Digital Innovations & Contemporary Research in SCIENCE, ENGINEERING & TECHNOLOGY
Vol. 10. No. 4, December 2022 – Special Issue on Cryptography & Security Mechanisms

Article Citation Format
Akoso, C.C. & Osang, F.B. (2022): Information Systems Methodologies: A Review. Journal of Digital Innovations & Contemporary Research in Science, Engineering & Technology. Vol. 10, No. 2. Pp 131-150
DOI: dx.doi.org/10.22624/AIMS/DIGITAL/V10N4P14

Information Systems Methodologies: A Review

Akoso, C.C. & Osang, F.B.
National Open University of Nigeria, Abuja, Nigeria
Email: fosang@noun.edu.ng

ABSTRACT

Research is a methodical investigation into a subject in order to discover or establish more facts or information. This work explored the various research methodologies as applied to information system with a focus on application development. Various research methodologies have been extensively discussed with a view to establishing the effects of wrong usage of research method by digging out the importance of the right usage of research methodology. The study reviewed 63 research works highlighting the author, year of research, aim of each research, the method used as well as the result of the finding. The result confirmed that adopting the right method for every research gives accurate results while wrong usage of research methodology leads to false outcome. This has great implications for information system development and sustenance.

Keywords: Information Systems, Methodologies, Reviews, Research, Usage, Methods, Outcomes.

1. INTRODUCTION

Research methodology does not only mean the identification of the research method – whether it is a qualitative research, quantitative research or mixed. Methodology actually provides accurate justification for the selection of the research method. Thus, an improper research methodology selected for research will invite grave consequences. An improperly selected methodology can never be able to provide proper justification for the methods selected to conduct the research work. According to Royal Research (2018), the following possibilities can be the direct consequences of a wrongly selected research methodology.

I. This may include:
    i. Inaccurate Research Findings: The selection of a wrong research methodology will always yield inaccurate research findings. Since the measures adopted to analyze the research data are wrongly chosen, there is no possibility that accurate results can be obtained.

ii. Unjustified recommendations: Since recommendations are drawn from findings, a slight change in the research outcome might turn those recommendations baseless and unjustified. In order to justify the recommendations, you have to provide evidence from the research results.
iii. Primary research question remains unanswered: In most research that uses research questions, an improper selection of research methodology can restrict the researcher from asking the primary question to its selected samples. Hence, the entire work may be incomplete.

The aim of this work is to discuss the various research methodologies in information system with a view to identifying the best applicable methods. The objective is to review and identify the existing methodologies applicable to information systems with a focus on vehicle duty payment and authentication. This study is significant as it serves as a guide for the correct choice of research methodology in determining the success and overall quality of information system research and documentation. Furthermore, becoming familiar with the research methods used by an area of study allows you to understand it more effectively.

2. REVIEW OF RELATED LITERATURE

The existing system used different technology and method as per application. The study comparison between existing systems as given in Table 1. The table shows the comparison of existing on the basis of parameter used in the system. It gives the total review of the existing system used for vehicle tracking, monitoring and alerting system.

Table 1: Reviews of Related Works

S/N	Author(s)	Research Objective(s)	Tools Used	Methodology	Findings
1	Tim *et al.,* 2022	Developed an easy-to-use vehicle tracking and monitoring system with route deviation detection and SOS capability.	*Arduino; global positioning system; GPS; global system for mobile communications; GSM; vehicle tracking; route deviation detection*	SSADM	The study proved that developing a vehicle tracking prototype with route deviation detection, emergency command, and current status command is possible
2	Dilip et al., 2022	Designed an embedded system used for tracking and positioning of any vehicle by using Global Positioning System (GPS) and GSM	GSM and GPS module	SSADM	This device invention was much more useful when the accidents occurred in deserted places and midnights

S/N	Author(s)	Research Objective(s)	Tools Used	Methodology	Findings
3	Saniah *et al., 2022*	Designed a system used for tracking and positioning of any vehicle by using Global Positioning System [GPS] and Global System for Mobile Communication [GSM].	Global Positioning System [GPS] and Global System for Mobile Communication [GSM].	SSADM	The system was flexible, customizable and accurate
4	Madhukara *et al.,* 2022	Implemented a vehicle monitoring and accident detection system using IOT	Arduino Uno Microcontroller, Gas Sensor, IR Sensor, Node MCU, Python 3.7 Version.	OOAD	The system utilized wireless sensors to alert the drivers which are user friendly
5	Nolan et al., 2022	*Developed an effective and practical working solution to a smart motion detector for LPWAN technologies using appropriate software and hardware platform.*	LORA, SIGFOX and NB-IOT	*OOAD*	*The evaluation which was based on extensive simulation demonstrated the detection of each sensor.*
6	Seyed et al., 2022	Provided a high-speed method for diagnosing and treating the elderly	SFS algorithm	Quantitative	The results showed that with the mean, skewness and kurtosis features and support vector machine classifier, the accuracy of fall detection was 96.33%
7	Mamatha et al., 2022	This document enables the real-time chase of a car and aims to reduce the risk of fatalities due to delays in the delivery of help by informing the involved parties about the vehicle's accident	AMS-based System	Qualitative	The victim's likelihood of survival is increased as a result.

