6.

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Figure 6. Finger Print sensor

GPS NEO-6M : The present module is a comprehensive GPS system that use the NEO 6M GPS technology as its foundation. This device utilizes state-of-the-art technology to provide optimal location information and is equipped with a bigger integrated 25 x 25mm active GPS antenna with a UART TTL connection. In addition, the inclusion of a battery facilitates the expeditious acquisition of a GPS lock. The present iteration of the GPS module demonstrates compatibility with the Ardupilot Mega V2 platform. The use of this GPS module provides optimal location information, hence enhancing the operational efficiency of Ardupilot or any other Multirotor control platform. The GPS module is equipped with a serial TTL output, including four distinct pins: TX, RX, VCC, and GND. The u-center software may be downloaded to facilitate the configuration of GPS devices, enabling users to modify settings and access additional functionalities.

Figure 7. GPS NEO-6M

HMI UART TFT LCD Module : The Liquid Crystal Display (LCD), sometimes known as the LCD, is a media viewer that utilises liquid crystals as its primary medium. The LCD feature has significant importance as it serves the purpose of displaying the operational status on a certain tool. The Inter-integrated Circuit (I2C) is a bidirectional serial communication protocol that utilises two channels and is especially designed for the purpose of receiving or transmitting data. The module comprises of two systems, namely the Serial Clock (SCL) channel and the Serial Data (SDA) channel. These systems provide the transmission of data between the module and its control.

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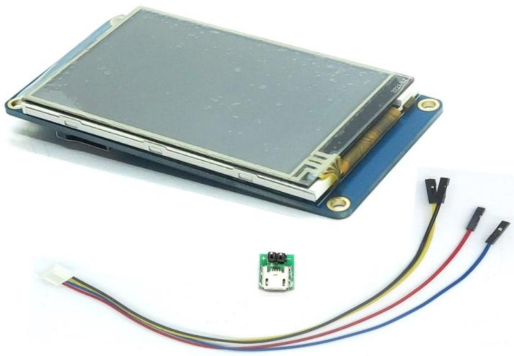

Figure 8. HMI TFT LCD

Planning: Planning is an integral component of the first phase of research endeavours, including the Literature Review and Project Scope. The purpose of doing the Literature Review was to gather reliable information and data pertaining to the symptoms of Covid-19, as well as the need for equipment necessary in the treatment and care of patients. The creation of a project scope serves the purpose of constraining the execution of research endeavours within defined boundaries, which are primarily determined by factors such as cost, time, human resources, and hardware requirements.

Product Research Processing: The stage of product research including the processing or implementation of research activities is referred to as project execution and Project Process Quality Management. The execution of a project starts from the analysis phase, whereby the issue is translated into the hardware and software requirements necessary for the research process. This execution continues until the monitoring and assessment of each step of the project's operations. Project Process Quality Management is conducted to uphold the quality of implementation activities pertaining to the management of research implementation, progress reporting, and research control in accordance with the research scope encompassing cost, schedule, human resources, and progress documentation.

Product Development : Product development is a crucial phase within the realm of research endeavours, including the creation of prototypes and the effective management of project closure. The prototyping phase occurs subsequent to the testing of the network, after the integration of hardware and software components of the equipment has been accomplished and successfully calibrated in accordance with the intended functionality of the Pulse Oximetry Kit.

4. Results

This study presents a research tool called the Pulse Oximetry Kit, which utilises the Internet of Things (IoT) technology. The kit includes a Pulse Oximetry BLE sensor that adheres to established health standards. The Pulse Oximetry BLE device is linked to the ESPDUINO-32 microcontroller by a Bluetooth connection, which is already included into both devices. Once the data is received by the ESPDUINO-32, it is then sent to the NodeMCU in a serial manner. The data acquired by NodeMCU is sent to the Database Server over the Wi-Fi network established on

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the device. The Oximetry BLE Pulse Sensor employs the fingertips as a medium for quantifying the concentration of dissolved oxygen in the bloodstream. The determination of oxygen levels is achieved using a direct measurement. The Pulse Oximetry Kit Sensor is connected to the ESPDUINO-32 device by Bluetooth technology, allowing for programming on the Arduino IDE using the C programming language. The finished measurements will be processed by Node MCU and then sent to the Database Server for direct access by the developed application. The results indicate that the use of pulse oximetry with the Jumper brand yields a SPO2 reading of 100%, whilst IoT-based pulse oximetry yields a SPO2 reading of 98%. Both oxygen saturation rates fall within the normal range.

