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Geospatial Cloud-Based Model for Mitigating Impact of Natural Disaster and Security Threats using Smart Digital Devices

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Abstract: Human beings live in a world that is vulnerable to disasters and huge security threats. The common occurrence of global natural disasters and security threats call for major attention by the government of nations and the International community. Man continues to live under perpetual fear of the unknown because of these events. Notably, the human being is at the receiving end of these events either as a victim or at times as a perpetrator. Locating and rescuing victims or perpetrators of these events can be effectively achieved using smart digital devices that are configured with their unique identities and this will aid in achieving sustainable peace and stability in society. Equally, the global proliferation of digital devices is always on the rise; hardly today is there anyone on the planet earth without a form of one digital device or the other. This study is exploring the use of smart mobile digital devices, geospatial, cloud, communication, and technologies in mitigating the impact of natural and security threats with the significance of promoting peaceful human co-existence in the society. A Google App for finding a device, clock- timer app, an Internet speed check app and an online weather app were used for the experiments conducted for the proof of concept of the model. A test of model robustness was evaluated using response time and visibility. The model consistently showed good attributes of robustness in its behavior. Furthermore, the following parameters: latency, upload speed, download speed, air quality index, visibility, humidity, wind gust and temperature were observed against the response time in the experiments. A single sample (one-tail) t-test for the response time with a mean population of 0.9 gave a t-test value of 1. The value of p is 0.162791 and the result is not significant at $p<.05$. This indicates that there was no significant difference in the response time of the model irrespective of the time of the day, weather conditions, and the communication parameters. The result showed that the response time of the conceptual model was fast and consistent with the experiments indicating that the model can be leveraged, to address the problem identified in an affordable manner. The study is highly significant due to the fact that exploring the technologies that support location-based systems has greater potential in addressing the problem occasioned by natural disasters and security threats to humans**.** Future consideration is focused on enhancing the model by scaling up the biometrics features of the victim or perpetrator for speedy location.

Index Terms: Geospatial, Communication, Cloud, Smart Devices, Disaster, Threats, Location-Based System

1. Introduction

Man lives in a world vulnerable to disaster and security threats. The prevalence of global natural disasters and security threats call for major concern by the government of nations and the international community. Man lives under perpetual fear of the unknown as a result of these events. On the other hand, the global proliferation of smart mobile digital devices is always on the rise hardly today is there anyone on the planet earth with a form of digital device. Technology has been introduced to make life better for man and addressing problems that made use of location data can leverage the technological advancement of the present day. The world is a global village, and we need to harness the benefits offered by newer technologies to make the world a better place. Peace is eminently a criterion for development in our world. Societies have been under siege of insecurity and the people are more and more getting involved in crime and criminality.

Across the globe, nations have been plagued by numerous security threats like militancy, terrorism, kidnapping, arm robbery, cybercrime, cattle rustling, herders/farmers clashes, communal clashes, political and election violence, ethno-religious violence, unemployment, cultism, piracy, smuggling, cross border banditry, drug abuse and trafficking, wrong value system, illegal migrants, poverty, pipeline vandalism, ritual killings, thuggery, illiteracy, human trafficking, etc. Age, class, and status are no barrier to the people involved. Despite claims by government and security agencies of being on top of the situation, the problem of insecurity is getting worse by the day, especially in developing countries. The level of sophistication of crime has gone beyond what the security agencies can cope with. One can hardly have a day free of crime globally. Hence, security is a crucial phenomenon that all citizens cannot overlook. It is a 24/7 affair that should guarantee freedom from danger, fear, or anxiety of any kind. It is a matter that we should all be conscious of and give adequate attention to.

Natural hazards are a threat to humanity. Over the years, there has been a dramatic increase in natural hazards, so the number of people injured and killed has grown tremendously. Among the natural possible hazards are earthquakes, volcanic eruptions, tsunamis, landslides, floods, drought, hurricanes, tornadoes, etc. All these processes have been operating throughout Earth’s history, but the processes have become hazardous only because they negatively affect us as human beings. The objective of the study is to explore the use of smart mobile digital devices, geospatial, cloud, communication, and technologies in addressing the impact of natural and security threats on human society. Location-based systems have been explored in resolving location-related problems but there is need for a less complex and affordable solutions.

In this paper, technologies that support location-based systems were explored to mitigate the impact of natural and security threats on society. The paper is organized as follows. Section one provides the introduction to the study, two discuss what motivated the study and three discusses the theoretical background that supports the study. Section four focuses on the proposed model. Section five discusses the proof of the concept. Section six talks about related works. Section seven is about the result analysis and section eight indicates the conclusions and future direction.

2. Motivation for the Work

In all these threats, man has been at the receiving end either as a perpetrator or victim. The result of these threats is a disaster and most of the time victims that survived these threats need to be rescued while there may be the need to find or locate perpetrators of crime to arrest the situation. A good number of people who survived these threats could not be rescued promptly and this has led to the loss of lives that could have been saved. Also finding criminals across different terrains has been very difficult.

Leveraging the evolving technologies for location-based services (LBS) can aid an effective rescue process as well as locating criminals wherever they are. This study is exploring the use of smart digital devices, geospatial, cloud, and communication technologies in mitigating the impact of natural and security threats on the society of which human being is at the nucleus. To achieve peace, natural disasters and security threats must be mitigated.

3. Theoretical Background

The following concepts provide the theoretical background for the realization of the proposed model. The model is multi-variable in nature bringing together technologies that can enable effective solutions to mitigate the impact of natural disasters and security threats using smart mobile digital devices**.** Exploring the possibilities provided by these various technologies and techniques highlighted below will contribute immensely to the realization of a proposed solution to addressing the above-identified challenges prevalent in society.

3.1 Geospatial analysis

Geospatial analysis is a method that applies statistical analysis and other informational techniques to data that has a geographical or geospatial aspect. It employs software that has the capacity for geospatial representation and processing and applies analytical methods to terrestrial or geographic datasets, including the use of geographic information systems and geomatics[1].

It entails the gathering, display, and manipulation of imagery, GPS, satellite photography, and historical data, described explicitly in terms of geographic coordinates or implicitly, in terms of a street address, postal code, or forest stand identifier as they are applied to geographic models[2].

3.2 Mobile computing

Mobile computing studies how mobile devices learn and sense the status of other devices and context related to their mobility and networking for improved access the internet and/or support mobile applications in an ad hoc communication environment[3].

A mobile device is a handheld tablet or other device that is portable and this made it to be lightweight and compact. Advancements in technologies have allowed these small devices to do nearly anything that had previously been traditionally done with larger personal computers [4].

Mobility is an everyday activity that man must undertake, and mobile devices also support humans as they transverse across the globe for effective communication, location-based services can ride on the mobility for object location and discovery.

