Journal, Advances in Mathematical & Computational Sciences
Vol. 10 No. 3, 2022
www.isteams.net/mathematics-computationaljournal

Journal of Advances in Mathematical & Computational Sciences
An International Pan-African Multidisciplinary Journal of the SMART Research Group
International Centre for IT & Development (ICITD) USA

Available online at https://www.isteams.net/ mathematics-computationaljournal.info
CrossREF Member Listing - https://www.crossref.org/06members/50go-live.html

Designing of an Arduino Nano Cloud Vehicle Based Anti-kidnapping Device for Tracking Kidnappers in Nigeria

Jayeola O. J[1], Akingbesote A. O[2], Orangun A.O[3] & Bello O.A[4]
Department of Computer Science, Adekunle Ajasin University, Akungba Akoko, Nigeria[1,2,3]
Department of Computer Science, Afe Babalola University, Ado-Ekiti, Nigeria[4]

ABSTRACT

Nigeria has been facing challenges in recent time. These include: security, political and others. While that of political and others seem to be gradually addressed, that of security is increasing daily. This security challenge includes kidnapping, robbery, raping and others. Currently, kidnapping tops the list of these security challenges based on the literature. To address this kidnapping challenge, the Federal Government has introduced several strategies. These include the use Joint Task Force, political solution and religious approach. In addition, some states government has introduced the "Amotekun" groups. However, these strategies have not yielded positive result. One reason attributed to this is the lack of good technology to capture the scene of the event to identify the kidnappers. Currently, the use of wearable equipment through the use of Aundo Uno Microcontroller Technology is ongoing. However, issues like Cost of the equipment, lack of good cloud storage facility, Loss or forceful hijack of the equipment by kidnappers, hazardous effect on health and Security of life of those wearing the device are major challenges. In addition, the issues size, compatibility, flexibility and the friendly nature of this Technology. This paper presents a Cloud vehicle Based Anti-Kidnapping Device (CVBAD) using the Arduino Nano based Technology that captures all the events in the car in the context of kidnapping in Nigeria. This is aimed at detecting, gathering information, sharing and monitoring the entire scenario that occurred within the domain of the event. The experiment is conducted based on three levels. These are the physical, logical and the circuitry level. The prototype road demonstration of this work was carried out in Adekunle Ajasin University campus. A comparative study was made between the result obtained with that of Arduino Uno Technology using cost, audio-video and face detection images as our metrics. The radius coverage of 30-meter was recorded. The cost ratio of the proposed system is about 1:5 in a car and about 1:12 in a bus.

Keywords- Microcontroller, Internet of Things, Arduino Uno, Arduino Nano

Jayeola O. J, Akingbesote A. O., Orangun A.O.. & Bello O.A (2022): Designing of an Arduino Nano Cloud Vehicle Based Anti-kidnapping Device for Tracking Kidnappers in Nigeria. Journal of Advances in Mathematical & Computational Science. Vol. 10, No. 3. Pp 43-60. Available online at www.isteams.net/mathematics-computationaljournal.

1. INTRODUCTION

Safety has become a paramount requirement as a result of unabated harassment, torture, threat to life and even killings associated with abduction on roads, offices, schools and homes. The prevalence of economic inequality, poverty, unemployment and corruption have increased the rise in varying degrees of crimes such as armed robbery, burglary, oil theft and kidnapping in the world at large. Out of these crimes, kidnapping has been so rampant recently and raised security concerns across Nigeria and the world at large. Several scholars have been able to define kidnapping with varying degrees of successes. In [1], kidnapping was defined as false imprisonment or illegal confinement of an individual against his or her own will by another individual such that there is a restriction on movement of such person. The work of[2] described it as the forcible seizure, taking away and unlawful detention of a person against his/her will.. Also, [3] defined the concept of 'victim of kidnapping' as a person who suffers harm or injury directly or indirectly as a result of forceful abduction and movement, either by a person or group of persons until the demand or payment of a specific ransom is met. On the other hand, kidnapping was viewed as abduction and hostage taking, with the motive of obtaining ransom by [4].

