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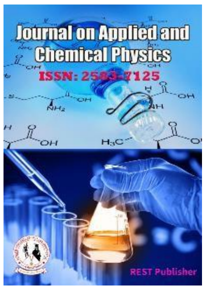

Application of Ultrasonic Sensors in Processing Industry Using GRA Method

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Abstract: *An ultrasonic sensor is a device that measures measuring to an item using ultrasonic sound pulses. An ultrasonic sensor transmits and receives ultrasonic pulses from a receiver to determine the proximity of an item. The main function of ultrasonic sensors is as distance sensors. They are present in anti-collision safety devices and self-parking automotive technologies. Robotic obstruction identification systems and production technology both use ultrasonic sensors. For air-coupled programmers, ultrasonic receivers operate at wavelengths between 30 and 500 kHz. The decrease rate increases with increasing ultrasonic intensity. As a result, high wavelength sensors are more successful for short durations and low energy sensors (30–80 kHz) are more useful for long distances. Ultrasonic sensors are very good at reducing background contamination since the time of movement, not sound quantity, is used to calculate the proximity to an objective. Despite of an object's color, it can be identified if it reflects sound. Alternative: speed of Sound, Density, Acoustic Impedance, Reflection Coefficient. Evaluation Preference: Water, Honey, Well-mixed, Well-mixed flour-water, Glass, Pyrex. from the result it is seen that Honey and is got the first rank whereas is the Glass, Pyrex got is having the lowest rank". The value of the dataset for ultrasonic sensor in GRA (Gray-related analysis) shows that it results in Honey and top ranking".*

Key words: *speed of Sound, Density, Acoustic Impedance, Well-mixed, Glass.*

1. INTRODUCTION

The radius comparison value to be contrasted with the ultrasonic detected distance is computed using the four voltmeter outputs. The automobile body plane was identified using the final release heights, which are calculated by multiplying the type deflections by the spring heights detected by potency meters. The location reference value that the ultrasonic sensor must provide in order for the core to answer to that distance measured using the selected plane equation's head positions. [1] The challenge of conducting non-contact distances measures is a significant issue in many economic situations. From a functional and financial standpoint, ultrasonic sensors are a cutting-edge, highly effective instrument for solving these kinds of problems. Numerous examples are present in a number of architectural disciplines, including chemical analysis, drainage treatment, medical images, robot directions, harmless testing of resources, flow speed, liquid level evaluation, and more. [2] For this, optically sensors including laser sensors and sensor powered by two or more cameras—are extremely helpful. When objects are far away and electronically conducting, optical localization is most successful. Ultrasound location and optics are better suited for the observation of elements that are close by. The focus of this paper is on ultrasonic sensors. [3] Ultrasonic sensors typically measure the amount of time that passes between transmitting a few brief pulses and returning a rebound of the received signal. Basic Transmission and receiver are the fundamental elements. Transmitter The module may contain one of two transducer types: Low frequency magnetoelectric transducers operate on the structural length change of the electromagnetic material as their fundamental concept. [4] The elastotic effect, which is caused by auditory induced structural strain, modifies the diffraction duration when ultrasonic waves hit the fiber. Variations in the FBG pitch alter the grating's reflectance at the laser's wave length, causing an ultrasound produced intensity fluctuation. A detector picks up the beam that was returned. [5] Using the for-profit Parametric programme, we created an approximative analytic continuity model. The bounds of the computing solution were established using the pictorial result of this model, which was utilized to analyses the impact of different design parameters. The corresponding position between the aluminum strip and the mechanical actuator was used to calculate each design parameter. The ultimate design answer was provided via boundary element analysis. Several tests employing an experimental ultrasonic sensor depending on the concept were used to confirm the model. [6] Simple sound waves are transmitted by ultrasonic sensors, which then receive them after coming into connection with the ultrasound wave and the operation under investigation. The ultrasonic signal contains knowledge about the characteristics to be examined when it reaches the sensor. The spectrum range of ultrasonic is 20 kHz to 1 GHz. The most crucial frequency band most technological purposes are 20 kHz to 10 MHz [7] to detect the concentrations of certain compounds, density, density, or nanoparticle concentration, ultrasonic detectors are frequently employed nowadays. Additionally, continuously observation of polymerization, crystallization, or ferment activities is possible with ultrasonic sensor systems, which is particularly useful if prompt process management is required. [8] The nearby item when the ultrasonic sensor is successfully placed is detected using the beam diameter by single echo function. Additionally, it considers the object's orientation or makes the assumption that the heading is perpendicular to the inclination. The multi-echo operate in contrast, sends a series of ultrasonic pulses after the initial echo is detected. [9] Although ultrasonic sensors have been utilized in earlier research to estimate forest size, sensor efficiency was subpar in the examined field settings. Additionally, liner field deployment poses particular difficulties for a canopy detecting system due to the generally close-spaced tree liner organization, the quick fluctuations in canopy size and color, and the restricted work space among rows. Due to their small size, ultrasonic sensors can resolve these difficulties. a strong line-of-sight selectivity mechanisms with directional selectivity versus targets with color variation. [10] Vibratory sensors are frequently employed for several tasks, including figuring out an object's acceleration, tracking their position, and figuring out the smoothness of a surface. Place an object next inside these ultrasound sensors' detecting range in succession. [11] This study does not employ a time-sharing technique since it makes use of the directness angle, one of an ultrasound sensor's features. Although having a straightforward design and inexpensive costs, this study can achieve a high sample rate by utilizing the transit-time measurements approach. [12] Finding the right guidelines for autonomous car moral and economic judgements is crucial, but it's trickier than it seems because driving selections impact not only the comfort of occupants but also the protection of other road users. As a result, we concentrate on examining the dependability of ultrasonic sensors and determining whether cars can rely on these sensors to make the right driving judgements. [13] An affordable and non-intrusive method of measuring the level of liquids, foams, and bulk particles is the use of ultrasonic sensors. As a result, there are numerous ultrasonic sensors available, each with a highly varied operating range, reliability, and cost. The ultrasonic sonar sensor SRF05, which is often used for industry operations and technology, was selected as the water level monitoring device due to its wide range of operating distances and affordable price. [14] This approach is appropriate for observing the mixing activity because it corrects the acoustic resistance difference among the vessel wall and mixture. Due to dispersion or dispersion, new boundaries within the compound reflect the wave's component that travels through it. However, the transducer only picks up reflects from barriers that are roughly orthogonal to the wave's path of transmission. The vessel wall's thin strength means that the ultrasonic technology only functions in the near field. [15].