8	Mounika *et al.,* 2021	The system uses the functions provided by car-to-car communication technology to provide automatic detection, reporting and assistance for passengers in traffic accidents	GSM module and GPS Module, Arduino IDE	OOAD	Accident detection and alerting via SMSs using GPS, GSM and sensors was achieved. It helped not only in finding the location of vehicle but also in saving the lives of victims by finding where an accident has happened.
9	Tejaswini *et al.,* 2021	The proposed method is a low-cost security system for vehicles that common people can afford it and the manufacture can built-in the security system in wide range of automobiles.	IOT, GPS, GPRS, GSM	Prototyping	With the new system, the vehicle owner could track the location, receives the thief photo link message and sends a message to the local police station to prevent vehicle theft and reduce the accidents.
10	Egwuonwu et al., 2021	This paper proposed a system designed to track and monitor vehicles for purpose of locating and monitoring them as well as to stop the vehicle if stolen and to track it online for retrieval.	IOT	Prototyping	This system is useful in many applications such as security, vehicle tracking, fleet management, and for theft prevention and recovery
11	Mounika, *et al.,* 2021	To alert the near and dear ones of the person in the vehicle about the accident to provide immediate medical aid.	GPS and GSM Module	OOAD	The system detected the accident and then alert the victim's dear ones nearby to provide medical aid to accident victim
12	Mauris *et al.,* 2021	The work presented an extended Intelligent System for	CAN, real time kernel	SSADM	The system presented an innovative approach to the road navigation problem, improving detection and warning of potentially

		Vehicle Navigation Assistance			hazardous traffic conditions
13	Kahled and Wasim, 2021	To improve vehicle traffic using an alerting and rerouting system	VANET, AODV	Prototyping	Simulation results showed the protocol's effectiveness in reducing routing load and sustaining more stable connections compared to AODV.
14	Vijayaprabakaran *et al.,* 2021	An intruder detection system using IoT (Internet of Things) was developed	Arduino	SSADM	The system was very effective
15	Hasan and Theyazn, 2021	Used advanced artificial intelligence algorithms such as CNN, LSTM, and a hybrid CNN-LSTM to develop a system to detect intrusions into the IoT environment.	IOT	*Prototyping*	Simulation was effective
16	Ayo *et al.,* 2021	Remodelled ATM operations to accommodate in a single transaction access to the various accounts with or without a card and authenticated through a combination of pin, fingerprint, Irish and or 3-D facial recognition	Multi factor Authentication ATM	Prototyping	It reported the prototype of a multi-factor authentication ATM system that does not require the use of card. The system offers ease of use and simplifies the use of the platform with the intention of encouraging financial inclusion in the country
17	Khairuddin et al., 2021	Developed the face detection and recognition in the security system in the building with recognizing human faces and image capture to the cloud storage	IOT	SSADM	The result showed that the video will stream and recognize human faces whether the person is authorized or unauthorized in the system image using Raspberry Pi 3.

18	Almawgani et al., 2021	The work presented a smart and efficient car-parking detection system	The proposed system comprised of two cameras connected to a mobile system that is devised with Arduino, four DC motors, and PIR sensor	SSADM	the efficiency rate of the proposed smart carparking monitoring system is 96%. This system offers suitable solution in assisting drivers to park properly within each parking lot and owners of parking area to keep it organized via remote monitoring system.
19	Bharggava et al., 2021	The paper proposed the design and development of smart system to prevent theft that uses biometric authentication to access the door and to start the engine of the automobile.	Biometrics, raspberry pi, fingerprint module, GSM module, Email, OpenCV, LBPH, Pillow, face Cascade	SSADM	The system is simple, user hostile and reliable that alerts
20	Abubakar, 2020	i. Developed an algorithm that maps an accident location to an emergency centre closest to the accident location and send notification to that centre.	GPS and GPRS	SSADM	The system was successfully implemented
21	Ebenezer and Willie 2020	The system detected vehicle overloading and automatically call the owner of the vehicle or the road safety officer in that event.	GPS and GPRS	SSADM	The system has facilities to lock a vehicle engine automatically
22	Ashwini 2020	Studied different IoT sensors to detect vehicles such as Optical sensor (infrared), Radar sensor, Wireless magnetometer, Video image processor and To	Radar, ROI, IOT	OOAD	The implemented system was satisfactorily implemented.