Meanwhile, one common thing about the definitions given by [2], [3], [4] is that the victims are always subjected to ransom payment. Based on these definitions, one can conclude that kidnapping is an act of illegal and coercive capture of people either in return for ransom or other heinous crimes such as slave trade, rituals, or human trafficking. There are various causes of kidnaping as stated in [5] and [6]. For instance, [5] submitted that kidnapping is still a common trend as a result of joblessness, political instability, hopelessness and the get rich quick syndrome amongst the Nigerian youths. This is coupled with the fact that some might be for religious reasons, ethnic nationalism, ethnic militia, economy, population, family influence etc. However, in [6], the author argument is based on economic reason as the most common cause for kidnapping in Nigeria. Meanwhile, going by the historical development, kidnapping has become a common tactic for obtaining ransom money, hostage negotiations, and slave labor and also a global threat[7].

This is predominant in countries like Mexico, Brazil, Colombia, Russia and most recently in Nigeria [6]. Currently, Nigeria has risen considerably high with 25% of global kidnapping [1]. Based on the statistic report of 1999 as reported in [9], Nigeria is now tagged among the global kidnapping Nation after ranked fifth to Columbia, Russia, Mexico and Brazil for ransom kidnapping operation. Kidnapping is said to have been in place since the early 1990s [10]. For example, the Nigeria Police Force was said to have recorded 887 cases between 2008 and 2010 respectively [11]. This trend has continued to increase geometrically, for example, between 2014–2017, over 2000 people were kidnapped. In 2014, almost 250 school girls in a girl's secondary school in Chibok, Borno State were kidnapped [6]. Other were young, old, government officials, politicians, and kings [12], [13][14]. The persistence growth on the issue of the kidnapping in Nigeria and the prevalence rise in kidnapping has led to fear, insecurity. This has recorded negative impact on the country economy and most importantly, has also have negative impacts on victims [5] [10].

The impact of this has caused for instance, has made some of the victims to have psychological instabilities, shock and sleepless night [7]. To add more is the pain and suffering caused on victims and their family in which cannot be measured or quantified. In the past years, people and security agencies rely only on their local power and courage to keep themselves and properties safe. However, this has proved ineffective because their action was a battle between life and death and also because they cannot face the current kidnapping challenges. [4]. In order to improve on this in Nigeria, the Federal Government has involved the Police Authority. However, rather than this being reduced, the rate of kidnapping is increasing daily. Nigeria was said to record more than 1,000 kidnapping incidents a year, and there are undoubtedly many that are unreported [6].

The local vigilantes were involved to join the Military in bush searching so as to detect dens of these kidnappers. However, this has not yielded positive result. To add more, the Military Authority was also deployed to mount road blocks and also involve in day and night patrol. This has not also produce the expected result. The advancement in technology has made people to have enough knowledge about several tracking devices [15], the emergence of Internet of things, Sensor cloud infrastructure, several smart and wireless technologies. This has helped people and also security operatives in making necessary findings linking to kidnapping cases. The world of Internet of Things and Sensor-Cloud infrastructure have in no doubt been able to provide an open, flexible, and platforms for several monitoring and controlling of applications [16]. The use of Arduino microcontroller, GSM module, GPRS module, GPS, Radio Frequency Identification (RFID), Smart Visual Systems (SVS) and PIR sensor were developed for the monitoring of kidnapping events both in remote and open locations [4].

While some of the techniques and technologies used in combatting kidnapping have worked, one great challenge is that most of these technologies were based on the use of wearable equipment and they are subjected to so many challenges[17], [18][19], These include Cost of the equipment, lack of good cloud storage facility to keep tracks of operation, loss or forceful hijack of the equipment by kidnappers. Others are the issue of Security of lives of those wearing the device and some of these wearable equipment are hazardous to health. In addition, the issues of size, compatibility, flexibility and the friendly nature of this Arduino Uno microcontroller Technology are of great challenges. This paper addresses the issue of kidnapping by designing a cloud vehicle based anti-kidnapping device for Tracking Kidnappers based on Arduino Nano Technology.