2. MATERIALS AND METHODS

Indeed, the knowledge and benefit of attending a large public institution with a variety of specializations and majors is the primary characteristic of such undergraduates. A framework like this also makes it easier to dedicate a large chunk of the first two years to universal education, which is a staple of the American liberal arts bachelor programme. [1] Grey Relational Analysis (GRA), a kind of fuzzy multi-criteria model, is advised as a tool for multi-criteria deployment. The fight night set options are utilized to find answers in the performance plan. An effect assessment model created by GRA can quantify the degree of relationship-based similarity or variation between two periods. The fundamental tenet is as follows: the alternative is preferable if a comparable sequence translation from a different option has the highest grey correlation coefficients among the reference sequences and itself. [2] multi-objective decision making (MODM) and multi-attribute decision making (MADM) are two categories in which MCDM can be extensively subdivided. Each of these areas contains a variety of techniques. Different approaches treat benefit and cost criteria differently and employ various normalization techniques. We concentrate on a hybrid strategy that uses these SAW, TOPSIS, and GRA methods. The SAW is particularly well-liked in practical settings because to its simplicity. It is frequently used as a standard against which to evaluate the outcomes of other MCDM techniques. Two distance-based methodologies are TOPSIS and GRA. The following is a description of the three various approaches. [3] The grey association grade between each comparing sequencing and the comparison sequence is then determined using these grey correlation coefficients. The degree of link between the reference and compared sequences is indicated by the GS Grey relational grade. The relative sequence has the highest association with the references sequencing when the grey relative rank is bigger. The value of the associated grey scale is equal to one if the two rows are identical. Alternatively, it is advisable to choose the alternative with the highest grey relationship grade. [4] Based on the choice knowledge presented in IFNs or IVIFNs, respectively, we employed a two GRA technique in a combination decision matrix to produce an overall relative grey degree for each option from the positive and negative best alternative. a final ranking by the relative importance of each possibility from positive. Finally, we use a mathematical example to explain the suggested model and contrast it with several currently used approaches to demonstrate its viability and efficacy. [5].