		compare their performance			
23	Gowri *et al.,* 2020	To employ proposes to advance the potential of a GPS receiver to detect the speed of a vehicle and detect an accident basing on the supervises speed and send the placement and time of the accident from the GPS data processed by a microcontroller by using the GSM network to the Alert Service Centre	Arduino, GSM, GPS, Ultrasonic Sensor, Vibration Sensor, Accelerometer	SSADM	This system showed the location of vehicle where the accident has occurred with the help of the GPS module connected to it and hence that information is added in the form of latitude and longitudinal values in accident alerting message.
24	Luckman and Jonathan, 2020	To develop In-Vehicle Traffic Accident Detection and Alerting System Using Distance-Time Based Parameters and Radar Range Algorithm	IOT	OOAD	The developed prototypical vehicle traffic accident notification and roadside barrier detection with an early warning was tested and prove to be efficient
25	Hassan et al., 2020	Developed a system that will quickly track the location of a stolen vehicle, thereby reducing the cost and effort of police.	IOT	OOAD	This ensures system to work continuously in different conditions, even when the vehicle battery stops and gives reliability and independence to the system. Another important feature is the use of Google Maps
26	Ravi, 2020	The work designed and implemented a fire alert system on train-like buses by sending alert of	Microcontroller, LCD display, GPS, GSM, Power supply, Infrared sensor, Fire detector	OOAD	The implemented system was reliable and has the function of preventing theft and providing accurate tracking system

		fire accident to save many lives.			
27	Abid, et al., 2020	We designed our project in such a way that if accident occurs then the system will have ask the driver whether to send message or not if the driver is safe he will not send message by pressing certain button otherwise the message will have send to the guardian	Arduino mega, SM (Global ystem for mobile ommunication) odule GPS (Global ositional system) odule Vibration sensor RFID security ystem HMI (Human achine interface) ouchscreen isplay	SSADM	This is effective in reducing the time gap
28	Sani et al., 2020	Developed Digital Authentication and Authorization for Facial Recognition and Speech Detection System	(Authentication and authorization for facial recognition and speech recognition system	*SSADM*	The proposed algorithms are simpler and faster as well as economical compared to previously reported algorithm.
29	Kanpath et al., 2020	The aim of the paper is to minimize the queue at the electricity billing and to restrict the usage of electricity automatically, if the bill is not paid.	IOT	SSADM	The system is easy to design and consume less power, and provides at low cost with portable size.
30	Ritesh et al., 2020	Investigated the possibility of designing a simple, robust automated real-time traffic control system using low-cost electronic components that will easily be adaptable to the existing traffic conditions at the junctions, with minimal physical	Traffic Signal Control Systems (TSCS)	OOAD	The implemented system was found to be effective.

		changes in the intersection.			
31	Mounika and nitha, 2019	The major concern of the proposed system is identifying the vehicle theft by implementing anti-system. Vehicle tracking system is bene-ficial in many ways such as providing security to the personal vehicles, taxis, cabs, school buses/cars and others.	GPS, GSM, IOT	SSADM	Satisfactory
32	Pardeshi *et al.,* 2019	to give Security to all vehicles.	GSM, LCD, GPS, CPU.	SSADM	improves safety and security, communication medium, performance monitoring and increases productivity.
33	Kanagaraj et al., 2019	Proposes a security model that will send a SMS to the possessor of an automobile to give an alert immediately particularly if the automobile is near	GPS, Ultrasonic Sensor, Vibration Sensor, Accelerometer	OOAD	The results and analysis of the proposed system working model is good
34	Vinitha et al., 2019	Provided a solution by implementing IoT, a smart solution which helps in reducing death rates.	GSM, GPRS	Qualitative	Results showed that this solution reduced the response time when compared to traditional systems. It minimized injured passenger interaction, providing basic medical information to emergency service providers
35	Friday and Sebastian, 2019	This paper proposed a two-factor authentication for	*ANPR; Vehicle access control; two-factor authentication*	SSADM	Satisfactory performance of the developed system.

		vehicle access controls using Automatic Number Plate Recognition (ANPR) and Radio Frequency Identification system (RFID			
36	Azihul *et al.,* 2019		GPS, GSM modules, IOT	Quantitative	The results include the successful operation of an automatic accident detection and notification systems.
37	Kate et al., 2019	Developed accident detection and alerting system	Arduino Processor, GSM Module, GPS Module, Accelerometer sensor, LCD Display, Smart phone	SSADM	The proposed embedded approach provides the promising result
38	Ndunagu and Nwoduh, 2019	The work focused on the development of a highly secure mobile banking platform to check mobile device identity authentication vulnerabilities.	IOT	SSADM	Provides good security
39	Razib, 2019	Developed a smart and cost-effective fire detection system based on the IoT that can detect the sudden uncertain fire in a quick succession to reduce the significant loss.	R-Pi-3 B+, MQ-2 sensor, 10 bits Analogue to digital power converter, 16 bits Analogue to digital power converter, MCP3008 chip, Buzzer, Breadboard, and Jumper cables.	OOAD	Our system is a flexible one that offers the users all kinds of accessibility that would make the system a more viable than most other systems available in the market
40	Komal et al, 2019	This project is based on accident detection and tracking system.	ARM7 Lpc2148, GPS module, GSM module, accelerometer, temperature	SSADM	Effective