3.3 Cloud

Cloud computing is the delivery of computing resources as services. This includes among others servers, storage, databases, networking, software, analytics, and intelligence over the Internet (“the cloud”) with a view to offer faster innovation, flexible resources, and economies of scale. The payment is made only for cloud services used, helping to lower the operating costs, and helping to run infrastructure more efficiently and scale as the business needs change [5]. Offering location detection as a service is a unique way of solving location-related problems

3.4 Telecommunication network

The previous generations of telecommunication networks such as 1G, 2G, 3G, and 4G so far have been mainly for people to communicate but now they will be for machines as well and on a mega scale connecting everything that needs to be connected [6]. In the future, there will be more connected machines than humans. This is what 5G and the next generation of mobile networks will achieve. Mobile networks are radio networks distributed over land areas referred to as cells and each cell is served by at least one fixed-location transceiver which is known as a cell site or base station [7].

Machines will be capable of talking to each other on 5G networks, leading to a large-scale Internet of Things communications era with sensors embedded in everything [6]. This high-speed 5G network will aid machines to communicate with almost zero latency. This will lead to improvement in transportation, traffic monitoring, factories operations and healthcare delivery. It will result into having smart cities, smart farms, and smart entertainment while location-based services will be transformed greatly for high-end service delivery [6]. 5G will comfortably support location-based services and revolutionize its performance by scaling it up for high-end service delivery.

4. Proposed Model

The methodology adopted for the study was an experimental approach. The experiment leverage smart mobile digital devices, geospatial, cloud, communication, and other enabling technologies as indicated in the objective of the research in the model conception for addressing the problem.

The proposed model is conceived to provide location-based services by locating individuals through their mobile digital devices. This can be achieved in real-time by tracking signals from the GPS on their mobile devices. Each device must have Device Identification Number (DIN) which must have a registered user who also has an identification number. Each device user will use his or her National Identification Number (NIN)/ social number to register the mobile device. Also, the user biometric feature of palm print is also captured during the registration process. The device must have an embedded chip with a passive human body sensor containing the users’ NIN and biometric feature captured that is trackable even when the device is switched off. The device will not work unless registration is done. Once a user registers, it syncs with the cloud repository and can be accessed via the Internet when the need arises. The movement information of the devices is collected and stored in the cloud repository which is also in sync with Google Map Server with a view to using it in locating the user when the need arises. Due to this being an emergency case, an emergency code will be generated to allow searching for the victim or perpetrator. Leveraging this information will assist substantially when there are disaster or threat situations. Rescue operations will be carried out with preciseness and lives can be saved from imminent dangers.

4.1 Assumptions

The following are the assumptions made in this research:

i. Internet connectivity is available, and the device is permanently connected.
ii. Every user has an identification number, NIN.
iii. Every device must have a DIN and a module for user registration to integrate NIN.
iv. No device can work except the user has registered it.

v. The device must be synced with the email address of the victim or perpetrator.

4.2 Mathematical Model

The proposed model is a union function of the various enabling technologies parameters and their techniques. The model is a union of location information (LINFO), Device Identification Number (DIN), mobile device signal strength (MDSS), communication network (CN), Internet (INET), and Cloud Repository (CR) as stated in equation (1).

$$M = \cup(LINFO, DIN, MDSS, CN, INET, CR) \tag{1}$$

The proposed model architecture shown in Fig. 1 has components that support the model function.

4.3 Proposed model architecture components

The following are the components of the proposed model architecture:

i. Global Positioning System (GPS): is a global navigation satellite system that provides location, velocity, and time synchronization of animate or inanimate objects. GPS aid mobile application in getting the current location of the mobile device. It serves as a relay station for communications signals
ii. Mobile Networks: is a radio network that supports a large collection of portable devices (such as mobile phones, pagers, etc.) for communication with each other as well as fixed transceivers and telephones anywhere in the network via base stations.
iii. Communication Network Backbone: this provides the needed connectivity among the various components of the architecture for achieving communication.

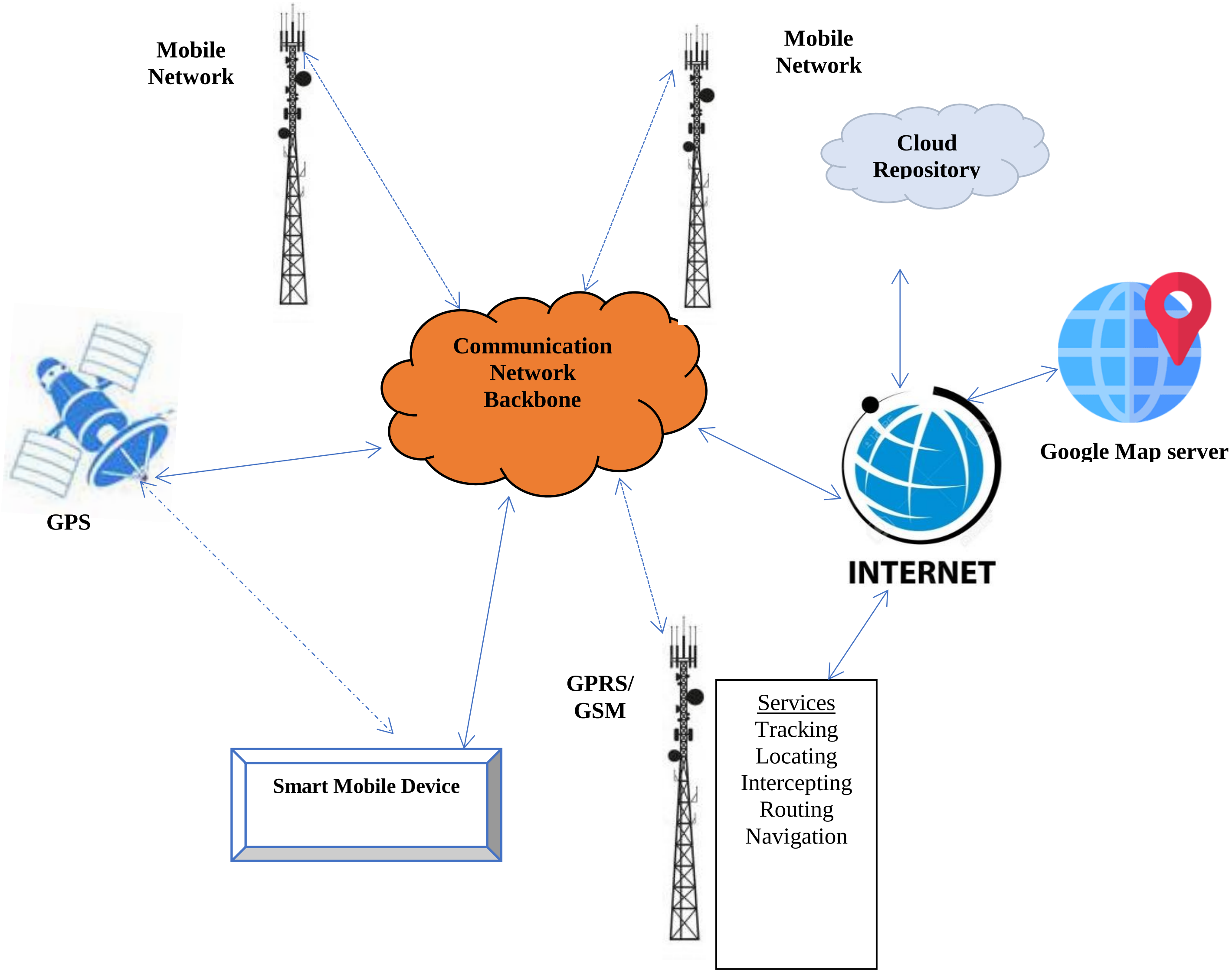


Fig. 1. Proposed Model Architecture

iv. Cloud Repository: this stores location information in sync with Google Map Server, DIN, NIN, and other relevant information

v. Internet: is the global information superhighway that provides the needed services by interfacing with Communication Network Backbone, Cloud Repository, and Google Map Server for the pooling of data and information.

