



RE-FOCUSING ON THE 21ST CENTURY CHALLENGES BY PROMOTING THE USE OF AFRICAN INDIGENOUS LANGUAGES TO DESIGN ARTIFICIAL INTELLIGENCE (AI) MODELS, YORUBA LANGUAGE OPTION.

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Abstract

Information Technology (IT) based Artificial Intelligence (AI) has become an essential tools for community development in the 21st century. The inception of IT has brought nations, regions, cities, villages and individuals together within global networked communities based on shared interests at a speed and

inclusiveness as never before

Key words: African Indigenous Language, Artificial Intelligence, Information Technology, Sustainable Development, Yoruba Language.

possible. IT promotes the pursuit of individual interests that are independent of local or

INTRODUCTION

Before the advent of colonial rule, African continent believed to be rich in culture and tradition and indigenous system of education. Their medium of instruction was their tongue (Fafunwa, 1996) as Reported by (Ojuope et al., 2021). The first formal (western) education was introduced in Nigeria in 1843 by Christian missionaries; their aim was to convert the heathen African to Christianity through education. Nigerian formal education was patterned after the English system. The emphasis was on 'English' both in thought and culture ability to speak English fluently was considered the hallmark of excellence.

It was observed that a vast majority of Nigerians (Africans) are not capable of reading and writing in English language. Whereas, the major language of use apart from signs and symbols to develop computer packages in Nigeria is English Language; this makes it difficult for most Nigerians accessing of information technology (Fafunwa, 1996) as Reported by (Ojuope et al., 2021). However, this should

community needs, it increases the integration of production systems and markets, the speed of communications, and the velocity of capital flows with corresponding increase in complexity and volatility that promotes sustainable development. The transformation in the structure of global community system has redefined the basis of digital inclusion by creating new levels of entry into the global community. Vast population of Africans living in rural

areas that can not read and write in any language other than their indigenous language are disconnected from the use of information technology applications. This paper explains the need to re-focus on the 21st century challenges by promoting the use of African Indigenous languages (AIL) to design Artificial Intelligence (AI) models, Yoruba Language option. This will promote the easy accessibility of rural communities to the IT most especially those that cannot

read or write in English language. It further explains the efficiency the researching community could derive from the use of indigenous language to develop AI models such include providing an enabling environment that facilitates appropriate research tools and support job creation. It further explains the need to provide real time access to information, regardless of geographical location, and disability.

be seen as a challenge to the multitude of software developers, that abound in Africa, they should imitate countries like China and India to develop ICT based Artificial Intelligence models and applications that are African-language friendly. This may be a way of surmounting the language obstacles in the accessing of IT, in Nigeria rural communities and this will contribute to sustainable national development; and among other things will bridge digital divide.

The challenge of IT in African communities

Prior to the introduction of western education, all African ethnic groups had their own distinctive languages and indigenous system of education. Their medium of instruction was their tongue (Fafunwa, 1996) as Reported by (Ojuope et al., 2021). The first formal (western) education was introduced in Nigeria in 1843 by Christian missionaries; their aim was to convert the heathen African to Christianity through education. Nigerian formal education was patterned after the English system. The emphasis was on 'English' both in thought and culture ability to speak English fluently was considered the hallmark of excellence; and fast majority of Africans most especially Nigerians cannot read and write in English Language (Fafunwa, 1996) as Reported by (Ojuope et al., 2021). This among other things makes access to Information Technology (IT) a difficult task for this category of people. The inception of COVID 19 Corona virus pandemic disease has brought about the challenge of using Artificial Intelligence technologies to carry out sensitive tasks that may require contact with individuals. This paper addresses the necessity of looking into the 21st century challenges by promoting the use of African Indigenous languages (AIL) to design Artificial Intelligence (AI) models, Yoruba Language option. The use of indigenous language will go a long way to increase the scientific skills of those that cannot read and write in English language. It will also help the physically challenged individuals that have little or no access to quality education as a result of difficulties they face in learning and comprehension World Health Organization (WHO) and World Bank (2011). the paper observes the degree of efficiency of the use of African Indigenous Languages to develop AI models. The design and methodology was based on the

research work we carried out in one of the government school for handicap children in Nigeria. From the cognitive ability testing of the research, we found out that the students learn faster and easier with the use of Yoruba developed applications than English Language developed applications. Base on this, the use of African Indigenous Languages for ICT based AI will be of great advantage.