			sensor, liquid crystal display, Power supply		
41	Ajith *et al.,* 2018	The goal of this paper is to build up a Vehicle accidental monitoring system using MEMS, GPS and GSM Technology	GPS and GPRS	SSADM	The Expected performance is achieved through implementation of the proposed system.
42	David *et al.,* 2018	The paper provided solutions to caretakers through application of multiple sensors for integration of a child detection system and also to discover the best placement of the sensors for a more effective system.	IOT, Arduino UNO	SSADM	The detection system was also validated based on criteria set which were accuracy, resistance and reliability
43	Kamoru *et al.,* 2018	Designed and implemented a motion detection alarm and security system	PIR	SSADM	The developed motion detection alarm and security system gives good response to the motion sensor when it detects intrusion at the windows or doors. The test result shows that both the braking switches attached to the door hinges and the motion sensors performed adequately as expected
44	Ilyasu, 2018	Provided the Vehicle owner with the SMS (Short Message Service) of details of the locations like the latitude and the longitude. To come with my own hardware of GPS and GSM tracking system	GPS module, GSM module, SIM,	SSADM	The objective of this project using GSM and GPS modules in order to track vehicle location was achieved

45	Akpan, Mmeah and Baah, 2018		System Development Life Cycle (SDLC)	SSADM	Effective
46	Rathod *et al.,* 2018	Implementing children tracking location system for every child attending school.	ARDUINO, GPS, Global system for mobile communication & mobile phone as receiver	Qualitative	The application automatically operated location request.
47	Swetha et al., 2017	The proposed system uses the IoT for vehicle accident detection and alarming the authorities regarding accidents, vehicle tracking using GPS Modem	Raspberry Pi, GPS, Vibration Sensor, L293D Motor Driver, Wi-Fi, Python	Quantitative	Designed IoT based vehicle accident detection and tracking system using GPS Modem. Hence IoT can revolutionize the way the system interacts and respond for the variety of applications especially in case of traffic control
48	Adelabu, 2017	Designed the GPS/GSM and Push button based on the system.	GPS module, GSM module, SIM,	SSADM	Improved safety and security, communication medium, performance monitoring and increases productivity
49	Kavitha et al., 2017	Designed alternate method of seat belt safety mechanism without changing the available space. It also provides safety to occupants in the cars in which air bags could not be implemented.	IOT, RFID	Reversed Engineering	Satisfied
50	Lavitha et al., 2017	Designed alternate method of seat belt safety mechanism without changing the available space. It also provides safety to occupants in the cars in which air bags could not be implemented.	Passive RFID tags	Reversed Engineering	Effective

51	Mistura and Ishola, 2017	The paper presented an electronic payment authorization system where T-FA was utilized for the authorization of payment transactions	E-Payment, E-payment Security, E-payment System, PKI, T-FA.	OOAD	The system is easy to use and available regardless of time, place and whether you are doing business over the counter at a supermarket or on the Internet.
52	Chandan and Sunil, 2017	Developed Privacy Protection System for Secure Authentication and Internal Intrusion Detection System	VANET, The proposed system affords a security system, titled Internal Intrusion Detection and Protection System (IIDPS),	Quantitative	The system can identify a user's forensic features by analysing the corresponding SCs to enhance the accuracy of attack detection, and able to port the IIDPS to a parallel system to further shorten its detection response time.
53	Viji et al., 2017	To develop smart vehicle authentication and due date monitoring system using IoT	IoT	SSADM	Effective
54	Ngumbi, (2017).	To formulate an adoption model for vehicle tracking and monitoring systems in the Kenya Police Service.	Radio frequency Identification model (RFIM)	Qualitive method	Model successfully developed and deployed.
55	Mulakalapalli and Markandeya, 2016	The proposed design provides information regarding vehicle Identity, and position on real time basis. This information are collected by the RASPBERRY PI by using different modules like Sensors and GPS, and dispatch it to the monitoring station where it	Raspberry Pi, GPS, GSM	SSADM	The proposed system was fully developed and tested to demonstrate its feasibility and effectiveness.

		stores the information in database and display it on graphical user interface (GUI) that is user friendly.			
56	Asif et al., 2016	To develop Smart Vehicle Security System for Defending Against Collaborative Attacks by Malware	PAS	OOAD	This system ensures that only the authorized person will be able to activate and use the vehicle and thus ensuring that unauthorized access is revented. The Person Authentication System (PAS) will prevent the person to operate the car and it will send the alert information image to the system controller

3. RESEARCH METHODOLOGY

A thorough investigated was carried out on past related work between 2016 to 2022. Several databases were searched. These include: EBSCOHOST, Google scholar, IEEE Xplore, Science direct and Emerald. The searched focused on vehicle tracking system, accident detection and alerting system, electronic payment authorization system, Intelligent System for Vehicle Navigation, intruder detection system.