vi. Google Map Server: is the server from which Google map-related data is pooled from through the Internet. It supplies satellite captured images, aerial view photography, street layout maps, interactive 360 ° panoramic views of streets, real-time traffic situations, and route planning options for traveling by foot, car, bicycle, air, and possibly public transportation. All of these can aid the effective location of objects of interest.

vii. Mobile Device: this is an android-based device that is used for the location detection of the victim or perpetrator.

viii. Location Detection as a Service: this is a component providing a cloud service designated as Location Detection as a Service (LDS) which is a unique way of solving location-related problems in the model such as Tracking, Locating, Intercepting, Routing, and Navigation.

5. Proof of concept of the Model

The following experiments were carried out to demonstrate the proof of the concept of the model.

5.1 Experimental settings

The experiment for the proof of the concept for the model was achieved using a Google App for finding a device [8]. It is assumed that the email address of the victim or perpetrator is retrieved from the cloud and these credentials are used to initiate the process. The victim or perpetrator has a google account/email address that is enabled for tracking their smart mobile device. To find the victim or perpetrator through their device, it is assumed that a Google Account has been added to the device, and then Find My Device is automatically turned on.

In addition, the google app used an online weather station known as AccuWeather [9] for weather condition parameters measurement while an online timer [10] for keeping track of the response time of the mobile device. The quality of the Internet connection of the laptop for communicating with the device for the experiment was measured using an online internet metrics measurement site [11].

The Smart Mobile Device used was an android mobile phone for the proof. It features a reliable battery with improvements in cameras, operating systems, RAM, and sensors. The device also has a larger display, and this makes it bigger, is a 4G LTE smartphone and supports second-generation and third-generation mobile network technologies. With the help of the 4G LTE support, users of the mobile phone can use the internet with high-speed connections. Some enhancements of this smart device include a LED flash, geo-tagging, touch focus, face detection, HDR, and panorama. Aside fingerprint scanner, the android phone comes with other sensors; to name a few, the phone features an accelerometer, a gyro, a proximity sensor, and a compass.

The computer system on which the experiment was carried out for the proof was a 64-bit Operating System running Windows 7 Professional on Pentium Dual-Core CPU T4500 2.30GHz processor with 4GB RAM.

5.2 Parameters for the experiment

The following communication and weather condition parameters were captured in the experiments:

i. Latency: is a measure of delay or time it takes for data to get to its destination across the network. It is measured as a round trip delay i.e., the time taken for information to get to its destination and back again. It is measured in milliseconds (ms)

ii. Upload speed: this refers to how many megabits of data per second can be sent from a client computer to another device or server on the internet. It is the speed that the client's computer can transfer or send information to the Internet. It is measured in Megabits Per Second (Mbps).

iii. Download speed is the speed that information on the Internet (e.g., text and graphics) is transferred to the client's computer; that is, how long it takes your computer to load websites and download files to display on your screen. Download speeds normally happen at faster speeds than uploads; however, that can depend on broadband connections or how web pages are created. It is measured in Megabits Per Second (Mbps).

iv. The AQI: is an index created by the US environmental protection agency for reporting daily air quality [12]. It tells how clean or polluted the air is, and what associated health effects might be a concern. The AQI focuses on health effects one may experience within a few hours or days after breathing polluted air. The classification of the AQI used in the work is shown below according to [12]. **Good** (Green): 0 – 50 AQI range is satisfactory, and air pollution poses little or no risk. **Moderate** (Yellow): 51-100 AQI range is acceptable; but, for some pollutants, there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution. **Unhealthy for Sensitive Groups** (Orange): 101 – 150 AQI range affects members of sensitive groups, and they may experience health effects. The public is not likely to be affected. **Unhealthy** (Red): 151-200 AQI range is considered unsafe, and anyone could experience negative health effects from pollution in the air. **Very Unhealthy** (Purple): 201-300 AQI range is a serious health risk level for everyone, and people may receive health alerts as a result. **Hazardous** (Brown): 301-500 AQI range indicates health warnings of emergency conditions and the whole population could be affected.

v. Visibility: is a measure of the distance at which an object or light can be clearly discerned. It is usually reported within surface weather observations and is measured in meters or kilometers or miles, depending on the country. Visibility affects all forms of traffic: roads, sailing, and aviation.
vi. Humidity: this describes the amount of water vapor or water molecules in the air.
vii. Wind gust: is a brief increase in the speed of the wind, usually less than 20 seconds.
viii. Temperature: is the degree of hotness or coldness measured on a definite scale.
ix. Response time: is the total amount of time it takes to respond to a request for service.

5.3 Procedure for the experiment

The steps of the procedure are illustrated below:

i. Activate the AccuWeather application to capture the weather conditions.
ii. On the browser go to android.com/find and sign into the Google Account connected to the device to be located.
iii. activate the clock timer application and play sound on the google find my device app concurrently so that the device will ring out.
iv. Observe and capture the response time for the ringing out of the mobile device via clock timer application; and
v. Get the exact device location on Google Map.

6. Related Work

Location-based services (LBS) were first discussed in the early 1990s (e.g. ActiveBadge), and by 2000s it became a research area with a high pace of development, as a result of the stoppage of the selective availability of the Global Positioning System (GPS) by the U.S. President Bill Clinton in May 2000 [13]. GPS is a part of the solutions for addressing location-related problems. This discontinuation made it possible for GPS technology to be more responsive to civil and business-oriented users worldwide. Subsequently, a lot of GPS-based applications emerged with a strong interest in LBS from both academia and the industry [13]. LBS is defined as computer applications (typically mobile computing applications) that can deliver information tailored to the location and context of the device and the user [14,15].

Raper et. al in [14,16] presented a state-of-the-art review of the research in the field of LBS and pointed out several research challenges. Due to the growing interest, there have been many changes in the field. In the first instance, rapid advances in its enabling technology, such as mobile devices and telecommunication have been witnessed in recent years (Huang, H et. al. 2018). Secondly, there has been a growing demand to expand LBS from outdoors to indoors, and from navigation systems and mobile guides to more diverse applications such as healthcare, transportation, and gaming [13]. Thirdly, new interface technologies that support more powerful smartphones, smartwatches, digital glasses, and augmented reality (AR) devices have emerged [13]. Fourthly, there has been an increasing smartness in our environments and cities having different kinds of sensors [17]. Smartness of the environment is part of the requirements in addressing location related challenges. An increased number of LBS applications are penetrating the general public’s daily lives, which greatly influence how people interact with each other and their behaviours in different environments. It also brings many opportunities such as traffic management and urban planning as well as challenges such as privacy, ethical, and legal issues to our environment and human society [13].