RELATED WORKS

Ojuope *et al.* (2022) worked on re-focus on the 21st century challenges by promoting the use of African Indigenous languages (AIL) to design Artificial Intelligence (AI) models, Yoruba Language option. The work established the fact that before the advent of Europeans, all the African ethnic groups had their own distinctive cultures, traditions, languages and indigenous system of education. Their medium of instruction was their tongue (Fafunwa, 1996) as Reported by (Ojuope *et al.*, 2021). The first formal (western) education was introduced in Nigeria in 1843 by Christian missionaries; their aim was to convert the heathen African to Christianity through education. Nigerian formal education was patterned after the English system. The emphasis was on 'English' both in thought and culture ability to speak English fluently was considered the hallmark of excellence; and fast majority of Africans most especially Nigerians cannot read and write in English Language (Fafunwa, 1996) as Reported by (Ojuope *et al.*, 2021). This among other things makes access to Information Technology (IT) a difficult task for this category of people. Base on this fact, this papetr concluded that the use of African Indigenous Languages for ICT, Mathematics, Science and Technology is highly imperative.

Thanveer *et al.* (2022), worked on the Remote patient monitoring using artificial intelligence: Current state, applications, and challenges. The work explained that the adoption of artificial intelligence (AI) in healthcare is growing rapidly. Remote patient monitoring (RPM) is one of the common healthcare applications that assist doctors to monitor patients with chronic or acute illness at remote locations, elderly people in-home care, and even hospitalized patients. The reliability of manual patient monitoring systems depends on staff time management which is dependent on their workload. Conventional patient monitoring uses invasive approaches which needs skin contact to monitor health status. This work carried out a comprehensive review of RPM systems including adopted advanced technologies. The results of this reviewed work show that AI-enabled RPM architectures have transformed healthcare monitoring applications because of their ability to detect early deterioration in patients' health, personalize individual patient health parameter monitoring using federated learning, and learn human behavior patterns using techniques such as reinforcement learning.

Ojuope *et al.* (2021) worked on developing ICT base virtual assistive system in Sub-Sahara African indigenous language Yoruba language option to promote virtual collaboration ability of Intellectually Challenged Yoruba ethnics living in rural communities for sustainable development during the COVID 19 lock down. They affirm that the inception of COVID 19 Corona virus pandemic disease has brought about the challenge of using Information and Communication Technology (ICT) in teaching and learning systems. The use of ICT in education is no longer a new idea, but the question is where the limit is when the use of ICT does not have the desired effect, most especially on the Intellectually Challenged individuals that cannot read and write in English Language. Most systems were developed without considering the fact that, there are different categories of users including people living with disabilities. Base on this, developing ICT base

virtual applications in Yoruba Language option that will encourage the virtual learning ability of these individuals during the COVID 19 pandemic outbreak is highly imperative.

Ruqiang et al. (2021), worked on AI-Enabled Monitoring, Diagnosis & Prognosis. The work stated that emerging and development of Artificial Intelligence (AI) particularly deep learning, has encouraged its application in various engineering domains. Monitoring, diagnosis and prognosis, as the key elements of intelligence maintenance of manufacturing systems in the era of Industry has also benefited from the advancement of AI technology. The main objective of this issue is to bring scholars to display their research findings in the field of monitoring, diagnosis and prognosis driven by AI, and promote its application in intelligent maintenance of manufacturing system.

Olivier et al. (2020), worked on Edge Computing and Artificial Intelligence for Real-time Poultry Monitoring, International Workshop on Artificial Intelligence & Internet of Things (A2IoT). The work observed that smart poultry acquires data from aviaries with the use of sensor network at reduced intervals of time that generate millions of data. The combination of Internet of Things (IoT) and Artificial Intelligence open the field of the real-time monitoring of poultry and ,advance analytic and automation if data is from high quality. This work proposed a scalable monitoring of a poultry achieved with open hardware wireless sensors network and software.

