Flattening the Curve of COVID-19 through Emerging Disruptive Technologies in Nigeria

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Abstract-**The coronavirus (COVID-19) which originated from Wuhan, China in December 2019, has become a global issue as it has spread rapidly to other countries. The aim of this paper is to look at how the curve of the virus can be flattened using emerging disruptive technologies such as Artificial Intelligence (AI), Virtual/Augmented reality and Internet of Things (IoT). Data for this research were collected using questionnaire which was created using Google forms. From the analysis carried out, all the emerging disruptive technologies played significant roles in flattening the curve of COVID-19 in Nigeria. In terms of the disruptive technologies that played most significant role in the pandemic, 72.7% of respondents attributed it to IoT. However, beyond Pandemic, 42%, 45% and 86% of respondents believed that AI, VR/AR and IoT respectively will play major roles towards disease control and public health emergencies.**

Keywords- artificial intelligence, COVID-19, internet of things, public health, virtual reality

I. INTRODUCTION

According to World Health Organization (WHO), the COVID-19 is an infectious disease caused by a newly discovered coronavirus and it spreads primarily through droplets of saliva or discharge from nose of an infected person [1]. The virus originated from Wuhan, China in December 2019. By early 2020, it has spread to other parts of the world which made the World Health Organization declare it a pandemic.

According to the European Centre for Disease Prevention and Control, COVID-19 has claimed the life of 327,904 people as of 21 May 2020, with over four million confirmed cases in 212 countries worldwide. In Nigeria, there are 6,677 confirmed cases with about 200 deaths as of 21 May 2020 [2]. The virus is spreading very fast and its end cannot be seen in the nearest future. It might even be a virus that has come to stay like the human immunodeficiency virus (HIV). Nigeria is even yet to reach its climax of the virus infection as the number of infected persons keeps increasing every day. The challenge globally with respect to COVID-19 is on flattening the curve while hope of potent vaccines and cure is gotten.

Flattening the curve here means slowing down the spread of the COVID-19. The curve can be flattened by using emerging disruptive technologies especially in the area of Information and Communication Technologies (emerging ICTs). The aim of this paper is to provide answers the following research questions (RQ):

RQ1: Which of the emerging Information and Communication Technologies has been the most effective in flattening the curve of COVID-19?

RQ2: Which of the emerging technologies has the Nigerian government been using in the fight against COVID-19 and, have they been using it effectively?

RQ3: What are the factors that can hinder the use of the emerging technologies in Nigeria?

RQ4: What are the factors that can aid the use of the emerging technologies in Nigeria?

RQ5: Beyond the pandemic, which emerging technology will remain in use?

There are over 200 countries that are suffering from the COVID-19 pandemic but this research will focus on Nigeria. The focus on Nigeria in this paper is due to the unique approach adopted by various countries and regions in addressing the pandemic [3] and due to coverage area of research interest due to limited works on Nigeria in similar area. To the best of our knowledge, this work is one of the few with Nigeria as a focus. While researchers have focused on several disruptive technologies, most works have identified internet of things (IOT) [4], artificial intelligence (AI) [5], [6] and virtual/augment reality (VR/AR) [7] as promising to the flattening of the COVID-19 curve. This justified the focus of this paper on these three.

II. EMERGING DISRUPTIVE TECHNOLOGIES AND HOW THEY CAN FLATTEN THE CURVE OF COVID-19

Emerging technology may mean different things to different people and as such, there is no universally adopted definition of the term.

Emerging technologies are technologies whose development, practical applications, or both are still largely unrealized, such that they are figuratively emerging into prominence from a background of non-existence or obscurity. A technology is emerging if it is not yet a "must have" [8], [9].

Some of the emerging disruptive technologies that is reported by recent works [5]-[7] in the areas of information and communication technologies are:

A. Artificial intelligence

B. Virtual/Augmented reality.

C. Internet of Things (IoT)

A. Artificial Intelligence (AI)

"Artificial intelligence is the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings" [5].

Frankenfield [10], noted that artificial intelligence is based on the principle that human intelligence can be defined in a way that machine can easily mimic it and execute tasks, from most simple to more complex ones [10].