Step 1. Design of decision matrix and weight matrix

For a MCDM problem consisting of m alternatives and n criteria, let $D = x_{ij}$ be a decision matrix, where $x_{ij} \in R$

$$D = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{bmatrix} \quad (1)$$

Step 2. Normalization of decision matrix

The normalization of two types of data i.e., better when higher type or better when lower is evaluated using equation 2 or 3 respectively. After normalization the data ranges from 0 to 1.

$$M_{ij} = \frac{N_{ij} - \min(N_{ij})}{\max(N_{ij}) - \min(N_{ij})} \quad 2$$

$$M_{ij} = \frac{\max(N_{ij}) - N_{ij}}{\max(N_{ij}) - \min(N_{ij})} \quad 3$$

$$\text{Where} i, j = 1,2,3, \cdots, n$$

Step 3. $Deviation = the \max value\ after\ normalization - value\ of\ the\ current\ row$ 4

Step 4. Calculation of Gray relation coefficient

$$C_{ij} = \frac{\Delta_{min} - \xi\Delta_{max}}{Current\ value - \xi\Delta_{max}}, where\ \xi\ is\ distinguishing\ coefficient \quad 5$$

Step 5. Calculation of Gray relation grade

It's the average of gray relation coefficient.

3. ANALYSIS AND DISCUSSION

TABLE 1. ultrasonic sensor in Data Set

	DATA SET			
	speed of Sound	Density	Acoustic Impedance	Reflection Coefficient
Water	51.08	139.5	19.15	22.05
Honey	59.12	138	13.69	27.3
Well-mixed	54.08	132.6	14.18	23.1
Well-mixed flour-water	53.17	138.3	15.6	21.59
Glass, Pyrex	56.33	136.4	17.96	28.89

Table 1 shows the ultrasonic sensor Alternative: speed of Sound, Density, Acoustic Impedance, Reflection Coefficient. Evaluation Preference: Water, Honey, Well-mixed, Well-mixed flour-water, Glass, Pyrex.

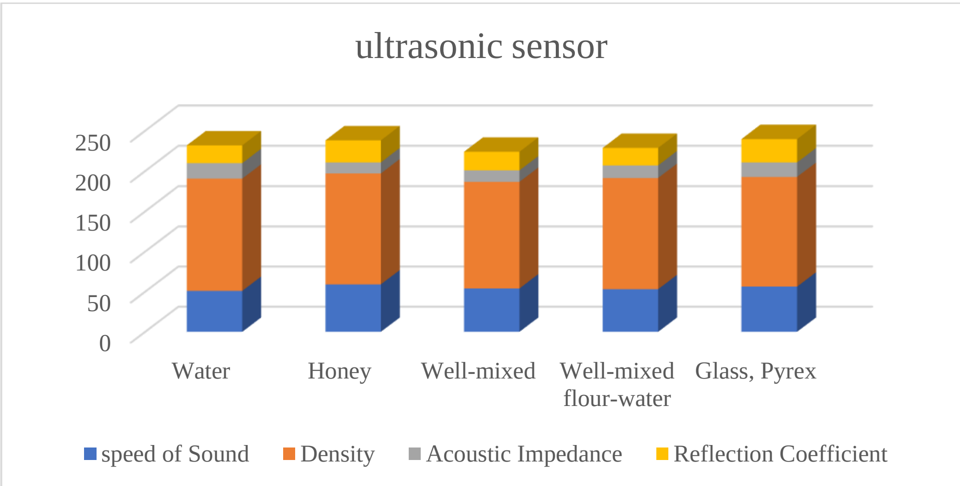

FIGURE 1. Ultrasonic Sensor

Figure 1 shows the ultrasonic sensor Alternative: speed of Sound, Density, Acoustic Impedance, Reflection Coefficient. Evaluation Preference: Water, Honey, Well-mixed, Well-mixed flour-water, Glass, Pyrex.

TABLE 2. Ultrasonic Sensor in Normalized Data

Normalized Data			
speed of Sound	Density	Acoustic Impedance	Reflection Coefficient
0.0000	1.0000	0.0000	0.937
1.0000	0.7755	1.0000	0.2178
0.3731	0.0000	0.9103	0.7932
0.26	0.82	0.65018	1
0.653	0.551	0.21795	0

Table 2 shows the values of Ultrasonic Sensor in Normalized Data from using gray relation analysis Find the Alternative: speed of Sound, Density, Acoustic Impedance, Reflection Coefficient. Evaluation Preference: Water, Honey, Well-mixed, Well-mixed flour-water, Glass, Pyrex.