The work focused on journals and conference proceedings. Searches are carried out on each of the databases, search criteria are refined after each search. This ensures that maximum papers are selected. Papers are selected based on their topics, abstract and relevance to the topics in focus. Completed and work-in-progress work were included in the search. Language used was English only.

3. RESULTS AND DISCUSSIONS

This section tries to perform a comparative analysis / evaluation of the different research methodologies used in ICT research and design even as they are captured in this research papers reviewed:

Table 2. Summary of ICT Research Methodologies

S/N	ICT Research Methodologies
1	Structured System Analysis and Design Methodology (SSADM)
2	Object-Oriented Analysis and Design Methodology (OOADM)
3	Prototyping Methodology
4	Reverse Engineering Methodology
5	Quantitative Methodology
6	Qualitative Methodology

Table 3: Breakdown of Research Methods Adopted in the Reviewed Papers

S/N	ICT Research Methodologies	Frequency
1	Structured System Analysis and Design Methodology (SSADM)	32
2	Object-Oriented Analysis and Design Methodology (OOADM)	14
5	Quantitative Methodology	6
6	Qualitative Methodology	5
3	Prototyping Methodology	4
4	Reverse Engineering Methodology	2

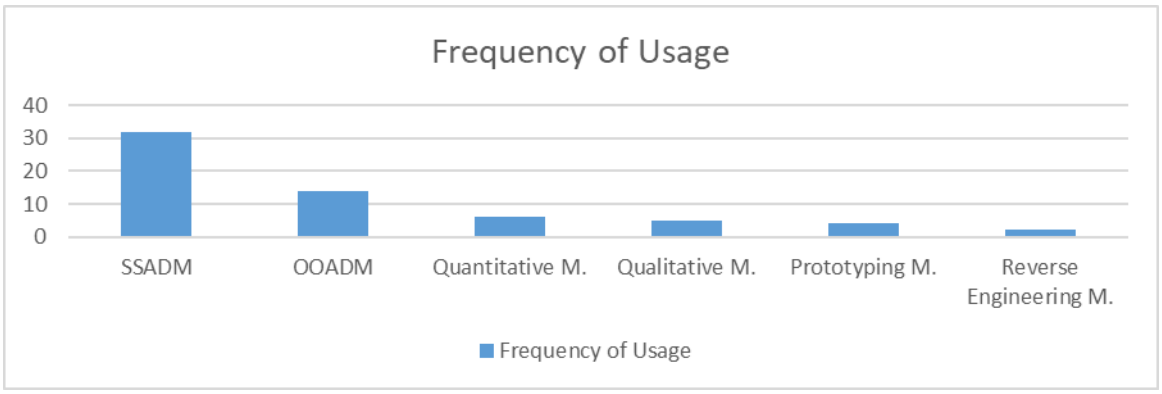

Figure 1: Bar Chart Showing Research Methods Used by the Reviewed Literature

From 1, the result shows that 32 research of the articles reviewed adopted Structured System Analysis and Design Methodology, which is the highest frequency while, OOADM, has a frequency of 14 and is placed as the second most used methodology. Furthermore, quantitative, qualitative, prototyping as well as reverse engineering are places third, fourth, fifth and sixth in the order frequency of usage with the frequencies of 6, 5, 4 and 2 respectively. This could possibly imply that Structured System Analysis and Design Methodology (SSADM) is the most used methodology in ICT research and design. This could be as a result of its advantage over other methodologies and the type of research been carried out.

Moreso, Object-Oriented Analysis and Design methodology (OOADM) is placed second most used method. Once again, we could ascribe this to its importance as well as its application over the research been carried out.
Reversed Engineering is seen as the least used method which implies that the method is not commonly adopted as it has to do with replacing the existed parts of an existing system. This is usually applicable when the manufactural of a particular product has gone extinct and there is need for reproduction of parts of that system or products.

