

# Knowledge Management in Pandemics: Design and Implementation of Social Distancing Mobile Application

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## ABSTRACT

Pandemics naturally are difficult to eradicate completely because of its long span but can easily be managed. The COVID-19 pandemic has forced individuals/decision-makers globally to have knowledge in its management. Despite measures taken to curtail the spread of the virus in Nigeria particularly in Kaduna state, there is no social distancing app developed as one of the strategies to curtail the spread of the virus in the state. Hence, this paper describes one of the management measures that can be enforced by the Kaduna state government (KDSG) to reduce the spread of the coronavirus in the state by designing and implementing a Social Distancing Mobile App called Kaduna trace (KDTRACE) for the state citizens. To achieved this, a flutter written in DART programming language is used for the frontend design while firebase is used for the backend design. The result will be the designed app for the iOS, and android based devices that will be pushed into Git hub repository for private use, will be uploaded to google play store for public consumption on completion. The extension of the app to handle contact tracing of the citizens with the virus in the state will be future work of this study.

**Keywords:** Knowledge management, Pandemic, COVID-19, Social Distancing, Mobile App.

## I INTRODUCTION

Pandemic is said to be defined as epidemic occurring globally or over a long period of time by crossing international boundaries and usually affecting a huge number of people that may occurs annually in each of the temperate southern and northern hemispheres, given that seasonal epidemics are not considered pandemics.

Covid-19 pandemic management is a difficult situation because of its long span, health and socio-economic effects. However, compare with other natural disasters, the covid-19 pandemics' overwhelming effects can actively be taking care of and reduced by managers, via right and timely decisions. Decision making to manage the wide spread of the covid-19 pandemic can be critical, and it effectiveness depends on the measures taking in

creating effective and efficient knowledge management awareness in pandemics (Ammirato, Linzalone, & Felicetti, 2020; Viner et al., 2020).

COVID 19 is spread globally by and large as a result of movement of people. With its emergence, researchers, entrepreneurs, governments and industries around the world have been involved in discovering or adapting existing technologies to support healthcare, government and industries in tackling the new crisis. Therefore, based on the classification of the COVID 19 Apps, social distancing apps is classified under contact tracing apps based on these related study (Behar et al., 2020). A lot of studies proffer solution to curtail the wide spread of COVID-19 pandemic globally. For example, the contact tracing apps in China such as WeChat and AliPay (Behar et al., 2020; Sookman, 2020); Singapore, TraceTogether (Cho, Ippolito, & Yu, 2020); BlueTrace (Bay et al., 2020); India "Aarogya Setu" (Bridge to Health in English) app (Behar et al., 2020; Tiwari, Kashyap, Rai, Tiwari, & Pandey, 2020). South Korea and Taiwan (Behar et al., 2020).

Millions of persons have been infected, nearly 200,000 death have been realised globally since its discovery based on this study (Alanagreh, Alzoughool, & Atoum, 2020). Similarly, in Nigeria according to the Nigeria Centre for Disease Control and Prevention (NCDC) daily updates the number of infected persons is 67,220 and the number of deaths is 1,171 nation-wide. Just as any other state in Nigeria, Kaduna state recorded 3,044 cases of infected persons and only 47cases of death recorded so far. Nigeria as a nation is finding a possible way out to fight the epidemic. They rely on classical public health measures in collaboration with its health agencies such as NCDC to curb the epidemic. The main goal of the public health measures is to prevent person-to-person spread of the disease by separating people to interrupt transmission using all the necessary tools obtainable. According to Tiwari (Tiwari et al., 2020), there are many negative consequences of a pandemic. Pandemic may engender psychological stress (Brooks et al., 2020), physical health problems (Zhang, Wu, Zhao, & Zhang, 2020) and decreased social support (Tiwari et al., 2020).