Ojuope *et al.* (2020) worked on Developing User Experience Interface in Yoruba Language in Improving Usability of the Intellectually Challenged that cannot Read and Write in English Language. From the work, it was observed that most interfaces were developed without considering the fact that, there are different categories of users including people living with disabilities. This paper focuses on the development of interface in African Language using Yoruba language option that will promote the user experience of persons with intellectual disability. The design and methodology was based on development of usability interface for people with intellectual disability using one of the government school for handicap children in Nigeria. During the process of this research, we discovered that most of the work reviewed did not focus on the use of local language to develop usability system for this category of persons.

Adeyemo and Idowu (2015), worked on Development and integration of Text to Speech Interface for Visually Impaired Users in Yoruba language. In the work, Text to Speech was described as a process whereby a system accepts text as input and produces a corresponding human voice of the text input. In the paper, Text to speech was developed in Yoruba language to assist users, it equally assist the users that want to learn Yoruba language from scratch, this includes how to learn, pronounce Yoruba language syllable formation from consonant and vowel. Standard performance error metrics was employed to measure the performance of the model. was also measured using a standard error metric. In the work, C# Programming language. Was used to implement a concatenative method of speech synthesis through syllable construction algorithm. And the the performance of the system was measured as well as the quality of 7synthesized speech was evaluated using Mean Opinion Score (MOS) tool; and the result generated was found to be 4.46 and 3.82 respectively. The use of MOS scale proved that the system was a good one.

METHODOLOGY

This section analysed the difficulties faced by the individuals that cannot read and write with the use of English Language in accessing Information Technology Applications and models. From the research carried out by the author of this paper in Home School for Handicapped Children, Ibadan, Oyo State 2018, It was discovered that, these people have little or no access to computer and IT facilities due to their inability to read and write in English Language. So they find it difficult

to learn and comprehend. Users from rural communities, predominantly farmers and herders have problem with using IT applications developed with the use of English Language since they cannot read and write in English Language.

Developing those Applications in African Indigenous language becomes imperative; this will enhance digital inclusion of these people and further promote job creation.

Artificial Intelligence and African Indigenous Language Applications.

The focus of this work is to leverage the potential of Artificial Intelligence, cloud computing, cognitive analytic and machine learning with the use of African indigenous language. The objective is to make the indigenous Africans that cannot read and write in English language more productive with the use of artificial intelligence models which as a tool for them. From Figure 1 (Thanveer et al. 2022), If Artificial Intelligence could be developed to monitor patient activities in the hospital, AI models and applications can as well be developed using African Indigenous language for accessibility by the rural communities.