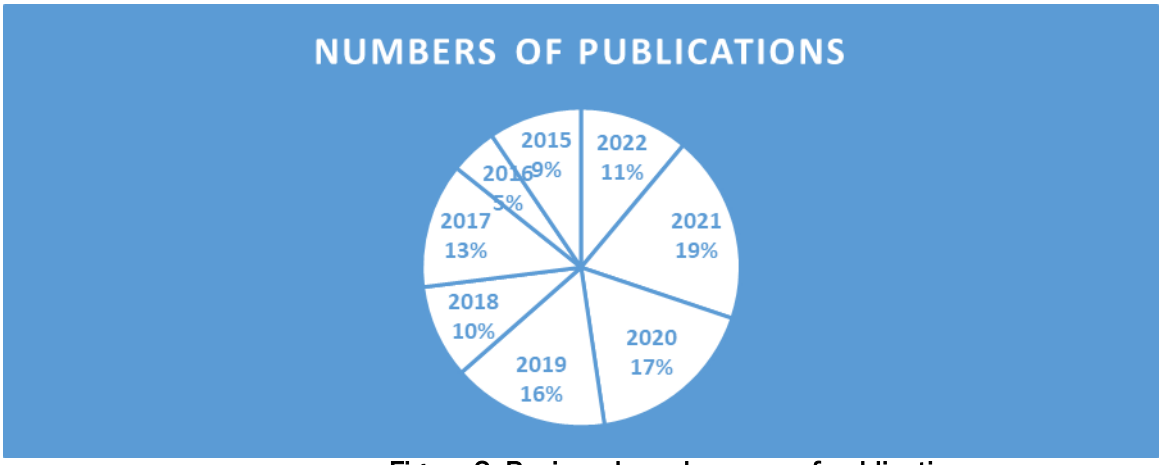

Figure 2: Reviews based on year of publication

The above figure depicts percentage of years of publication of the articles reviewed in this seminar work. The figures shows that 7 articles were published in 2022 which constitute a total of 11% of the total reviews. The result further shows that articles published in 2021 were highest with a frequency of 12 which constitutes 19% of the reviewed literatures. The result further revealed that 2016 has the least frequency (3) of articles used in this seminar with a percentage of 5. The frequency of usage for 2020, 2019, 2018 and 2015 are 11, 10, 6, 8 and 6 with a corresponding percentage of 10%, 16%, 13%, and 10% respectively.

4. CONCLUSION

This seminar work has successfully reviewed and discussed ICT Research and methodologies as they are applied in ICT Research and Design. This is necessary because methodology goes a long way in determining a research outcomes and result. The right research methods yields the desired result whereas wrongly chosen research methodology will result in poor outcome/result.
As seen above, a total of six (6) research methodologies are applicable in ICT Research and Design. The reviewed works indicates that 32 articles reviewed used SSADM, while 14 made use of OOADM, 6 articles employed Quantitative Research Method while Qualitative, Prototyping, and Reversed Engineering Methodologies were used by 5, 4 and 2 articles respectively. The review further indicates appropriate results or desired outcome which implies that the right methodologies were used.

5. RECOMMENDATIONS

As stated in the conclusion and the overall review, the following recommendation are made. The right research methodology should be frequently used in order to achieved desired outcome. Care should be taking in selecting the research method for every research intended.

REFERENCES

1. Mounika, A. & Chepuru. A. (2019). IOT Based Vehicle Tracking and Monitoring System Using GPS and GSM. International Journal of Recent Technology and Engineering (IJRTE) ISSN: 2277-3878, 8(2), S11.
2. Abubakar L. (2020). Vehicle crash location detection and alerting system using android smart phone and GPS technologies. Unpublished thesis.
3. Agarwal, S., Chandankhede, H., Agarwal, S., Chaudhari, S. S., Amb, S. K., Chaudhary, B., ... & Gore, M. M. (2017). Communication Technology (CICT).
4. Ajith, K. A., Jaganivasan V., Sathish T., Mohanram S. (2018). Accident Detection and Alerting System Using GPS & GSM. *International Journal of Pure and Applied Mathematics.* 119 (15), 885-891
5. Akpan, A. G., Shedrack, M. & Barida. B. (2018). E – Wallet System Implementation: Impact on Small Scale Business in Nigeria. International Journals of Advanced Research in Computer Science and Software Engineering ISSN: 2277-128X (Volume-8, Issue-10).
6. Almawgani, A. H. M., Alsuwian, T., Alhawari, A. R., Alhuthari, A. N., Alhezabr, M. A., Alharethi, M. S., & Alqahtani, F. H. (2021). Smart and efficient system for the detection of wrong cars parking. *Bulletin of Electrical Engineering and Informatics*, *10*(4), 1968-1978.
7. Ashwini. N., S. Mahalakshmi, Bhagya G. (2020). Study of IoT sensors for vehicle detection.