TABLE 3. Ultrasonic Sensor in Deviation sequence

Deviation sequence			
speed of Sound	Density	Acoustic Impedance	Reflection Coefficient
1	0	1	0.063
0	0.224	0	0.7822
0.6269	1	0.08974	0.2068
0.74	0.18	0.34982	0
0.347	0.449	0.78205	1

Table 3 shows the values of Ultrasonic Sensor in Deviation sequence from using gray relation analysis Find the Alternative: speed of Sound, Density, Acoustic Impedance, Reflection Coefficient. Evaluation Preference: Water, Honey, Well-mixed, Well-mixed flour-water, Glass, Pyrex.

TABLE 4. Ultrasonic Sensor in Grey relation coefficient

Grey relation coefficient			
speed of Sound	Density	Acoustic Impedance	Reflection Coefficient
0.3333	1	0.33333	0.8881
1	0.69	1	0.39
0.4437	0.333	0.84783	0.7074
0.4032	0.735	0.58836	1
0.5903	0.527	0.39	0.3333

This table 4 shows the values of Ultrasonic Sensor in Grey relation coefficient from using gray relation analysis Find the Alternative: speed of Sound, Density, Acoustic Impedance, Reflection Coefficient. Evaluation Preference: Water, Honey, Well-mixed, Well-mixed flour-water, Glass, Pyrex.

TABLE 5. Ultrasonic Sensor in GRG

	GRG
Water	0.639
Honey	0.77
Well-mixed	0.583
Well-mixed flour-water	0.682
Glass, Pyrex	0.46

Table 5 Ultrasonic Sensor in GRG from the result it is seen that Honey and is got the first value whereas is the Glass, Pyrex got is having the lowest value.

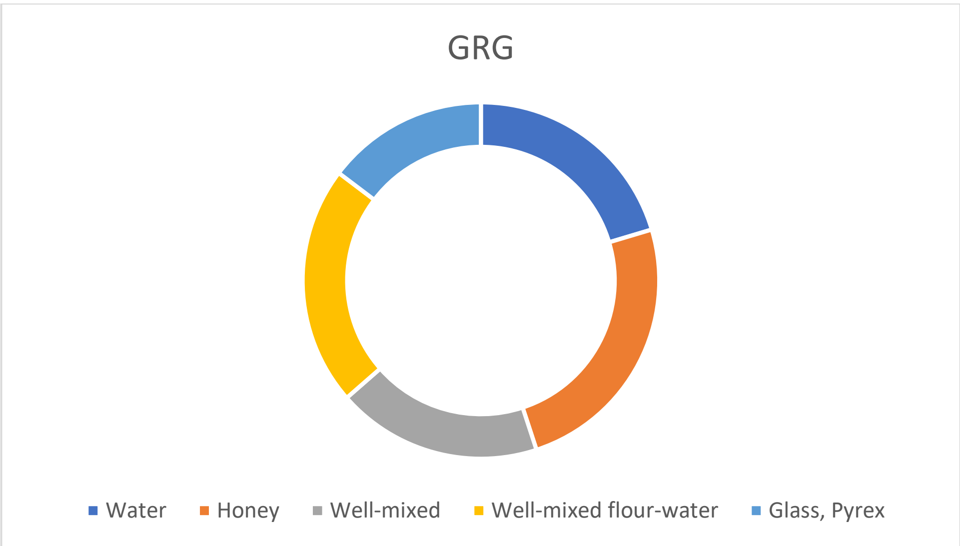

FIGURE 2. GRG

Figure 2 Ultrasonic Sensor in GRG from the result it is seen that Honey and is got the first value whereas is the Glass, Pyrex got is having the lowest value.

TABLE 6. Ultrasonic Sensor in rank

	Rank
Water	3
Honey	1
Well-mixed	4
Well-mixed flour-water	2
Glass, Pyrex	5

Table 6 Ultrasonic Sensor in GRG from Water 3rd rank, Honey 1st rank, Well-mixed 4th rank, Well-mixed flour-water 2nd rank, Glass, Pyrex 5th Rank.

FIGURE 3. Ultrasonic Sensor in rank

Figure 3 Ultrasonic Sensor in GRG from Water 3rd rank, Honey 1st rank, Well-mixed 4th rank, Well-mixed flour-water 2nd rank, Glass, Pyrex 5th Rank.