The NCDC has redefined social distancing as “remaining out of congregate settings, avoiding mass gatherings, and maintaining distance (approximately six feet or two meters) from others when possible” during the COVID-19 pandemic period. Hence, the term connotes physical distancing that aims to curtail the wide spread of the virus by contact. According to World Health Organization (WHO) when “an infected person coughs or sneezes, droplets containing the virus are deposited on objects and surfaces where people may likely touch”. Hence, anyone in close proximity of about 1-2 meters may be at risk and the possibility to contract and spread the virus is negligible when appropriate physical distance is upheld (Agusi et al., 2020).

More so, the knowledge of the environment in the society particularly the societal interactions of human in public places such as workplaces, markets, religious places of worship, schools, hospitals, motor parks, airports are highly required. Having the adequate knowledge of the societal interactions of citizens in such places will provide cue on the appropriate technological tools to utilize in fighting against pandemic like COVID-19 in the society. However, so far, the conventional preventive measures adopted to fight against the pandemic as suggested by the WHO have been adopted by Kaduna state to curtail viral spread. These measures by themselves are inadequate without technological supplementation with tools like robots, apps etc. Apps such as the social distancing app are being utilized globally in bridging gaps in the fight against coronavirus spread. Thus, having the knowledge of the environment and the right tools (social distancing apps) to utilize during pandemics is one of effective and efficient strategies of management of the pandemics in our societies.

Based on the analysis of the previous work done on the COVID 19 pandemic Apps, there is paucity of research on the development of social distancing mobile app to mitigate the spread of COVID 19 in Nigeria, particularly Kaduna State. The apps have become popular in almost all part of the world for their success in curtailing the virus. As such, this paper will bridge the gap by designing and implementing a social distancing mobile app (KDTRACE) for the state citizens as one of the management strategies to curtail the spread and effects on health and socio-economic crises in the state particularly during this crucial period when schools, social and economic activities have resume normalcy after almost a year of lockdown. The app will cement the mitigation efforts as it will allow people to maintain adequate distance while they are out and about. Having the advantage of giving the society the opportunity to return to normalcy unlike

other measures that involve confinement of large segments of the population.

## II COVID-19 PANDEMIC IN KADUNA STATE

The Kaduna state government (KDSG) is at the forefront of all activities where Industries, Universities and all other governmental bodies are supporting the government. Unlike the other states in the country, in which a lot of solutions to problems are gained from companies or institutions alone and then adopted by the government to solve and prevent the COVID-19 from its wide spread. Kaduna State being situated in the northwest zone of Nigeria, is one biggest educational center in the country and the 18<sup>th</sup> state of the Federation. Education is one of the key objectives of the government of Kaduna State. It was formerly Liberal State. It has now become Centre of Learning because of the presence of many tertiary institution in the state. The State consists of 23 local government areas. Population of over six million people.

According to NCDC report as of 30<sup>th</sup> November, 2020, in Kaduna state the number of confirmed cases is 3,064 and 191 confirmed death cases.

## III KNOWLEDGE MANAGEMENT IN PANDEMICS

Pandemic generally cannot easily be predicted because it is not time-bounded, single, or discrete event (Ammirato et al., 2020). It is rather a continuous process, that functions for a certain period that lasts until its cure has been introduced and pandemics knowledge management is vital to curtail mass contaminations and loss of lives.

Knowledge management generally refers to set of processes designed to create, store and apply knowledge. Knowledge management in pandemics has a higher strategic objective, aim at saving lives. Knowledge is a strategic means to drive decision-makers in the management of a pandemic. Pandemics can extensively be spread worldwide and its economic loss circulate over time and across nations. As such, it infers a feature of Pandemics-knowledge management has to cross diverse knowledge domains such as political sector, governmental, health, economic, political and government sectors. However, knowledge management can improve the process of pandemic management, by ensuring the accessibility of precise and reliable vaccines when available.