European Journal of Molecular & Clinical Medicine ISSN 2515-8260 Volume 08, Issue 02.
8. Bhargava, N., Mor, R. S., Kumar, K., & Sharanagat, V. S. (2021). Advances in application of ultrasound in food processing: A review. *Ultrasonics sonochemistry*, *70*, 105293.
9. CH. Gowri, B. Raj Kumar, R. Jagadeesh, CH. Sai Kumar, G. Srinivas. (2020). Accident Detection and Tracking System Using GSM, GPS And Arduino. Journal of Emerging Technologies and Innovative Research (JETIR). 7, (4). 2349-5162.
10. Charles, K. Ayo and Wilfred Isioma Ukpere. (2021). Design of a secure unified e-payment system in Nigeria: A case study. African Journal of Business Management Vol. 4(9), 1753-1760.
11. Choosri, N., Yu, H. and Atkins, A. (2013) 'Practical aspects of using passive UHF RFID technology for vehicle tracking', Int. J. Agile Systems and Management, Vol. 6, No. 1, pp.43–65.
12. Kavitha, D. Deepika, T.G. Devapriya, A. & Bharathi. N.D. (2017). A Survey on Vehicle Monitoring System. *International Journal of Scientific Development and Research (IJSDR)* 2 (4), 2455-2631.
13. Dileep, P. K., Tröger, J. A., Hartmann, S., & Ziegmann, G. (2022). Three-dimensional shear angle determination with application to shear-frame test. *Composite Structures*, *285*, 115134.
14. Ebenezer, N. O., and Willie K. O. (2020). Design and Construction of Vehicle Loading Monitoring System Using Load Sensor and GSM. *International Journal of Applied Science and Technology.* 10(1), doi:10.30845/ijast.v10n1p1
15. Egwuonwu, A. C., Okemiri. H. A. and Chioma, V. A. (2021). Vehicle Monitoring System based On IOT, Using 4G/LTE. International Journal of Engineering and Management Research (4), 2394-6962.
16. Friday, C. C, Phiri, J. & Namukolo, S. (2019). Development of a Two Factor Authentication for Vehicle Parking Space Control based on Automatic Number Plate Recognition and Radio Frequency Identification. (*IJACSA) International Journal of Advanced Computer Science and Applications*, 10(1), 588 – 597.
17. Kanagaraj, G. Priya. J, Anitha .P. (2019). Automobile Monitoring and Tracking System: A New Model. International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, 8 Issue-12S.
18. Gangadhar, M. Madhu, M. S. Pushpalata, S. "Vehicle tracking and monitoring by ARM 7," SSRG International Journal of Electrical and Electronics Engineering (SSRG-IJEEE), Volume 1, Issue 4, June 2014.
19. Gupta, B.N. & Gupta, N. (2022). Research Methodology. Information Technology, Vol. 38, No.1, April 2012.
20. Hussain, F., Hussain, R., Hassan, S. A., & Hossain, E. (2020). Machine learning in IoT security: Current solutions and future challenges. *IEEE Communications Surveys & Tutorials*, *22*(3), 1686-1721.
21. Saranya, J. & Selvakumar, J. (2013). Implementation of children tracking system on android mobile terminals," International Conference on Communication and Signal Processing, April
22. Vijayaprabakaran, K. Kodidela, P. & Gurram. P (2019). IoT Based Smart Intruder Detection System for Smart Homes. International Journal of Scientific Research in Science and Technology Print doi : https://doi.org/10.32628/IJSRST218410 8, (4): 48-53

23. Kamoru Olarewaju Iyapo, Olukayode Michael Fasunla, Shadrack Alaba Egbuwalo, Akin James Akinbobola and Olatunji Temitope Oni. (2018). Design and Implementation of Motion Detection Alarm and Security System. International Journal of Engineering and Advanced Technology Studies 6(1), 26-38.
24. Kate, K., Balla, V., K. H., Satyavolu, J., Singh, P., & Tadimeti, J. G. D. (2019). Additive manufacturing of natural fiber reinforced polymer composites: Processing and prospects. *Composites Part B: Engineering*, *174*, 106956.
25. Komal, K., Vigneswari, N., Krishna, D.V. & Phanindra, G. V. (2019). An optimized random forest classifier for diabetes mellitus. In *Emerging Technologies in Data Mining and Information Security* (765-773). Springer, Singapore.
26. Khairuddin et al 2021 IOP Conf. Ser.: Mater. Sci. Eng. 1176 012030
27. Madhukara S, Varsha Singh V, Veena M, Vidya V, and Vidyashree M. (2022). Implementation of Vehicle Monitoring and Accident Detection system Using Internet Of Things. International Research Journal of Modernization in Engineering, Technology and Science. e-ISSN: 2582-5208. 04 (06).
28. Mamatha, S. U., Devi, R. R., Ahammad, N. A., Shah, N. A., Rao, B. M., Raju, C. S. K., ... & Guedri, K. (2022). Multi-linear regression of triple diffusive convectively heated boundary layer flow with suction and injection: Lie group transformations. *International Journal of Modern Physics B*, *37*(01), 2350007.
29. Mounika J., N. Charanjit, B. Saitharun & B. Vashista (2021). Accident Alert and Vehicle Tracking System using GPS and GSM. Asian Journal of Applied Science and Technology (AJAST) Volume 5, Issue 2, Pages 81-89
30. Mounika, J. and Charanjit, N. and Saitharun, B. and Vashista, B., Accident Alert and Vehicle Tracking System using GPS and GSM (April 17, 2021). Asian Journal of Applied Science and Technology (AJAST) Volume 5, Issue 2, Pages 81-89, April-June 2021, Available at SSRN: https://ssrn.com/abstract=3869132
31. Mulakalapalli P. D., & N. Markandeya Gupta (2016). Design and Development of Vehicular Monitoring, Tracking and Accident Identification System using Raspberry Pi. International Journal of Engineering Research & Technology (IJERT) http://www.ijert.org ISSN: 2278-0181 IJERTV5IS110083 Vol. 5 Issue 11.
32. Vijayalashmy, V. Yamuna, N., Rupavani, G., Kannaki, A. & Azhagu, V. (2014). GNSS based bus monitoring and sending SMS to the passengers. International Journal of Innovative Research in Computer and Application Engineering, 2, Special Issue 1.
33. Ngumbi, D. N. (2016). A model for vehicle tracking and monitoring systems adoption in Kenya Police Service (Thesis). Strathmore University. Retrieved from htpp://su-plus.strathmore.edu/handle/11071/4845.
34. Owan, V. J., (2022). A Data Mining Algorithm for Accessing Research Literature in Electronic Databases: Boolean Operators. *Innovative Technologies for Enhancing Knowledge Access in Academic Libraries. DOI: 10.4018/978- 6684-3364-5.ch009*
35. Pankaj Verma, J. S. Bhatia, "Design and development of GPS-GSM based tracking system with Google map based monitoring," International Journal of Computer Science, Engineering and Applications, Vol. 3, No.3, June 2013.
36. Pardeshi S. M, Bokde. P. N, Nimbalkar R. K., Somvanshi. P. (2019). Alert System for Vehicle. *International Journal of Engineering Science and Computing*. 20304 – 20306