4. CONCLUSION

The amount of pollution on the earth is increasing, and every attempt is being made to cut CO2 emissions and rescue the environment. The development of electric automobiles is one such initiative (EV). Being one of the largest producers of CO2 emissions, the transportation industry must be transformed into a green one. To stay up with the worldwide development of EVs, the Indian government has developed ambitious plans to introduce EVs to the Indian market. The acceptance of cars operated by alternative fuels during the past ten years is a consequence of the worldwide desire to cease transportation dependence on the petroleum industry. Modern propulsion system electrification makes sustainable road networks possible. The scientific, organizational, commercial, and policy issues are preventing EVs from becoming more widely used. By properly utilising technology in the areas of materials engineering, electric power conversion, battery management, and power generation, among other things, these difficulties might be lessened. To create regulations that will encourage more manufacturers and consumers to invest in the field of EVs, infrastructure support from some government agencies and significant stakeholder groups is necessary. In this study TOPSIS method analyses the rank of Mercedes-Benz EQS as first, Audi e-tron GT as fourth, Porsche Taycan as fifth, Audi e-tron as third, Audi RS e-tron GT as second and Mercedes-Benz EQC as sixth. So, the result from the TOPSIS method shows that Mercedes-Benz EQS is highlighted as the best choice of the selected battery electric vehicles followed by the Audi RS e-tron GT.

REFERENCES

[1]. Cuma, Mehmet Ugras, and Tahsin Koroglu. "A comprehensive review on estimation strategies used in hybrid and battery electric vehicles." *Renewable and Sustainable Energy Reviews* 42 (2015): 517-531.
[2]. Hwang, Jenn-Jiang, Jenn-Kun Kuo, Wei Wu, Wei-Ru Chang, Chih-Hong Lin, and Song-En Wang. "Lifecycle performance assessment of fuel cell/battery electric vehicles." *International journal of hydrogen energy* 38, no. 8 (2013): 3433-3446.
[3]. Inaganti Rambabu, "Preserving Patient Privacy: A Focus on Cyber Security in Healthcare", International Journal of Emerging Technologies and Innovative Research, 10(10), d218-d222.
[4]. Dhanabalan.R Nandhini.M and Jaya Singh R. Madura, T. Sheela, "Production of Keratinase from Feather Degrading Microorganisms from Poultry Soil", Bulletin of Environment, Pharmacology and Life Sciences, Spl issue 5, 2022, 772-776.