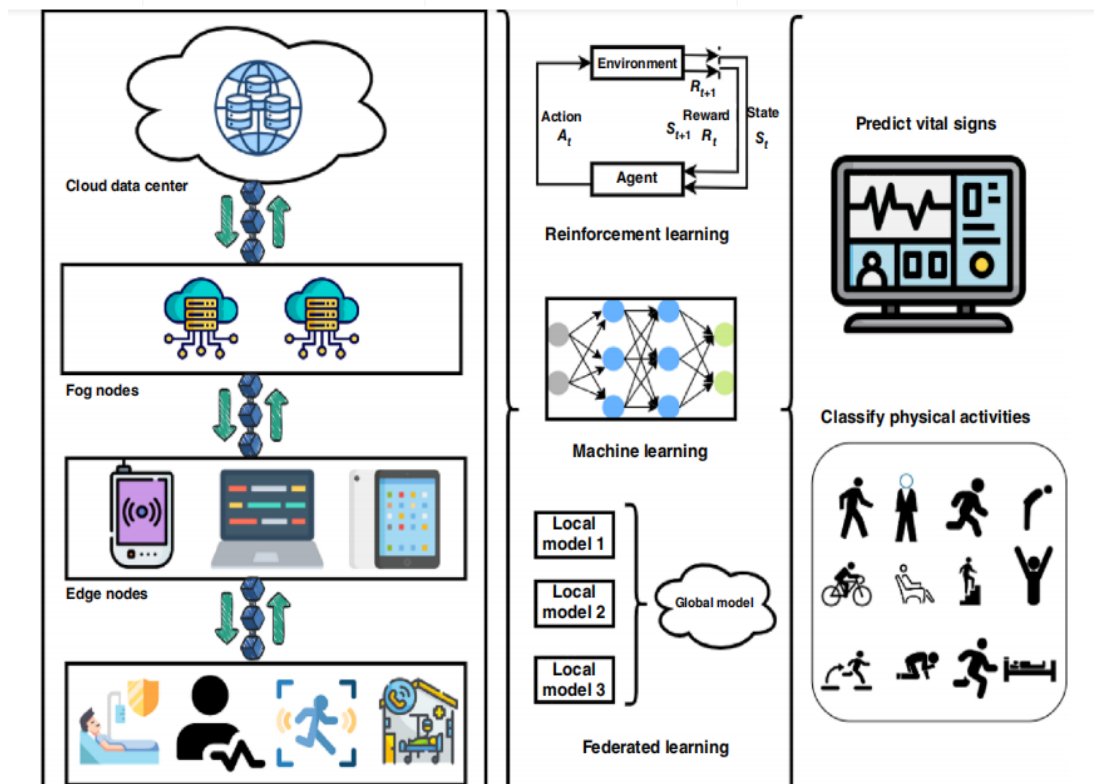


Figure 1, Artificial intelligence-enabled remote patient monitoring architectures, source: Thanveer et al. 2022.

3.2 Expression of Yoruba Standard Word

Yorubá is one of the three major languages spoken in Nigeria. Yoruba language is spoken by the South western part of Nigeria and other countries like Republic of Benin, Togo and part of Ghana. It is widely spoken language because of its prevalence both in Nigeria and outside Nigeria (Odetunji, 2008).

The Yoruba Alphabet

Yoruba alphabet has 25 letters which is made up of Eighteen (18) consonants (represented by the graphemes: *(b, d, f, g, gb, h, j, k, l, m, n, p, r, s, s, t, w, y)* and seven (7) vowels (*a, e, e, i, o, o, u*) while the Latin Letters <c> , <q> , <v> , <x> , <z> are not used. There is also addition of a diagraph <gb> which combines two consonants together that form a unit (Adeyemo and Idowu, 2015).

Yoruba Vowel

Phoneme Orthography Examples English

/a/ a ajá ‘dog’
 àbá ‘motion’
 /e/ e ewé ‘leaf’
 Ètè ‘lips’

as in English bait

/e/ e è j è blood
 è f è jest

as in English ‘bet’

/i/ I ìrì ‘dew’
 ìdí ‘buttocks’

as in English ‘beat’

/o/ o owó ‘money’
 òdo ‘zero’

as in English ‘boat’

/o/ or /o/ c oḻò
 Inca
 ntation
 ojó , day

as in English ‘bought’

/u/ u ojú ‘eye/face’
 òwú ‘thread’

as in English ‘boot’

Adapted from:

African Studies Institute manual, University of Georgia, USA

Tabla 1 Ccomputer / ICT Keywords in Hausa and Yoruba languages

S/N	ENGLISHH	HAUSA	YORUBA
1	File	File	Faili

2	Edit	Gyaran rubutan	Atunse
3	View	Duba	Fihan
4	Insert	Shigar da	Fikun
5	Format	Tsara	Fomati
6	Tools	Kayan aiki	Ohun Elo
7	Table	Gidan dara	Tabili
8	Window	Taga	Ferese
9	Help	Taimako	Iranlowo

Table 2 Translating Science and Technology terms from English Language to Igbo Language

ENGLISH	EXPLANATION	IGBO
ACCESS CONTROL	A security technique that can be used to regulate who or what can view or use resources in a computing environment.	nchekwa kembanye
AD BLOCKER	A software product that prevents advertisements from appearing with the content the user is intentionally viewing.	mgbochi mgbasa ozi
ADDRESS BAR	The familiar text field at the top of a web browser's	àdreèsi njirichòta
ADDRESS BOOK	A location of data, usually in main memory or on a disk. You can think of computer memory as an array of storage boxes, each of which is one byte in length.	akwùkwọ àdreèsi
ADSL PROVIDER	ISP i.e Internet Service Provider.	ihe na-eme ka ADSL ruọ ọrụ
ANTIVIRUS PROVIDER	A utility that searches a hard disk for viruses and removes any that are found.	ihe na-ewepụ nje
BANDWIDTH	The amount of data that can be transmitted in a fixed amount of time or range within a band of frequencies or wavelengths.	mkpurụọzi nziga
BOOKMARK	In the context of the World Wide Web, a bookmark is a Uniform Resource Identifier (URI) that is stored for later	usoro nchoputa ihe nchekwa