Presently, there are several key trends that are observable from the research and industrial development in the LBS domain over the last decade: from the mobile guide and navigation systems to more diverse applications, from outdoor environments to indoor and mixed outdoor/indoor environments, from location-awareness to context-awareness, from smartphone-based mobile maps and audio only to more diverse and ‘natural’ user devices and interfaces, from technology-driven to more holistic research considering both technical and non-technical issues such as social and ethical aspects, as well as the rise of analysis of “big” LBS-generated data [13]. It is important to note that while rapid advances have been made in these aspects, many open issues still exist, especially concerning ubiquitous positioning, context modelling, and context aware LBS, social, ethical, and behavioural implications [13].

As mobile devices and communication technologies continue to improve at a very great speed coupled with the increasing smartness of our environments and cities, it is expected that the demand for LBS in different aspects of our daily life will continue to be very strong, which will push LBS towards the 4A vision of anytime, anywhere, for anyone and anything [13]. An ubiquitous solution that is affordable will go a long way in resolving location related problems in our society.

The works of literature above showed the different advances in the location-based systems but these advances are a bit complex and not easily affordable. Hence, this research is leveraging these advances in technologies to address the societal problem of disaster and insecurity in an affordable manner.

7. Experimental Result Analysis and Model Evaluation

This proof of concept of the model is a demonstration of the capability of the techniques and technologies evolving in addressing location-based system problems with a view to mitigating Natural disasters and Security Threats which have bedeviled our society. The experiment leveraged the communication and weather parameters for understanding the behaviour of the proposed model. The experiments were run 30 times over a period of two months at different times (morning, afternoon, evening, night) of the day. The null hypothesis (H_o) is that there is no significant difference between the response time of the model at different the time of the day, weather conditions and, the communication parameters while the alternative hypothesis (H_a) states that there is a significant difference in the response time of the model at the different of the time of the day, weather conditions and the communication parameters.

7.1 Experimental Results Analysis and Discussion

Table 1 and 2 provides the results of the experiments.

Table 1. Results for the first 15 experiment runs

Latency (ms)	19	25	24	23	31	150	148	155	149	156	292.5	283.3	259.7	316.9	33045.2
Upload Speed (Mbps)	0.09	0.04	0.09	0.07	0.08	0.08	4.27	0.79	0.08	0.06	0.21	24.69	0.79	0.2	0.38
Download Speed (Mbps)	0.77	0.92	0.77	1.07	0.93	1.06	0.93	0.96	0.65	0.85	0.36	30.22	0.47	0.92	0.63
Air Quality Index (AQI)	43	43	43	34	37	39	30	41	26	49	68	60	41	36	36
Visibility (km)	6	10	6	11	6	10	6	16	8	16	6	5	6	6	6
Humidity (10*%)	8.9	6.4	9	6.7	7.9	9.4	6.9	5.3	9.4	6.2	10	9.9	10	7.5	8.8
Wind Gust (Km/h)	7	10	8	11	11	9	12	13	10	14	11	9	9	13	8
Temperature (^{0}C)	24	29	24	29	28	24	28	33	25	32	24	23	24	28	26
Response Time (s)	0.9	1	1	0.9	0.9	0.9	0.85	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9

Table 2. Results for the second 15 experiment runs

Latency (ms)	348.5	213.3	319.1	505	1473.5	279.2	3543.3	265.3	445.8	1211.3	445.8	267.2	445.8	408.4	253.2
Upload Speed (Mbps)	0.59	0.98	4.47	0.38	0.17	0.64	0.59	18.42	1.09	0.68	1.09	22.31	1.09	0.51	0.91
Download Speed (Mbps)	0.59	0.99	2.96	1.1	0.92	1.06	0.03	19.99	0.6	0.55	0.6	15.54	0.6	0.73	0.96
Air Quality Index (AQI)	41	58	62	40	39	45	30	52	35	30	35	86	35	46	84
Visibility (km)	11	3	8	10	6	16	10	10	16	10	16	8	16	16	11
Humidity (10*%)	6.8	6.3	8.6	7.3	7.4	6.4	9.2	8.4	6.2	8.4	6.2	8.2	6.2	5.5	6.4
Wind Gust (Km/h)	11	14	14	10	12	12	8	7	12	8	12	7	12	10	11
Temperature (^{0}C)	31	31	26	26	28	30	25	24	31	25	31	24	31	32	33
Response Time (s)	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9

The results in Tables 1 and 2 were used in plotting the graph of the response time for locating the device against each of the following parameters: latency, upload speed, download speed, Air quality index, visibility Humidity, wind gust and temperature. The observations are discussed below:

a. Latency: Fig. 2 showed the relationship between response time and latency. It was observed that the response time was consistent in its behaviour despite the sudden and later gradual rise in the network latency.
b. Upload Speed: Fig. 3 showed the relationship between response time and upload speed. It was observed that the response time was consistent in its behaviour irrespective of the fluctuations of the upload speed.
c. Download speed: Fig. 4 showed the relationship between response time and download speed. It was observed that the response time was consistent in its behaviour irrespective of the fluctuations of the upload speed.
d. Air Quality Index: Fig. 5 showed the relationship between response time and air quality index. It was observed that the response time was consistent in its behaviour despite the variations observed in the air quality index.