[5]. Sreenath Devineni, Bhargavi Gorantla, “Security and Privacy Issues in Internet of Things (IoT) Devices Using COPRAS Method” REST Journal on Data Analytics and Artificial Intelligence, 2(4), 2023, 15-22.
[6]. Madhusudhan Dasari sreeramulu, “Optimizing Cloud Computing Networks in Information Security Controls using COPRAS Method”, Computer Science, Engineering and Technology 1(2), 2023, 42-54.
[7]. Dr. N. subash, M. Ramachandran, Vimala Saravanan, Vidhya prasanth,, “An Investigation on Tabu Search Algorithms Optimization”, Electrical and Automation Engineering 1(1) 2022, 13-20.
[8]. Herath, Madhawa, Tharaka Jayathilaka, Hazi Mohammad Azamathulla, Vishwanadham Mandala, Namal Rathnayake, and Upaka Rathnayake. "Sensitivity analysis of parameters affecting wetland water levels: A study of flood detention basin, Colombo, Sri Lanka." *Sensors* 23, no. 7 (2023): 3680.
[9]. Verma, Pradeep. "Effective Execution of Mergers and Acquisitions for IT Supply Chain." International Journal of Computer Trends and Technology 70, no. 7 (2022): 8-10.
[10]. Murthy, Ashwin Narasimha, Souptik Sen, and Ramesh Krishnamaneni. "Enhanced image retrieval and classification frameworks for brain disease diagnosis using hybrid deep learning models." *International Journal of Computer Science and Information Technology Research* 3, no. 1 (2022): 37-47.
[11]. Shanmugasundar, G., R. Sivaramakrishnan, and S. Balasubramani. "Method of Trajectory Generation of a Generic Robot using Bresenham’s Circle Algorithm." *Indian Journal of Science and Technology* 9, no. 48 (2016): 1-6.
[12]. Omara, Ahmed M., and Michael A. Sleptsov. "Performance assessment of battery-powered electric vehicle employing PMSM powertrain system." In *2017 IEEE Conference of Russian Young Researchers in Electrical and Electronic Engineering (EIConRus)*, pp. 963-968. IEEE, 2017.
[13]. Neha Bharani, “Blockchain Technology and Its Role in the Bitcoin Ecosystem A Review” International Journal of Novel Research and Development, 2023
[14]. Ramya Sharma, M. Ramachandran, Vimala Saravanan, Prabakaran Nanjundan, "Feasibility Analysis of Power Generation from Internal Combustion Engine (ICE) Using EDAS Method", R EST Journal on Advances in Mechanical Engineering, 2(4), December 2023, 8-17.
[15]. Sreenath Devineni, Bhargavi Gorantla, “Energy-Efficient Computing and Green Computing Techniques”, Computer Science, Engineering and Technology, 1(4), 2023, 37-45.
[16]. Madhusudhan Dasari sreeramulu, “Sensitive Analysis of Natural Language Processing Using for MOORA Method”, Computer Science, Engineering and Technology, 1(1), March 2023, 46-53.
[17]. Shatjit yadav; M. Ramachandran; Chinnasami Sivaji; Vidhya Prasanth; Manjula Selvam, “Investigation of Various Solar Photovoltaic Cells and its limitation”, Renewable and Nonrenewable Energy, 1(1), 2022, 22-29.
[18]. Carignano, Mauro G., Javier M. Cabello, and Sergio Junco. "Sizing and performance analysis of battery pack in electric vehicles." In *2014 IEEE Biennial Congress of Argentina (ARGENCON)*, pp. 240-244. IEEE, 2014.
[19]. Jaganathan Rajamanickam, M. Ramachandran, Ramya sharma, Chinnasami Sivaji, "Distributed Generation (DG) system using COPRAS method", REST Journal on Advances in Mechanical Engineering, 2(3) September 2023, 11-22.
[20]. Verma, Pradeep. "Sales of Medical Devices–SAP Supply Chain." International Journal of Computer Trends and Technology 70, no. 9 (2022): 6-12.
[21]. Murthy, Ashwin Narasimha, Souptik Sen, and Ramesh Krishnamaneni. "Enhanced image retrieval and classification frameworks for brain disease diagnosis using hybrid deep learning models." International Journal of Computer Science and Information Technology Research 3, no. 1 (2022): 37-47.
[22]. Alagarsamy, Shanmugarathinam, Shri Devi SDK, P. Srinivasan, Prakash Gadipelli, M. Anchana, and Sheela Thangaraj. "STUDIES OF AYURVEDIC POLYHERBAL FORMULATIONS AND ITS SPECTRAL CHARACTERISTICS."
[23]. Inaganti Rambabu, Yalavarthy Sreekanth, “FUSING CYBERSECURITY, AI, AND EMERGING TECHNOLOGIES IN MEDICAL DEVICES FOR IMPROVED HEALTHCARE” INTERNATIONAL JOURNAL OF RESEARCH AND ANALYTICAL REVIEWS, 10(4), 2023, 74-81.
[24]. Madhusudhan Dasari sreeramulu, “Analysis of Wireless Security and Networks using COPRAS Method” REST Journal on Data Analytics and Artificial Intelligence 2(4), December 2023, 32-41.
[25]. Carlstedt, David, and Leif E. Asp. "Performance analysis framework for structural battery composites in electric vehicles." *Composites Part B: Engineering* 186 (2020): 107822.
[26]. Logeshwaran, J., Venkata Ashok K. Gorantla, Venkataramaiah Gude, and Bhargavi Gorantla. "The Smart Performance Analysis of Cyber Security Issues in Crypto Currency Using Blockchain." In *2023 6th International Conference on Contemporary Computing and Informatics (IC3I)*, vol. 6, pp. 2235-2241. IEEE, 2023
[27]. Bharani, Neha. *Complexity study of software engineering phases and software quality*. Book Rivers, 2022.
[28]. Kurinjimalar Ramu, M. Ramachandran, Ramya sharma, Prabakaran Nanjundan, "Urban Agriculture Overview of Sustainability Using GRA Methodology", Building Materials and Engineering Structures, 2(3), September 2023, 7-14.