The remainder of this paper is organized as follows: Section two discusses the literature review. Section three discusses the architecture of the proposed work. In section four the experimental set up is discussed and section five is on the results and discussion. The paper ends with conclusion in section six.

2. RELATED WORK

Most Scholars have done several works in solving the issue of kidnapping in Nigeria and the world at large. An Internet of Things based architecture of web and smart home interface using GSM was proposed in [20]. The architecture enables users to control and keep an eye on smart devices through GSM and Internet supports. This architecture consists of an implanted system, sensors and actuators which are the corporal devices that interact directly to users.

The Internet acts as a middleware between the user and intelligent parts while the sensors and actuators relates with the environment in a consistent manner. The Semantic Oriented infers Intelligent Process (IP) presents the knowledge and decision making processes. While the architecture is suitable for monitoring and control of devices in the deployed environment, however the issues of strong GSM network for best performance and the failure to give consideration to video streaming are challenges.

In [17], Child kidnap protection using RFID and GSM technology was carried out due to the need to curtail the rising cases of missing school children. .The author used a hand tag sensor with alarm or message system as a solution approach that monitors the position of children. The device allows information about the movement of the child to be sent to the user through the ARM 7 Processor LPC2148 and the RF communicates data while the GPS tracks the position. The success of this work is based on quick response to scnene of event based on the alarm and the messahges. However, how this work could record the audio, video event and also retreival from the cloud to assist forensic experts to track down the perpetrators was not discussed.

An adaptive Distance Alert System (ADASS) on child trafficking was proposed in [19]. This was achieved by the use of Arduino Uno hardware and software to control the input and output in the system. This consists of the transmitter module, receiver module, alarm buzzer and the GSM The system used RF transmitter and receiver sets at 100 meters as the maximum range The architecture alerts guardians through the transmitter module and the receiver module if a child goes beyond the settled safety area. The contribution of this work is the use of this technology for child protection. However, issues like detail record of audio and video of the event, cost implication, misplacement of the transmitter due to negligence and lack of good storage facilities were not addressed fully adressed. A prototype for a personal safety Gadget using Arduino Uno was presented in [21].

It was designed for personal safety that features both the importance of safety and security. The device was designed and developed such that Arduino Uno was interfaced with SIMCOM which produce SIM900 GSM modem and also by using an LDR as the receiver for stimulus. The device was able to work once the user exposes the hardware that is hidden in the dark when they are in distress thereby, causing the light intensity to alert the circuit board which will then power the GSM modem. The exposure of this device to light causes an instant message to be sent to the victim's emergency number. The device proffer solutions to only those that can keep it in a closed place e.g. hand bags or pockets and swiftly expose it to light so as the trigger the GSM modem to send message as soon as possible. This has some shortcomings like inability to expose the equipment to light under threat; also, the bag may contain liquid and other things that will have negative impact on other equipment therefore causing damage.

Akinyokun et al in [4] proposed a framework for combating human trafficking and kidnapping using smart objects. This is a hand tag sensor The system consists of a hardware operational phase that has four stations. This includes the Sensor Processing Station that does the sensing of signal, Media Server Station Smart Engine Server and Digital Situation Room. The concept was able to integrate smart technologies and internet of Things so as to track criminal activities and also for the safety of lives and properties.

However, chip misplacement, hazard to life and cost are major challenges of this work. In addition, is that of the size of the hardware proposed that is not fully compact? For example, the chip that is meant to capture video, audio and picture in the course of a kidnap can be misplaced .Because, it's either attached to the human hair or a broach-type model (attached to the cloth or button) and even wrist misplacement can occur as a result of panic.