Figure 9. Program

5. Conclusion

The results of the conducted study indicate that the IoT-based pulse oximetry system has effective performance. The sensor exhibits a commendable level of sensitivity, enabling the IoT-based pulse oximetry device to accurately detect the blood oxygen saturation level (SPO2). After conducting a comparative analysis between conventional pulse oximetry, widely employed in the medical field, and IoT-based pulse oximetry, and evaluating the test outcomes, it can be deduced that IoT-based pulse oximetry demonstrates a commendable level of accuracy and a reasonably satisfactory sensor sensitivity, with an approximate response time of 5 seconds. The Tool Pulse Oximetry Kit, which operates on the Internet of Things (IoT) framework, employs a Pulse

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Oximetry BLE Sensor to quantify the concentration of dissolved oxygen (O2) in the bloodstream. Subsequently, the collected data is processed by the ESPDUINO-32 device and sent to a Database Server via the NodeMCU platform. The investigation and experimental phase have been conducted to ascertain the lowest threshold of dissolved oxygen levels in the bloodstream. The purpose of developing an Internet of Things (IoT)-based pulse oximetry system was to enable the detection of oxygen saturation levels in a patient's blood. In the event of a reduction in oxygen saturation or abnormal conditions, the health Centre may promptly respond and make informed decisions about necessary actions. An area of potential future investigation is including the monitoring of the geographical whereabouts of individuals diagnosed with Covid-19 who have oxygen saturation levels below the established normal range.

References

[1] Gradwell, D.P.; Rainford, D.J. Ernsting's Aviation and Space Medicine, 5th ed.; CRC Press: Boca Raton, FL, USA, 2016; ISBN 9781444179941.

[2] Sugathan, A.; Roy, G.G.; Kirthyvijay, G.J.; Thomson, J. Application of arduino based platform for wearable health monitoringsystem. In Proceedings of the 2013 IEEE 1st International Conference on Condition Assessment Techniques in Electrical Systems(CATCON), Kolkata, India, 6–8 December 2013; pp. 1–5.

[3] V. No and N. Mona, "KonsepIsolasi Dalam JaringanSosialUntukMeminimalisasiEfekContagious (Kasus Penyebaran Virus Corona Di Indonesia)," *J. Sos. Hum. Terap.*, vol. 2,
no. 2, pp. 117–125, 2020. https://doi.org/10.7454/jsht.v2i2.86

[4] A. F. Al-zubidi, N. F. AL-Bakri, R. K. Hasoun, S. H. Hashim, and H. T. S. Alrikabi, "MobileApplication to Detect Covid-19 Pandemic by Using Classification Techniques: ProposedSystem," *Int. J. Interact. Mob. Technol.*, vol. 15, no. 16, pp. 34–51, 2021. https://doi.org/10.3991/ijim.v15i16.24195

[5] A. Hidayat *et al.*, "Designing IoT-Based Independent Pulse Oximetry Kit as an Early
Detection Tool for Covid-19 Symptoms," *2020 3rd Int. Conf. Comput. Informatics Eng.IC2IE 2020*, pp. 443–448, 2020. https://doi.org/10.1109/IC2IE50715.2020.9274663

[6] J. Xu and M. Gu, "Realtime calibration of pulse oximetry based on grey model," *2010 OSAIEEE-COS Adv. Optoelectron. Micro/Nano-Optics, AOM 2010*, 2010. https://doi.org/
10.1109/AOM.2010.5713537

[7] A. A. Radhi, "Use QR Code and IoT Mobile Devices to Prevent the Spread of an Epidemic
(COVID-19)," *Int. J. Interact. Mob. Technol.*, vol. 16, no. 12, pp. 127–136, 2022.
https://doi.org/10.3991/ijim.v16i12.32125

[8] Juan-Carlos Cobos-Torres and Mohamed Abderrahim. SimpleMeasurement of Pulse Oximetry Using a Standard Color Camera.Department of Systems Engineering and Automation Carlos IIIUniversity of Madrid. Madrid, Spain. 978-1-5090-3982-1/17 ©2017IEEE.

[9] Mohamed A. Zaltum, M. Shukri Ahmad, Ariffuddin Joret, M. MahadiAbdul Jamil. "Design and Development of a portable Pulse Oximetrysystem" International Journal of Integrated Engineering (Issue onElectrical and Electronic Engineering)

[10] RadhaKrishna Karne, Dr TK. "Review on vanet architecture and applications." *Turkish Journal of Computer and Mathematics Education (TURCOMAT)* 12.4 (2021): 1745-1749.

ISSN PRINT 2319 1775 Online 2320 7876
 Volume 11, Iss 12, 2022

[11] Karne, RadhaKrishna, S. Mounika, and Dr Nookala Venu. "Applications of IoT on Intrusion Detection System with Deep Learning Analysis." *International Journal from Innovative Engineering and Management Research (IJIEMR)* (2022).

[12] RadhaKrishna Karne, Dr TK. "COINV-Chances and Obstacles Interpretation to Carry new approaches in the VANET Communications." *Design Engineering* (2021): 10346-10361.

[13] Karne, RadhaKrishna, et al. "Simulation of ACO for Shortest Path Finding Using NS2." (2021): 12866-12873.

[14] Karne, RadhaKrishna, and T. K. Sreeja. "Routing protocols in vehicular adhoc networks (VANETs)." *International Journal of Early Childhood* 14.03 (2022): 2022.