In terms of literature review on KM in pandemics according to (Ammirato et al., 2020), “To the best of our knowledge no literature review on knowledge management in pandemics exist”. However, as shown

in figure 1, the study gave some knowledge-related reviews that uses pandemic as an important test to formulate theories highlighting the state of the art.

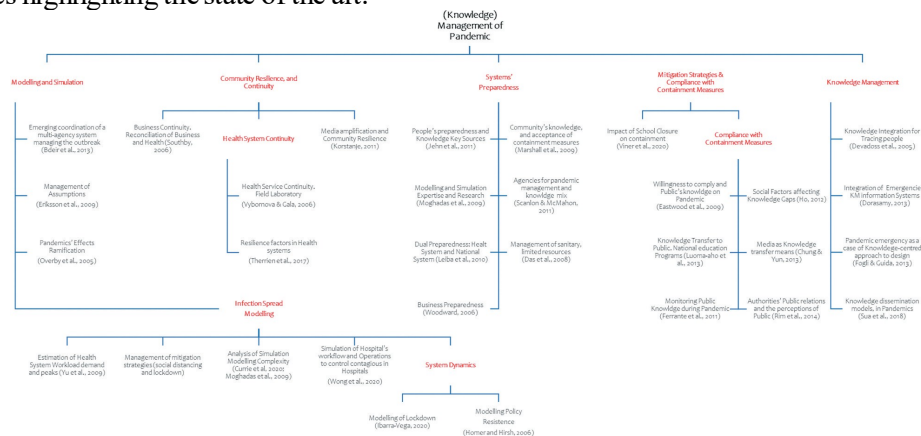


Figure 1. Literature On Management Of Pandemics (Ammirato et al., 2020).

#### IV KDTRACE OVERVIEW

KDTRACE is a social distancing app where KD is representing Kaduna and TRACE is a monitoring process of the app. The app is mainly design for Kaduna state citizens of Nigeria. The app uses procedures to register Bluetooth encounters among participating devices to manage and curtail the spread of the virus in the state. The app is design using Bluetooth with beacon technology. Beacon is a tiny wireless transmitter which utilize low-energy Bluetooth to send signals to other nearby smart devices. They are able to connect and transmit information to those smart devices by making position-based searching and interaction much easier and very accurate.

When two or more participating devices come into close proximity of 2 meters of radius to each other, they exchange identifiable messages that are non-personal containing temporary identifiers. The identifier is a unique ID number that smartphones identifies as unique to the beacon. The uniqueness of the beacon technology is that after searching for devices within the proximity, it connects to smartphones that has similar app installed on them and ignore the rest unlike using only Bluetooth that can connect to any device that broadcasted signal within the proximity range. When it searches and connect to devices having the app installed on them, the app beep a number of times and triggers a simple voice message "Kindly Maintain the 2 Meters Distance Apart as stipulated by the KDSG" as warning.

For the frontend design of the App, a flutter as a framework for building cross platform apps writing using DART programming language. One of the advantages of using DART is that it has cross platform features in the sense that one can write a single software that can run on multiple platforms

such as on iOS, and Android devices. While for the frontend a firebase is use for user authentication. It has advantage of being serverless software, one need not to develop backend from the scratch and it save cost of infrastructure on the cloud. The results obtained will have significant impact on practice, policy and implementation of Sustainable Development Goals (SDGs) that will support public health authorities of Kaduna state and the Nigeria Centre for Disease Control (NCDC) Kaduna unit in curtailing the spread of the pandemic in the state. There are procedures involve for the workability of the app including the collection of personally-identifiable information like phone number to authenticate user devices.