AI is continuously evolving to benefit many different industries and individuals and as such, it can be used to flatten the curve of COVID-19 in the following different ways [11],[12]:

a) Diagnosis: According to Samer, pneumonia, which is a common symptom of COVID 19 infection, can now be diagnosed by computed tomography (CT) scan in less than sixty seconds with an accuracy of 92% and a recall rate of 97% on test data sets [6].From this, AI technologies can be used to diagnose persons with COVID-19 or detect persons with COVID 19 symptoms for isolation [11]. Thermal cameras are also being used to detect people with fever which is also a symptom of COVID-19 [12].

b) Contact Tracing: Advancements in artificial intelligence applications such as speech recognition, data analytics, machine learning and facial recognition have not only been utilized for diagnosis but also for contact tracing [6]. With AI, contact tracing can be easily carried out with data analytics to know the travel history of a COVID-19 patient and those he/she might have encounter [13]. These people will be isolated to prevent them from infecting more people.

c) Treatment: AI technologies are now being used for dosing drugs and different treatment of COVID-19 patients. Also, the time required to develop medicine is reduced since AI can learn and make deductions based on the virus and other medical data. Patients that are being treated can be monitored with AI technologies. In China, robots were used to test and treat COVID-19 patients while healthcare workers stood at safe distance to minimise the risk of infection. A hospital in Wuhan, the epicentre of the outbreak, was being staffed entirely by robots [13], [14]. In the same way, authors in [15] reviewed the potentials of ICT implementation in the Nigerian healthcare system pointing out the promising use of ICT for effective healthcare services and managing the large population in the country. Humanoid robots that can screen people and deliver drugs and food to coronavirus patients have been deployed in some part of Africa like Rwanda thus, reducing exposure of health workers to COVID-19 patients [15].

d) Social Distancing: AI technologies can also be used to enforce social distancing. Singapore announced on May 7, 2020, that the country will henceforth be deploying robot dogs to help people practise social distancing [10]. Social distancing is very important in the fight against COVID-9.

e) Disinfection: Agricultural drones were used to spray disinfectants public spaces in most developed countries [4]. This will go a long way to help since the disinfectant will kill the virus that might be on surface in public. The role of drones in COVID-19 management was highlighted by [4].

f) Transportation of Medical Equipment/Samples: Drones were used in countries like China to transport medical equipment and patient samples [14]. This prevents the contamination of the samples and saves time of delivery.

B. Virtual/Augmented Reality (VR/AR)

In Virtual reality (VR), a person is placed in a computer-generated world. In Augmented reality (AR), the real world is augmented by computer generated content. The aim of both concepts is to blur the line between the real world and computer-generated content.

VR/AR can flatten the curve of COVID-19 in the following ways:

a) Treatment: VR/AR technologies aid the treatment of patients with COVID-19 by providing virtual overlays to guide medical practitioners. It can also offer a repetitive cost effective on how to handle COVID-19 patients.

b) Video games: VR/AR can also help people self-isolate in a fun-filled way without getting bored. This can be achieved through video games that use VR/AR technologies like AR air hockey, Titans of space, Jurassic World Alive, Zombies, Run! etc. With these, someone who has met an infected person can self-isolate without any fear of boredom. This will go a long way to flatten the curve of COVID-19.

c) Education: The use of virtual reality has demonstrated being capable of promoting the interest and commitment of student [16]. With AR/VR technologies like the virtual classroom, Construct3D, HP Reveal, etc students can study from home effectively [17]. This will also help to mitigate the spread of COVID-19 because; going to school where they will mingle with students/pupils from different locations can increase the spread of the virus.

d) Social interaction: AR is used to facilitate social interaction. An AR social network framework called Talk2me enables people to disseminate information and view information in an augmented reality way [18]. In Nigeria, applications like zoom and WhatsApp video conferencing are being used the conduct activities like wedding ceremonies, court hearings, meetings etc. With these, people can interact with each other without having to meet physically.

C. Internet of Things (IoT)

Internet of Things (IoT) is a network of interconnected devices containing software, electronics and actuators that interact and exchange data [19]. Simply put, IoT is the concept of connecting any device (like cell phones, lamp, cars, computers, wearable devices, etc) with an on/off switch to the internet and/or to each other [20]. IoT can help flatten the curve of COVID-19 by offering crucial data that will help in the fight against COVID-19.