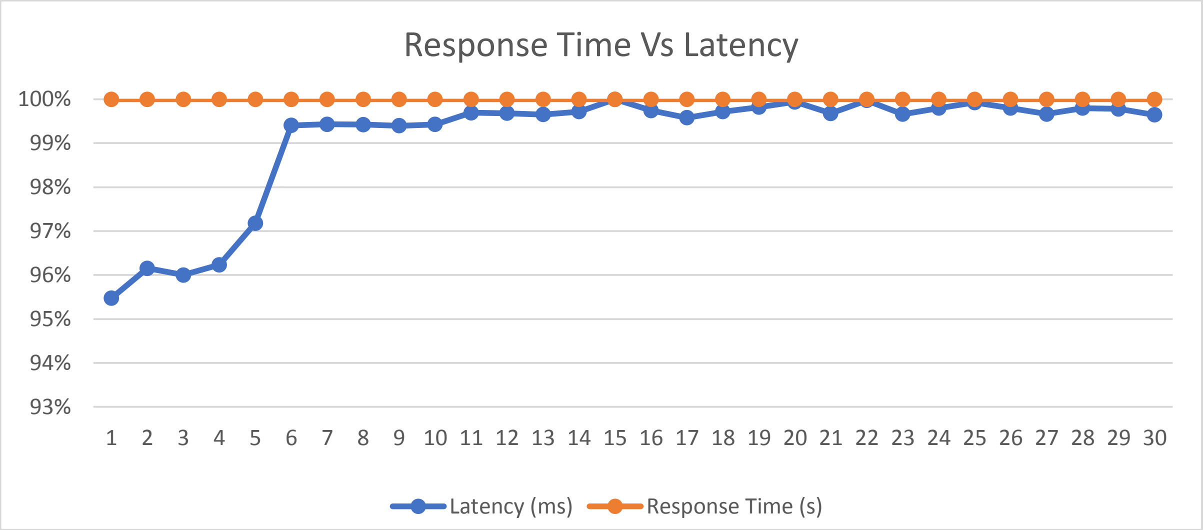


Fig. 2. Relationship between response time and latency

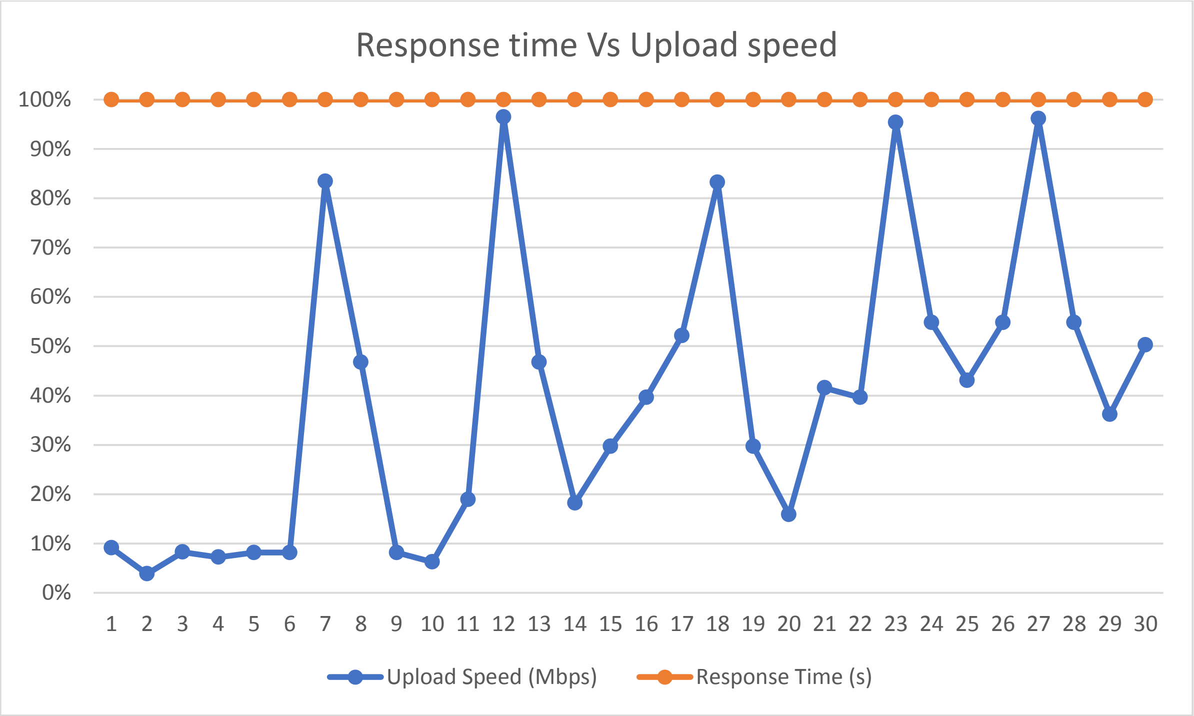


Fig. 3. Relationship between response time and upload speed

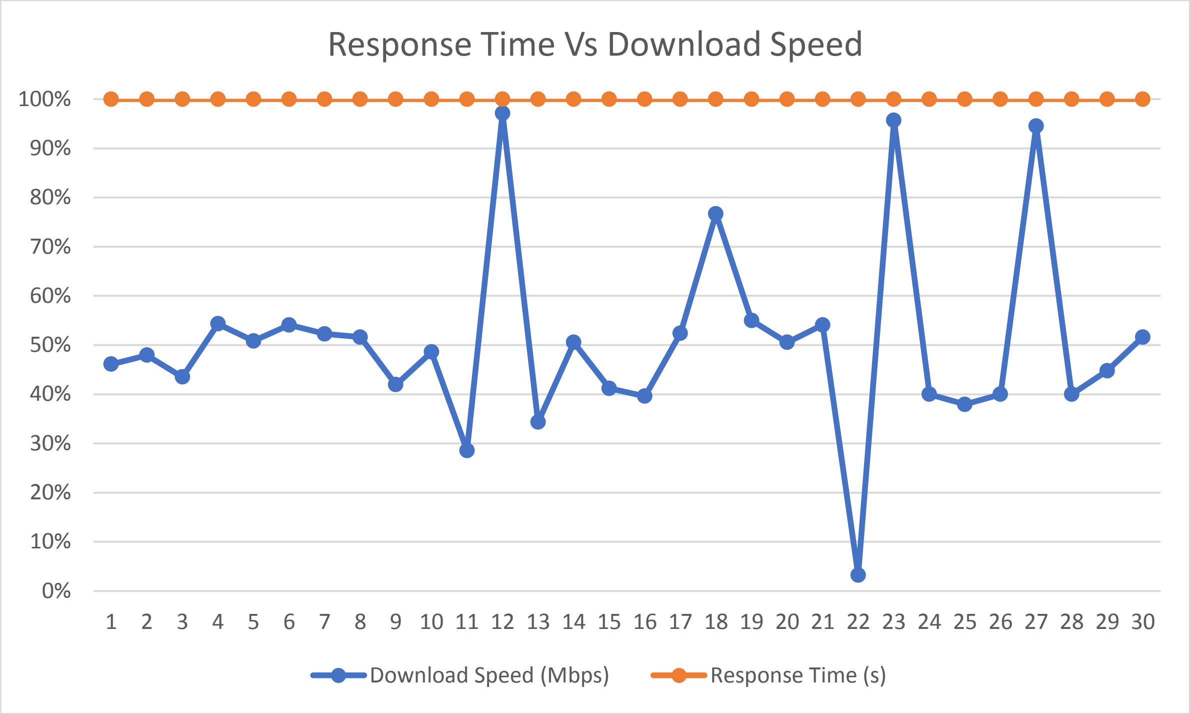


Fig. 4. Relationship between response time and download speed

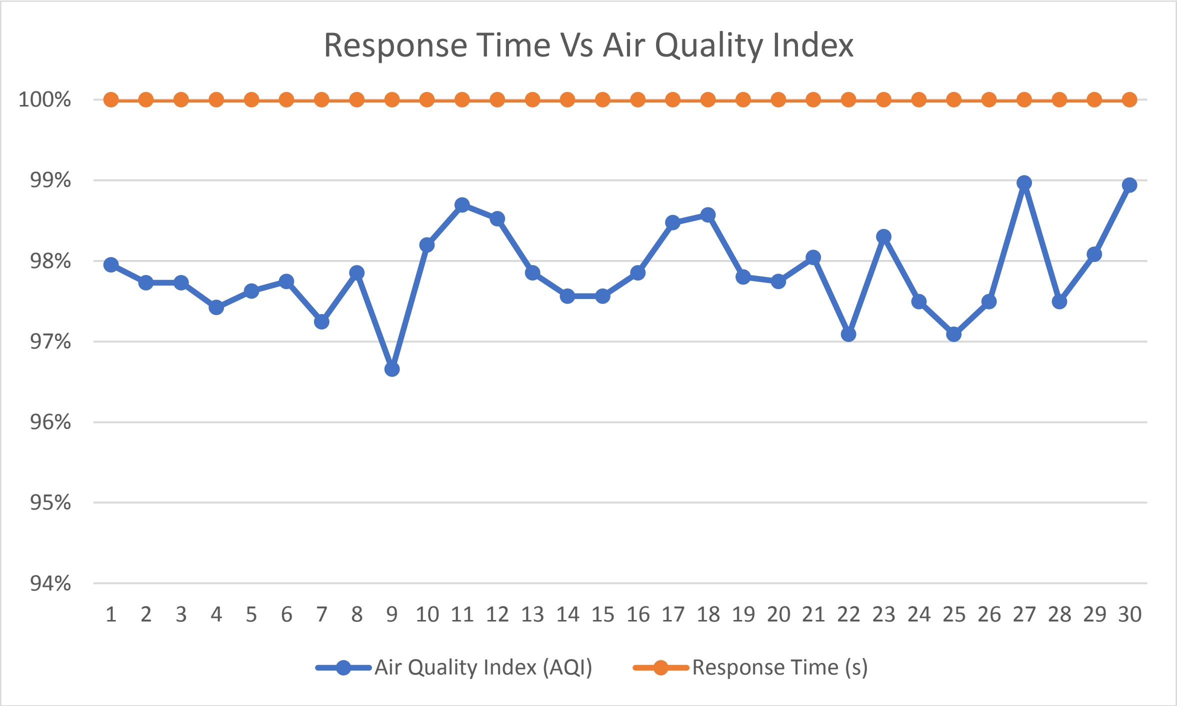


Fig. 5. Relationship between response time and air quality index

e. Visibility: Fig. 6 showed the relationship between response time and visibility. It was observed that the response time was consistent in its behaviour despite the changes observed in the visibility of the environment.
f. Humidity: Fig. 7 showed the relationship between response time and humidity. It was observed that the response time was consistent in its behaviour despite the fluctuations observed in the humidity level of the environment.