	retrieval in any of various storage formats.	
CHAT GROUP	A group created for a group of people in order to share likely ideas.	otu mkpakorita uka
UPLINK	A wireless connection from a local area network (LAN) to a wide area network (WAN)	mjikọ kemgbago
STARTUP	Starting something in motion	Mmalite
POPUP	A graphical user interface (GUI) display area, usually a small window that suddenly appears (pops up) in the foreground of the visual interface on the world wide web.	popopu
NEWS GROUP	A worldwide network of news discussion group.	otu mkpakorita uka ndi nta akuko uwa - ebe mkpakorita uka - otu ndi nta akuko - ebe nzuko
NAVIGATION BAR	A user interface element within a webpage that	iba Ntaneti
ENCRYPTON SYSTEM	The encryption protects the confidentiality of digital data stored on computer systems or transmitted via the Internet or other computer networks.	usoro nzowe ihe na komputa
FIREWALL	A network security device that monitors incoming and outgoing network traffic and decides whether to allow or block specific traffic based on a defined set of security rules.	mgbochi mbata ozi ojoo
FTP ACCESS	FTP is used to transfer files between computers on a network.	mnweta FTP
HYPERLINK	In computing, a hyperlink, or simply a link, is a reference to data that the reader can directly follow either by clicking, tapping, or hovering.	usoro mbanye komputa
INTELLIGENT AGENT	An intelligent agent is software that assists people and act on their behalf	komputa mnyemaka

Source: Felix and Okeogu (2018)

From **table 1 and 2**, we can see that interpreting ICT tools, Science signs and symbols into African indigenous languages will encourage African software developers and scientists to develop Artificial Intelligence models and applications that are African-language friendly **Figures 2 to 5**. This may be a way of surmounting the language obstacles in the accessing of IT and science in African rural communities; and this will contribute to sustainable national development; and among other things will enable us to achieve the millennium development goals.