IoT can help flatten the curve of COVID-19 in the following ways.
a) Telemedicine: This connects patients and healthcare professions through telecom and mobile devices. Telemedicine allows medical appointments to be done

physical contact. Telemedicine protects patients and health professionals from possible exposure and, the healthier health professionals can stay, the slower the spread of the virus [4].

b) Home monitoring: Some COVID-19 patients quarantine from home, making room for the patients whose cases are more severe. These home bound patients may be provided medical devices like blood pressure monitoring tools and these devices sends physiological data to healthcare professionals [21]. Some of these devices can also remind patients to take their medications.

c) Vaccine: The raw data collected via medical devices can also hasten the search for a COVID-19 vaccine and, researchers can share what they have learnt with each other [14].

d) Enforcement of Lockdown: The use of IoT has been efficient in enforcing lockdown. The use of devices like the CCTV camera has been helpful in monitoring the boarders to prevent people from travelling between states and countries. For instance, in Nigeria, states like Plateau state installed CCTV cameras at their boarders in order to monitor effectively, those going in and out of the state. This goes a long way to prevent those from affected states from coming into the state and eventually infecting people with the virus.

e) Contact Tracing: The use of QR (Quick Response) codes can be very helpful in contact tracing. South Korea made known her desire to use QR codes to replace the list of names and contact details that people are required to write before entering entertainment locations [22]. This arose as a result of the fact that some people do not give their correct names and contact details. A digital card that contains QR codes will be issued by telecom carriers and these cards will be scanned before entry into public places [23]. With this, those that an infected person had met can be contacted and ask to self-isolate.

III. DATA COLLECTION METHOD

Primary data was used for this research. The primary data was generated from questionnaire which was created using Google forms. The link to the Google form was then shared on various social media to allow for Nigerians to give their perceptions. Data collection was done for a period of one month with no limit to who can give their perception.

IV. RESULT AND DISCUSSION

Results will be discussed in line with research questions and data gotten from questionnaire as follows:

RQ1: Which of the emerging Information and Communication Technologies has been the most effective in flattening the curve of COVID-19?
From figures 1 to 3, the emerging Information and communication technology that has been most effective in flattening the curve of COVID-19 is the Internet of Things. This is followed by virtual/augmented reality then, artificial intelligence. All over the world, IoT has been very helpful in terms of contact tracing, enforcement of lockdown, home monitoring, telemedicine, etc [21], [24].

Also, IoT has been helpful to individuals in this period of pandemic as can be seen in figure 4. Most of the way it has helped individual is in using their mobile phones to access data and information about the corona virus from the internet and sharing this information with each other.
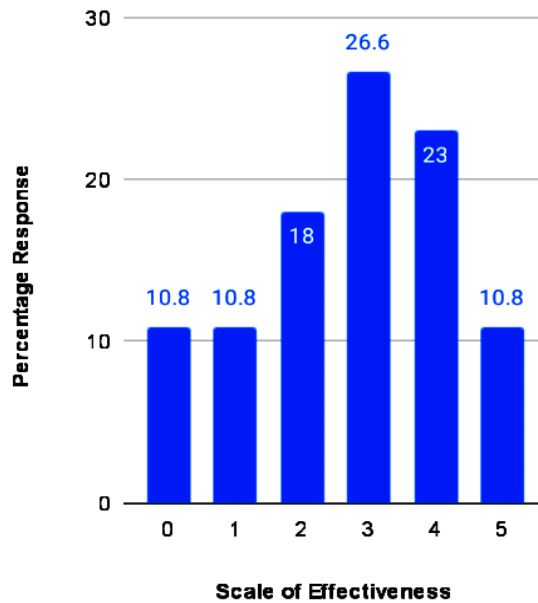

Fig 1: Effectiveness of AI

Fig 2: Effectiveness of Virtual/Augmented reality
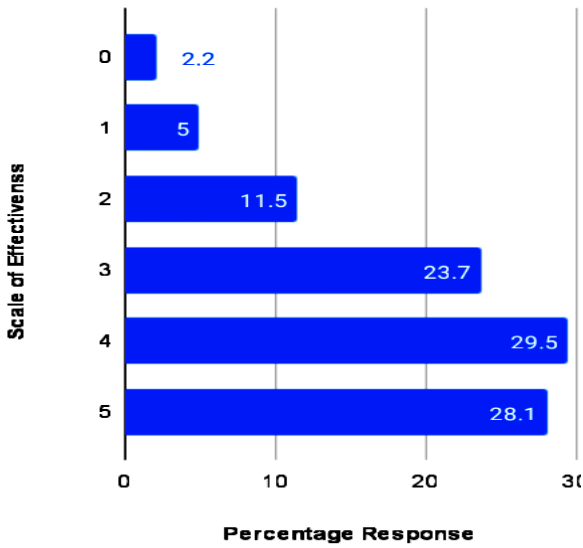
Effectiveness of IoT in Flattening COVID-19