g. Wind gust: Fig. 8 showed the relationship between response time and wind gust. It was observed that the response time was consistent in its behaviour despite the changes observed in the wind gust of the environment.

h. Temperature: Fig. 9 showed the relationship between response time and temperature. It was observed that the response time was consistent in its behaviour despite the variations observed in the temperature of the environment.

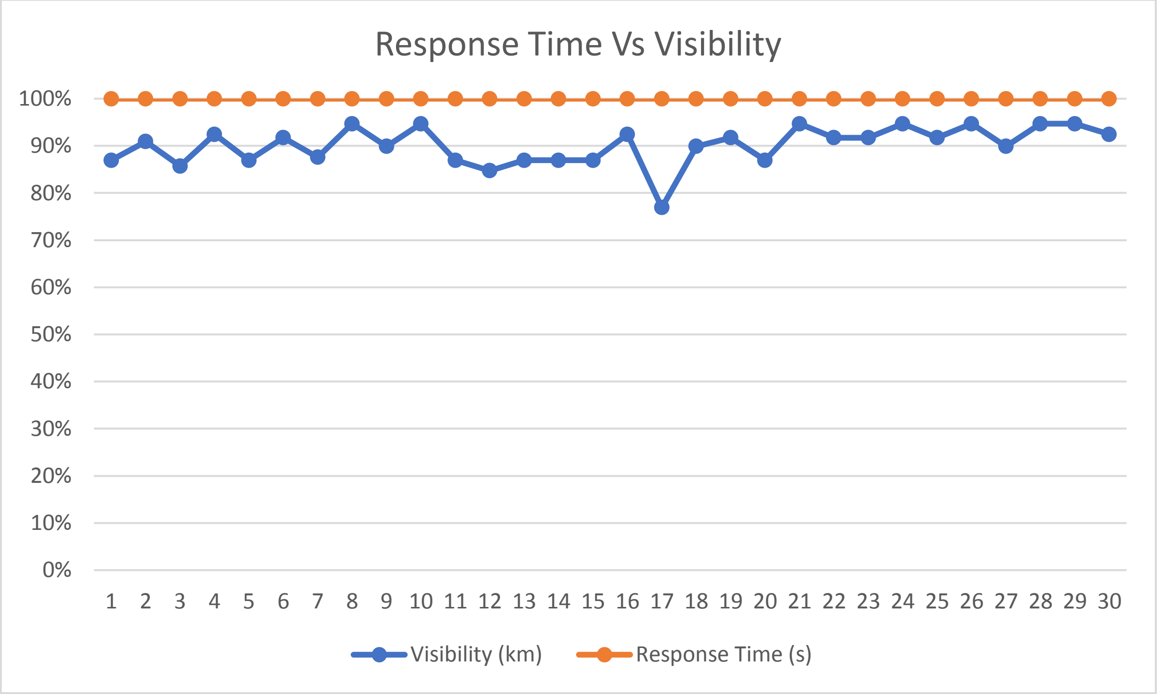


Fig. 6. Relationship between response time and visibility

i. Location Detection of Mobile Device: Getting the exact device location requires map information. On google Maps, the information about where the phone is located was retrieved. The location information was approximate. The map in Fig. 10 provides the location information and possible direction to reach the device and which aid in locating the victim or perpetrator in any case of threat or disaster. Similar satellite location information and possible direction to reach the device are also provided in Fig. 11.