#### V HOW KDTRACE WORK

The flowchart in figure 2 represent the flow on how the KDTRACE supposed to work. In that figure three main stages were involve; first, is the initialization/information stage, second, is the authentication and the third, is the activation stage. Thus, the detail explanation of the stages is giving as follows. At the initialization/information stage, the App launches with a welcome /information screen where general messages, KDSG guidelines/rules and user agreement regarding the Covid-19 are displayed, KDSG guidelines/rules on Covid-19 and user agreement are also provided on that stage. Then, the user will click on get started. Next is the authentication stage where the app at that stage will prompt the user to enter his/her phone number. When the user enters his phone number, that is at the back-end by generating unique randomized User-ID and associates it with the user's phone number called one-time password (OTP) containing six numeric digits that is done using firebase. It will be sent to the user's phone, if the user receives the OTP, he will enter the send OTP to verify. These as shown in

Figure 3 Otherwise it will resent the OTP again. After verifying the OTP, the app request for Bluetooth access, and when the access is permitted, then the app enters the third stage that is the activation stage. At that stage, the app opens up the connectivity page whereby the app searches for devices within 2 meters range and get connected to those devices that have similar app installed on them. The app will beep for certain number of times and trigger a voice message as indicated in the flowchart.

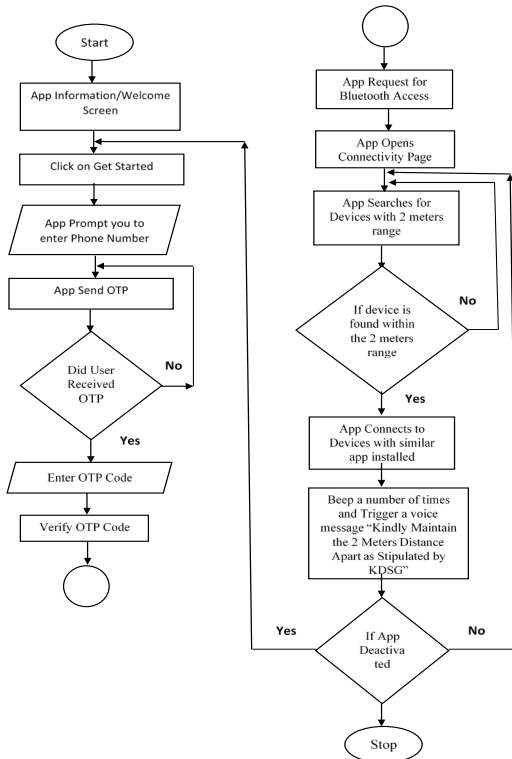


Figure 2. KDTRACE Working Procedures

Otherwise it will start searching for devices within that range to connect and if the app is deactivated the procedure is also shown the flow diagram in Figure 2.

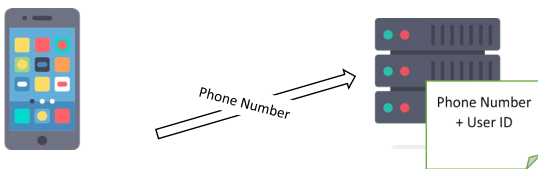


Figure 3. User Verification

In this study, phone contacts are the only personal identifiable details needed from the user.

When the OTP verification is successful, then it will move to the next stage that is, the contact tracing. At that stage, the app will request for Bluetooth access/activation. Once the Bluetooth is activated, the app opens the connectivity page/home screen. Under the home screen there two menus thus; search and connection. The search, searches for the users'

devices that has the app installed by discovering them – using beacon technology and connect to them. In this case, the KDTRACE devices exchange signals over the Bluetooth Low Energy (BLE) protocol. In the BLE jargons, devices can either taken on Peripheral or Central function or may alternate between the functions. This can be illustrated in figure 4.

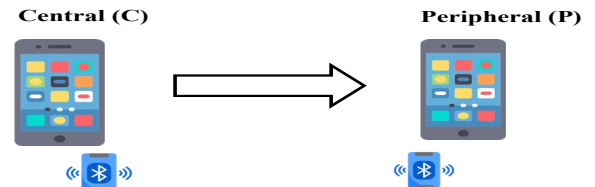


Figure 4. BLE Handshake Flow

When 2 devices are linked, the Central reads the Peripheral's Encounter Message, and then writes back its own Messages that it comes across; each of the linking permits a two-way communication between the Central and Peripheral. Allowing two-way communications encourages symmetry and handles the constraint where other devices are only able to work as Peripherals.