Fig 3: Effectiveness of IoT

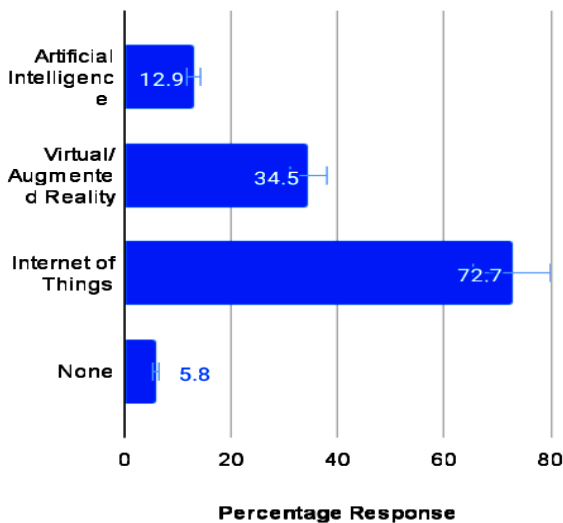## Technology that Helped Respondents during the COVID-19

Fig 4: Most used emerging ICT

RQ2: Which of the emerging technologies has the Nigerian government been using in the fight against COVID-19 and, have they been using it effectively?

From figure 5, the Nigerian government has used IoT in her fight against COVID-19 more than it has used other disruptive technologies. For instance, the use of CCTV cameras by the Plateau state government to monitor their borders. CCTV cameras are installed at the land border and monitored on a computer system. Once a vehicle or individuals are seen approaching any of the land borders, security operatives are alerted to question the individuals in

order to know whether to allow them into the state or not. Also, the Kogi state government developed an application that allows individuals to know whether they are at a high risk of contacting the coronavirus or not. The application asks the individual if they have any of the coronavirus symptoms, then goes ahead to ask if the person has met an infected person or been to a state or country that has recorded cases of the corona virus. From these, appropriate recommendations will be given.

The emerging ICT that Nigeria is using

- Artificial Intelligence
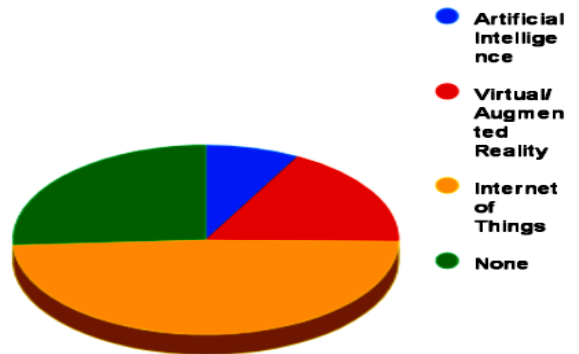- Virtual/Augmented Reality
- Internet of Things
- None

Fig 5: The emerging ICT being used by the Nigerian government

From figure 6, the highest percentage (which is 26.6%) on the rating is on scale 2 and 2 is below average on a scale of 0 to 5. 14.4% of the respondents feel the emerging ICTs are not being used effectively with their rating of zero. Only 2.9% of the respondents feel the emerging ICTs are being utilised effectively. From these the emerging ICTs are not yet fully utilised in Nigeria.

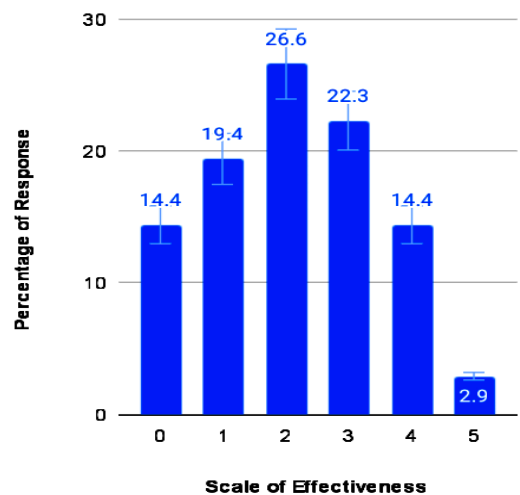## Nigeria's Effective use of Emerging ICT in Flattening COVID-19

Fig 6: How effective the emerging ICT is being used

RQ3: What are the factors that can hinder the use of the emerging technologies in Nigeria?

There are so many factors that can hinder the use of emerging technologies in Nigeria. Some of them are:

I.   Ignorance: most Nigerians are ignorant when it comes to the use of ICT devices. This ignorance is as a result of illiteracy and not being opened to new ideas.