37. Prafill D. Patinge, N. R. Kolhare, "Smart onboard public information system using GPS and GSM integration for public transport," International Journal of Advanced Research in Computer and Communication Engineering, Vol. 1, Issue V, July 2012.
38. Anderson, R. E., Poon, A., Lustig, C., Brunette, W. & Borriello, G. (2009). "Building a transportation system using only GPS and SMS infrastructure," International Conference on Information and Communication Technologies and Development (ICTD), pp: 233-242.
39. Rajib, S. U., Adhikari, P., Hoque, M., & Akter, M. (2019). Institutionalisation of the Cash Basis International Public Sector Accounting Standard in the central government of Bangladesh: an example of delay and resistance. *Journal of Accounting in Emerging Economies*.
40. Ravi, K. (2020). A survey on opinion mining and sentiment analysis: tasks, approaches and applications. *Knowledge-based systems*, *89*, 14-46.
41. Ritesh, P., & Srivastava, V. C. (2020). Understanding of ultrasound enhanced electrochemical oxidation of persistent organic pollutants. *Journal of Water Process Engineering*, *37*, 101378.
42. David, C. et al 2018 IOP Conf. Ser.: Mater. Sci. Eng. 429 012056
43. Asif, S., Hussain, C., Shekar, R, Yahya. A, Hussain, S. (*2016.*). Smart Vehicle Security System for Defending Against Collaborative Attacks by Malware.
44. Ting, S. LWang. L. X. & Ip, W. H. (2012). A study of RFID adoption for vehicle tracking in a container terminal. *Journal of Industrial Engineering and management.* 5(1):22-52
45. Sani, M. H., Tabrizi, A. A., Saghaei, H., & Karimzadeh, R. (2020). An ultrafast all-optical half adder using nonlinear ring resonators in photonic crystal microstructure. *Optical and Quantum Electronics*, *52*(2), 1-10.
46. Seyed-Ahmadi, A., & Wachs, A. (2022). Physics-inspired architecture for neural network modeling of forces and torques in particle-laden flows. *Computers & Fluids*, *238*, 105379.
47. Swetha, B. & Shruti, S. (2017). IoT Based Vehicle Accident Detection and Tracking System Using GPS Modem. International Journal of Innovative Science and Research Technology. 2(4) 2456 – 2165
48. Tejashwini, R., & Panda. S. K. (2021). Design and Development of Vehicle Theft Detection, Tracking and Accident Identifier System using IoT. Journal of University of Shanghai for Science and Technology ISSN: 1007-6735.
49. Trainor, A., & Bouchard, K. A. (2013). Exploring and developing reciprocity in research design. International Journal of Qualitative Studies in Education, 26(8), 986-1003. DOI: 10.1080/09518398.2012.724467
50. Ramya, V., & Palaniappan, B. (2012). Embedded Technology for vehicle cabin safety Monitoring and Alerting System. International *Journal of Computer Science, Engineering and Applications (IJCSEA)* 2(2).
51. Vijay, K., Murmu, M., & Deo, S. V. (2017). Bacteria based self healing concrete–A review. *Construction and Building Materials*, *152*, 1008-1014.
52. Vinitha, A., & Rukmini, M. S. S. (2019). Secure and energy aware multi-hop routing protocol in WSN using Taylor-based hybrid optimization algorithm. *Journal of King Saud University-Computer and Information Sciences*.
53. Rathod, Y. Dighole, M. & Sharma, R. (2018). International Research Journal of Engineering and Technology (IRJET). p-ISSN: 2395-0072