Moreover, KDTRACE devices scan and broadcast on configurable cycles. Scanning occurs always during which devices scan for other KDTRACE devices as Central. A shorter duty cycle for scanning to preserve resources is recommended. It is also recommended both scanning and broadcasting duty cycles should be  $> 1$ , to guarantee that devices have the chance to see themselves.

## VI DESIGN PROCEDURE CONSIDERATIONS

### A. Bluetooth vs GPS

This paper considered only Bluetooth with beacon technology solution for now no GPS. Because our devices are not saving any data for security and legal considerations, until terms and conditions for storing public data have been reviewed approved by the authority. In the context of this paper Bluetooth was chosen mainly because it classifies nearby contacts with a lower false positive rate than GPS.

### B. Bluetooth Limitations

Today, a lot of smartphone users uses Bluetooth to link their phones with peripherals like smart watches, headphones, etc. Limitations are occasionally realized in the use of the Bluetooth technology. The weaknesses have to be updated at the operating system-level, and hence users are to be encouraged to certify that their operating systems are regularly updated. The apps may be alerting users if an obsolete operating system is detected, to notify

users to consider updating them. However, these are beyond the scope of this paper.

## VII KDTRACE IMPLEMENTATION CHALLENGES

### A. iOS background Bluetooth Challenges

Whereas Android category of the KDTRACE reference execution functions fully for Central and Peripheral whereas the app is in foreground and contextual execution modes, the iOS category of KDTRACE has restriction on contextual Bluetooth workability.

When in the contextual, the iOS app broadcasts in a proprietary broadcasting format which is not part of the Bluetooth standard and hence not readable by non-iOS devices. It may also be unable to scan for other KDTRACE devices around it. As such, this is done to encourage iOS users to keep their app open, especially when in dangerous environments. The app also alerts the user if access is not granted/Bluetooth is not on, this may cause the app not to function well.

### B. Transmission Power Differences

There are transmission power differences across devices. KDTRACE utilizes RSSI readings to estimate distance. Though, through tests of devices in local environments, it has been confirmed that the alteration in transmission power across popular mobile devices can be as large as 30 dB (1000x). At the course of testing, also it was discovered that transmission power varies little between different devices of similar model and is slightly affected by mobile phone covers. To account for the differences, reference signal strength readings have been taken for popular mobile devices in greater than API 18. This has been used to standardize RSSI readings when categorizing encounters by proximity.

## VIII CONCLUSION

The development and implementation of the social distancing app is one of the management strategies to curtail the pandemic in Nigeria, particularly KDSG. Once the App has been adopted by the government, in an attempt to save both its citizens and the economy of the state, can launch a public awareness campaign to inform the general public about the existence of the App generally and the measures that will be taken if individuals do not adhere to the practice of social distancing as informed by the App. Such measures include but are not limited to implementing pecuniary taxing regulations of levying fines etc.

Conversely, non-adhering citizens could even be subjected to the wrath of the law. Thus, the KDSG using the KDTRACE app in tandem with other appropriate measures could successfully monitor

and reduce the spread of the virus in the state. These measures consequently can afford the state the opportunity to resume normal economic and social activities without fear that the state will go back facing massive poverty which reverse the economic and social downturn. The relevance of the study to SDGs is that, the economic impact of COVID-19 has increased the poverty toll globally and locally and if left unchecked, it will plunge large swaths of humanity into severe poverty and destitution. Thus, precluding poverty both at local and global level is one of the objectives of the SDGs.

However, if the App is fully implemented in Kaduna state and widely accepted, it will be extended to handle contact tracing of the citizens with the virus in the state using locations such as Geographical Positioning Systems (GPS) and this will serve as the future work of this paper.

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