II.   Lack of Skills: Nigeria like most developing countries lack skilled individuals in the area if technology and that is why emerging technologies especially the use of AI is being under-utilised.

III.   Lack of Stable Power Supply: power supply has always been an issue in Nigeria. And without electricity, most of the emerging ICTs cannot be used effectively.

IV.   Internet Access: most rural areas has poor mobile network and because of this, activities like attending a meeting through Zoom, surfing the web for information, and others are difficult. Also, the cost of data is expensive making it hard to access the internet.

V.   Corruption: Corrupt government has also hindered the use of emerging ICTs in Nigeria. Money to be used in purchasing some of the devices for the emerging technologies or for developing the devices might end up being embezzled by some people in government.

RQ4: What are the factors that can aid the use of the emerging technologies in Nigeria?

The following can be helpful in aiding the use of emerging ICTs in Nigeria:

I. Awareness/Enlightenment: Awareness should be created on the benefits of using ICT devices. Those that do not know how to use them should be enlightened on the use [15].

II. Internet Access: Telecommunications companies should try and improve on their mobile network. They should also make the cost of data reasonably cheap so that it can be affordable by all.

III. Power Supply: The government should try and make some improvement in the power sector so that there will be stable power supply.

IV. Training: individuals should be trained on how to develop, use and maintain ICT devices.

RQ5: Beyond the pandemic, which emerging technology will remain in use?

According to figure 7, IoT has 86.3% chance of being used after the pandemic. This is followed by virtual/augmented reality with a percentage of 45.3 and then, AI with 41.7%. One can say IoT has a higher percentage of being used even after the pandemic because so far, most people has used it more than the other emerging ICTs and it has been the most effective in flattening the curve of COVID-19. Even though the percentage of virtual/augmented reality is below average, it also has a chance of remaining in use after the pandemic. This is because Nigerians are beginning to embrace it for activities like weddings, meetings, seminars, talk shows etc.
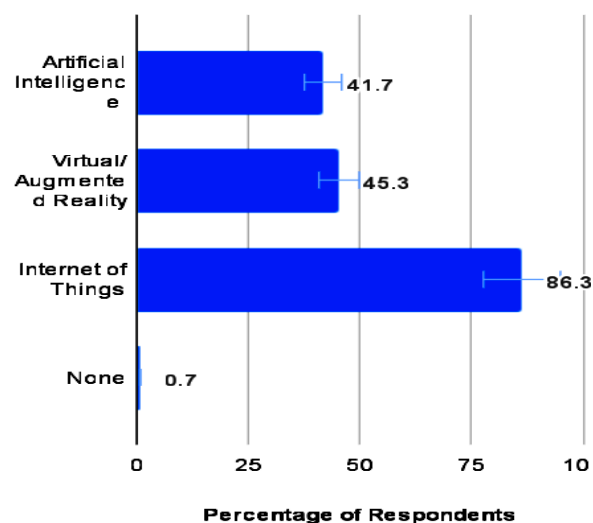

Fig 7: The technology that will continue to be in use beyond the pandemic.

V.   CONCLUSION

Even though COVID-19 is a deadly disease that has a very high rate of transmission, its curve can be flattened in so many ways. The use of emerging information and communication technologies has proven to be effective in flattening the curve in countries like South Korea and China. Even in Nigeria, emerging ICTs has also played vital roles in the fight against COVID-19. The most used and most effective of these technology in Nigeria is the IoT. The virtual/augmented reality is also becoming acceptable for social activities and learning in Nigeria with people using Zoom to conduct wedding ceremonies, business meetings seminar and workshops and a host of others. Nigeria, like other developing countries is yet to fully utilize AI in terms of robots and drones making AI the least utilized and considered not effective in the fight against COVID-19 in Nigeria. The emerging ICTs use in this paper are not fully utilized due to some factors some of which are, lack of stable power supply, lack of skilled individuals and ignorance. In this paper, a perception evaluation of how these disruptive technologies have assisted in flattening the curve of COVID-19 was carried out using online perception survey. It was observed that IoT played major role while it is expected that beyond the pandemic, other disruptive technologies such as VR/AR and AI will continue to play roles in public health emergencies and disease control in Nigeria. However, challenges impeding the full adoption of these disruptive technologies can be resolved through creating awareness, training of individuals, improvement in the power supply and improved internet access. It is believed that embracing the use of emerging information and communication technologies, will assist countries worldwide (Nigeria inclusive) in flattening the curve of COVID-19 as the world awaits potent cure and vaccination.

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