A model of Yoruba word pad

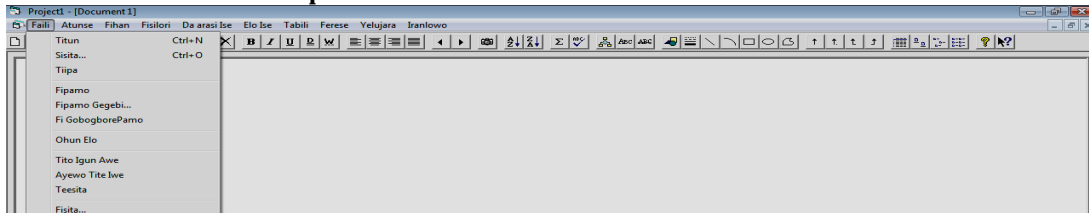


Figure 2: A model of Yoruba Word Pad

A model of Yoruba browser

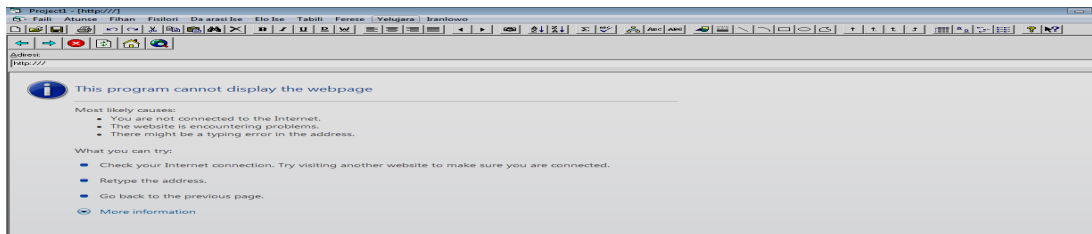


Figure 3: A model of Yoruba Browser

A model of Hausa word pad

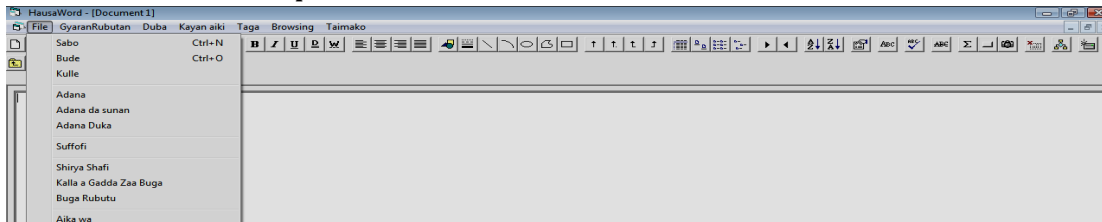


Figure 4: A model of Hausa word pad

A model of Hausa Browser

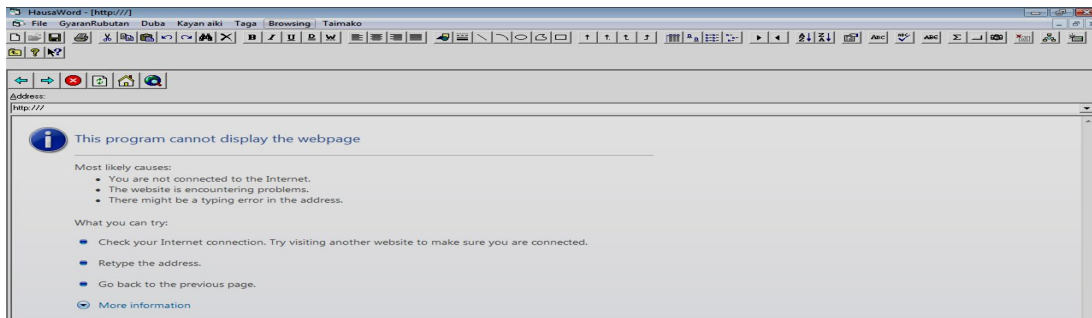


Figure 5: A model of Hausa Browser

Economic and social impact of Developing AI in African Indigenous Languages.

Most Africans living in rural communities have little or no access to ICT which are the principal resources that drives economy base on:

- a. Inability to learn and comprehend western education.
- b. poor funding
- c. policy instability
- d. lack of commitment
- e. curriculum development and
- f. focusing on resources base economy rather than knowledge base economy.

National Bureau of Statistics (NBS) (2022) submitted that the power of Digital inclusion pave way for high job opportunities in the society and digital barrier has brought about low employment among people living in rural communities. Manipulation of information has pave way for job creation for people with living in rural communities; it gives opportunity for this category of people to work alongside urban citizens. Consequently, the job opportunity rate of persons living in rural communities still remains extremely low (Ojuope et al., 2022). Development of ICT based AI applications in African indigenous languages can go a long way to bridge this gap. Information society is being built on technology, knowledge and intelligence; appropriate use of the knowledge by people with intellectual disability contributes to economic and social development. Information technology facilitates fast, cheap, equitable, and resource efficient; access to information, adequate research for learning opportunities become a support tools for job creation and sustainable development.

Participants selection

Experienced computer users participated in the test of the appropriateness of the guidelines and some selected staff of Home school for handicapped children, Ijokodo, Ibadan were used. Four (4) participants were tested. These students cannot read and write in English Language very well but they can read and write in Yoruba Language very well.

System Testing

The test was conducted with the students was based on the concept of Accessible Website Content Guidelines for Users with Intellectual Disabilities, Joyce Karreman et al (2007). Parametric ANOVAs (Analysis of Variance) were applied, with the use of T-Test. The test assesses whether the means of two groups were statistically different from each other.

Results

Satisfaction with the model

The satisfaction of the participants with the model developed with Yoruba language was tested by asking them to express their opinions on a 15-item questionnaire. The mean scores of the participants were taken with the use of a rating scale. The participants used English developed (existing) existing application had mean score of 1.08 and the participants used Yoruba developed application had the mean score of 4.95 The difference in mean score was 3.87 and the difference in the SD is 0.099. This is statistically significant. The participants expressed their 98% satisfaction with the model developed in Yoruba language.

CONCLUSION

In conclusion, the usability performance metrics used to measure the performance accuracy of the system during the system testing shows that the objective of developing ICT based Artificial Intelligence in Yoruba Language to encourage the digital inclusion of those that cannot read and write in English language have been achieved. The degree of efficiency of the model was compared with the Applications developed in English Language it recorded high efficiency. Therefore the use of African indigenous languages to develop Artificial Intelligence models and applications has becomes a necessity.

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**INTERNATIONAL JOURNAL OF INNOVATION RESEARCH & ADVANCED
STUDIES (VOL. 22 NO.2) SEPTEMBER, 2023 EDITIONS**

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