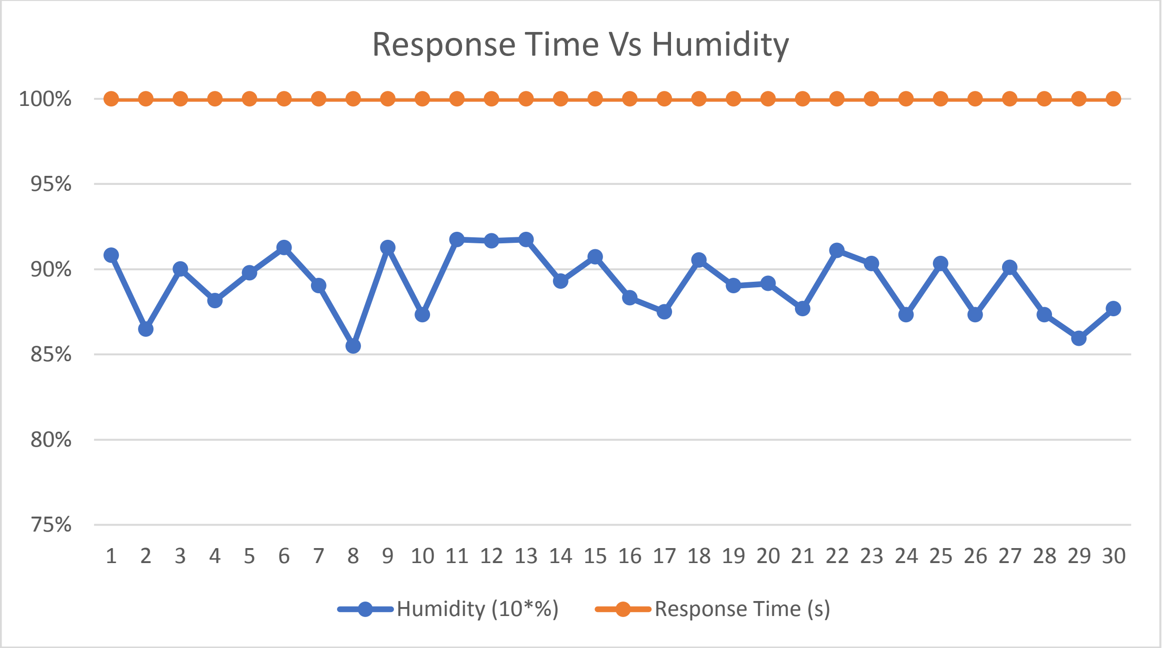


Fig. 7. Relationship between response time and humidity

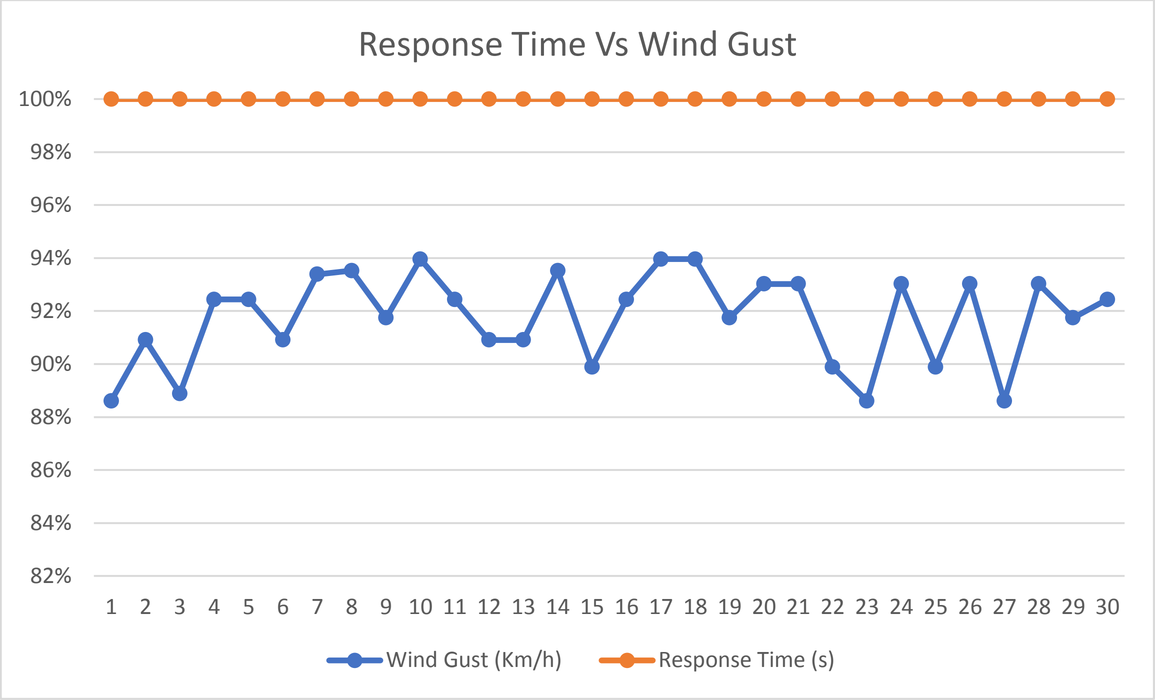


Fig. 8. Relationship between response time and wind gust

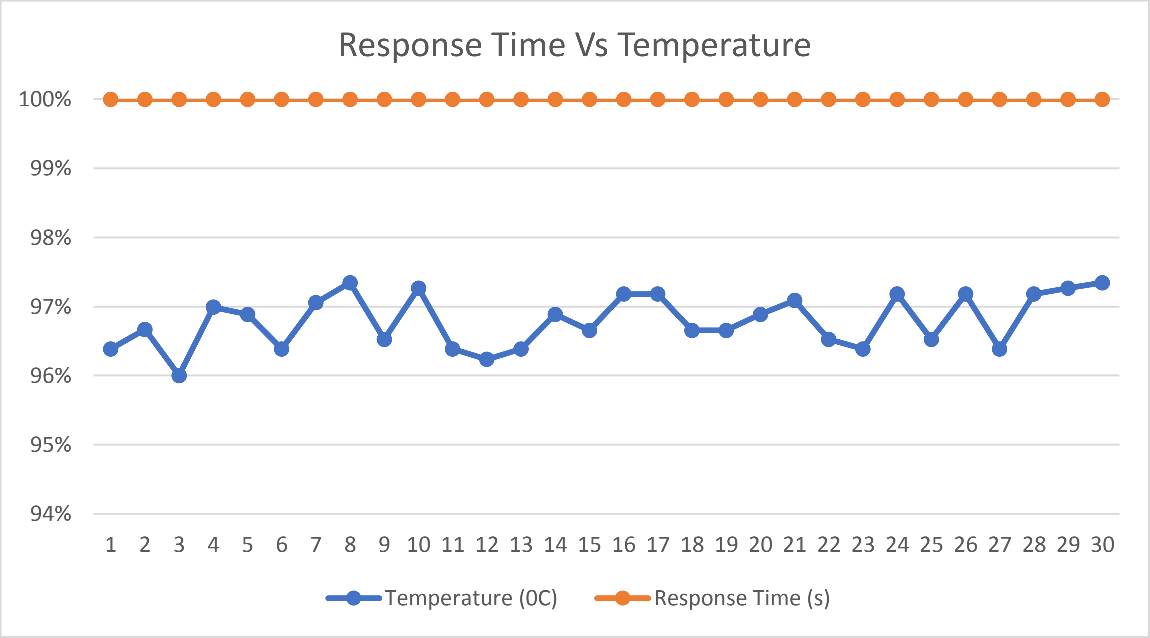


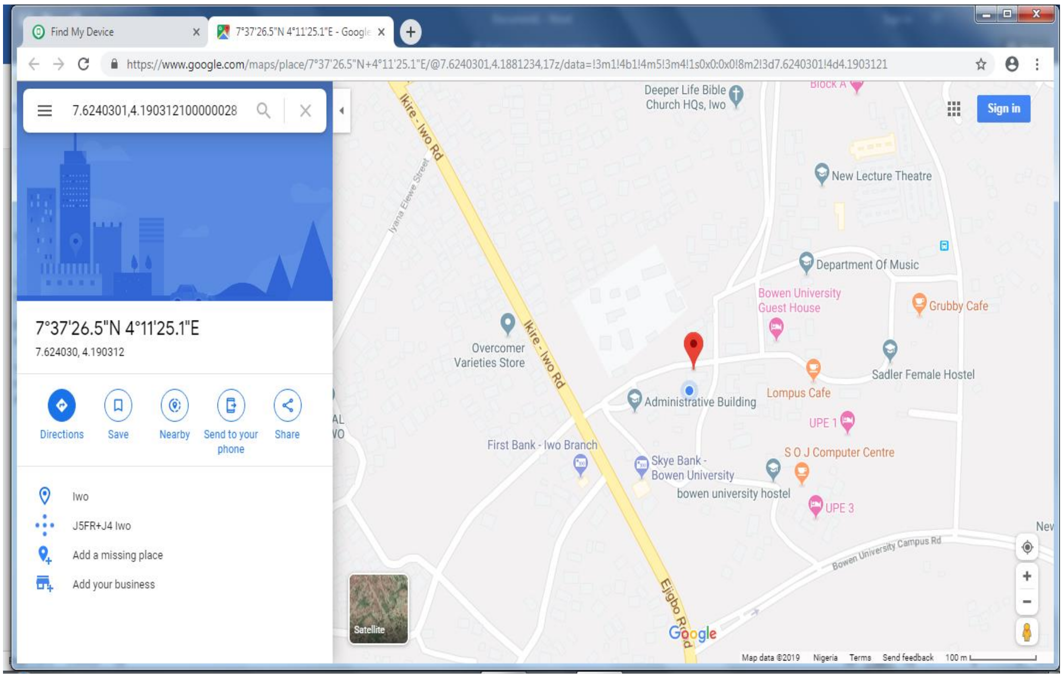
Fig. 9. Relationship between response time and temperature

7.2 Model Evaluation

In order to evaluate the model rationally, robustness of the model was assessed using the behavior of the response time versus visibility as shown in fig. 6. The choice of visibility as a parameter was because it is a critical factor when it comes to rescue operations across different terrains.

$$\text{Robustness} = f(Response\ Time, Visibility) \tag{2}$$

A closer look at fig. 6 showed that despite the fluctuations in the visibility values, the response time was consistently showing high level of linearity in its behavior and gave R Square value of 0.0968.Furthermore, despite variations in the behaviour of the communication parameters namely, latency, upload, and download speeds, the response time of the model for the proof of concept were fast and consistent with the experiments. A similar trend was also observed when considering the weather conditions of the environment namely, air quality index, visibility, humidity, wind gust, and temperature. A single sample (one-tail) t-test for the response time with a mean population of 0.9 gave a t-test value of 1. The value of p is 0.162791 and the result is not significant at p<.05. There was no significant difference in the response time of the model irrespective of the time of the day, weather condition, and the communication parameters. Google map aided the location of the approximate location of the device. The results clearly showed that the proposed model is robust and has the capacity for addressing the identified problem of disaster and security threats irrespective of the time of the day, weather condition, and the communication parameters in an affordable manner.