[15] Karne, Ms Archana, et al. "Convolutional Neural Networks for Object Detection and Recognition." *Journal of Artificial Intelligence, Machine Learning and Neural Network (JAIMLNN) ISSN: 2799-1172* 3.02 (2023): 1-13.

[16] Karne, Radhakrishna, and T. K. Sreeja. "Clustering Algorithms and Comparisons in Vehicular Ad Hoc Networks." *Mesopotamian Journal of Computer Science* 2023 (2023): 121-129.

[17] Kumar, A. Arun, and Radha Krishna Karne. "IIoT-IDS Network using Inception CNN Model." *Journal of Trends in Computer Science and Smart Technology* 4.3 (2022): 126-138.

[18] Bompelli, Nagaraju, Ramadevi Manchala, and RadhaKrishna Karne. "IoT Based Smart Sensor Soc Architecture for The Industrial Internet of Things." *The International journal of analytical and experimental modal analysis* 12: 491-496.

[19] RadhaKrishna Karne, Dr TK. "ROUTING PROTOCOLS IN VEHICULAR ADHOC NETWORKS (VANETs)." *International Journal of Early Childhood Special Education (INT-JECS) ISSN*: 1308-5581.

[20] Mounika Siluveru, Dharavath Nanda, & RadhaKrishna Karne. (2022). Study and Analysis of OTFS and OFDM. *Journal of Artificial Intelligence,Machine Learning and Neural Network (JAIMLNN) ISSN: 2799-1172*, *2*(06), 13–23. https://doi.org/10.55529/jaimlnn.26.13.23

[21] Radha Krishna Karne and Dr. T. K. Sreeja (2022), A Novel Approach for Dynamic Stable Clustering in VANET Using Deep Learning (LSTM) Model. IJEER 10(4), 1092-1098. DOI: 10.37391/IJEER.100454.

[22] Karne, R. K. ., & Sreeja, T. K. . (2023). PMLC- Predictions of Mobility and Transmission in a Lane-Based Cluster VANET Validated on Machine Learning. International Journal on Recent and Innovation Trends in Computing and Communication, 11(5s), 477–483. https://doi.org/10.17762/ijritcc.v11i5s.7109

[23] R. Mohandas, N. Sivapriya, A. S. Rao, K. Radhakrishna and M. B. Sahaai, "Development of Machine Learning Framework for the Protection of IoT Devices," 2023 7th International Conference on Computing Methodologies and Communication (ICCMC), Erode, India, 2023, pp. 1394-1398, doi: 10.1109/ICCMC56507.2023.10083950.

[24] Vaigandla, Karthik Kumar, S. Bolla, and R. Karne. "A survey on future generation wireless communications-6G: requirements, technologies, challenges and applications." *International Journal* 10.5 (2021).

[25] Vaigandla, Karthik Kumar, Radha Krishna Karne, and Allanki Sanyasi Rao. "A Study on IoT Technologies, Standards and Protocols." *IBMRD's Journal of Management & Research* 10.2 (2021): 7-14.

[26] Vaigandla, Karthik Kumar, et al. "A Survey On Wireless Communications: 6g And 7g." *International Journal Of Science, Technology & Management* 2.6 (2021): 2018-2025.

[27] Vaigandla, Karthik Kumar, Sravani Thatipamula, and Radha Krishna Karne. "Investigation on unmanned aerial vehicle (uav): An overview." *IRO Journal on Sustainable Wireless Systems* 4.3 (2022): 130-148.

[28] Vaigandla, KarthikKumar, Nilofar Azmi, and RadhaKrishna Karne. "Investigation on intrusion detection systems (IDSs) in IoT." *International Journal of Emerging Trends in Engineering Research* 10.3 (2022).

[29] Vaigandla, Karthik Kumar, RadhaKrishna Karne, and Allanki Sanyasi Rao. "Analysis of MIMO-OFDM: Effect of Mutual Coupling, Frequency Response, SNR and Channel Capacity." *YMER Digital-ISSN* (2021): 0044-0477.

[30] Vaigandla, Karthik Kumar, et al. "Millimeter wave communications: Propagation characteristics, beamforming, architecture, standardization, challenges and applications." *Design Engineering* 9 (2021): 10144-10169.

[31] Vaigandla, Karthik Kumar, et al. "Review on Blockchain Technology: Architecture, Characteristics, Benefits, Algorithms, Challenges and Applications." *Mesopotamian Journal of CyberSecurity* 2023 (2023): 73-85.

ISSN PRINT 2319 1775 Online 2320 7876

[32] Vaigandla, Karthik Kumar, et al. "Investigation on Cognitive Radio Networks: Introduction, Spectrum Sensing, IEEE Standards, Challenges, Applications." *International Journal of Engineering Applied Sciences and Technology* 6.9 (2022): 91-103.

[33] Vaigandla, Karthik Kumar, Mounika Siluveru, and RadhaKrishna Karne. "Study and Comparative Analysis of OFDM and UFMC Modulation Schemes." *Journal of Electronics, Computer Networking and Applied Mathematics (JECNAM) ISSN: 2799-1156* 3.02 (2023): 41-50