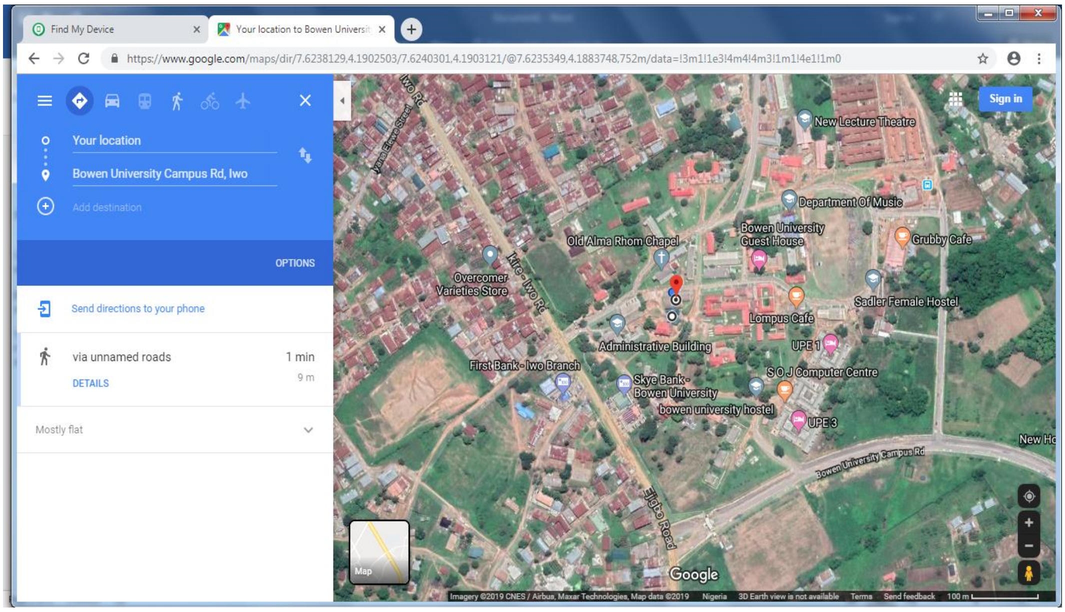
https://www.google.com/maps/place/7°37'26.5"N+4°11'25.1"E/@7.6240301,4.1881234,17z/data=!3m1!4b1!4m5!3m4!1s0x0:0x0!8m2!3d7.6240301!4d4.1903121

7.6240301,4.190312100000028

7°37'26.5"N 4°11'25.1"E
7.624030, 4.190312

Iwo
J5FR+J4 Iwo
Add a missing place
Add your business

Fig. 10. Location information and possible direction to reach the device



https://www.google.com/maps/dir/7.6238129,4.1902503/7.6240301,4.1903121/@7.6235349,4.1883748,752m/data=!3m1!1e3!4m4!4m3!1m1!4e1!1m0

Your location
Bowen University Campus Rd, Iwo
Add destination

Send directions to your phone

via unnamed roads 1 min
9 m
DETAILS

Mostly flat

Fig. 11. Satellite location information and possible direction to reach the device

8. Conclusion and Future Scope

Leveraging the techniques and technologies of geospatial, cloud, communication, and mobile computing, the study has shown the possibility of exploring the use of smart digital/mobile devices in further extending location-based systems solutions, in mitigating the impact of natural and security threats on the society in which human being is at the centre of it as a victim or perpetrator irrespective of the time of the day, weather condition and the communication parameters in an affordable manner. This will aid in timely rescue operation of victims of disasters or locating perpetrators of security threats. Locating victims or perpetrators of these events can be effectively achieved using mobile/digital devices and this will aid in achieving sustainable peace and stability in society.

Future work considers further the expansion of the study in terms of improving the smartness of the digital device to accommodate different human biometric features that can be used in tracking a victim or perpetrator.

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