Design and Implementation of a Rescue System for the Safety of Women was carried out in [18] using the Arduino Uno microcontroller. The research focuses on the development of a wearable arm band for safety and protection for women and girls. It was achieved through the analysis of the physiological signal in conjunction with the body position which are the pulse rate sensor, vibration sensor, fault detection sensor. The Arduino Uno microcontroller was able to function through the raw data acquired by activating the GPS to send alert messages through the GSM. Likewise, images and videos were captured through the wireless camera. This Arduino Nano microcontroller technology gives alert both to Police and the family. The use of this technology in allowing video calls has been a great contribution. However, the issue of information storage was not discussed. In addition, the issue of compatibility and costs of this equipment are challenges. The authors in [22] developed a fog-FISVER system that helps to improve public safety as a result of prompt responses from police personnel after detecting real time crimes. It was accomplished by the use of in-vehicle and fog infrastructures that support autonomous and real-time crime detection on public bus services.

The major improvement of this work is in the area of assisting the police authorities in finding prompt location of a crime and also to respond promptly. However, one major shortcoming observed from this work is the security of the information as they are received by the police system analyst and also the crime information may be delayed, deleted and manipulated.

The works of these preceding authors presented the us the opportunity to make our contribution in this paper. For example, the argument for using the Arduino Nano is based on foundation laid in the work of [21] and [22]. Also, the work of [19] [20] are the forerunners of the idea of proposing other technology as our solution approach. However, most of these technologies are wearable gargets. These gargets are costly and cannot be afforded by common man. In addition, they are hazardous to our health, subject to misplacement and not compatible to be working with. Another is the lack of good storage system that keeps the recorded audio, video and face detection of events for police and forensic expert's investigation. To address some these issues, this paper proposes an Arduino Nano cloud vehicle Based Anti-kidnapping Device.

3. ARCHITECTURE OF THE PROPOSED WORK

The architecture of the proposed work is into three levels. The first is the physical level, the second is the logic level and the third is the circuitry level. The physical layer consists of the cloud based anti-kidnapping device (CBAD) that has the Wi-Fi camera mounted on the car in hidden places. This is depicted in Figure 1. The information about the car (e.g. Video, Audio, Camera and Car location) are transmitted to the central processors that are connected to servers providing the mobile network services through a base stations (e.g., base transceiver station, access point, or satellite). This establishes and control the connections (wireless links) and functional interfaces between the

networks and the car.
After that, the subscribers' requests are delivered to a cloud through the Internet. In the cloud, the cloud controllers process the requests that provide car users with the corresponding kidnapping service. An online message is then sent to the security unit. For example, Police Authority for proper monitoring of events.

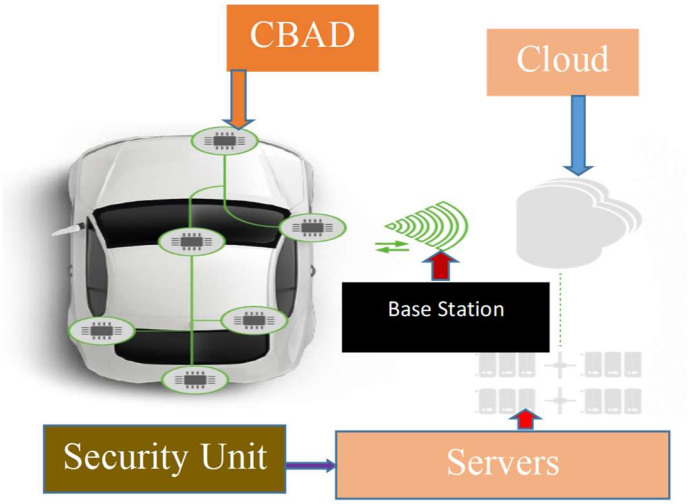

Figure 1: Prototype Diagram, of CBAD

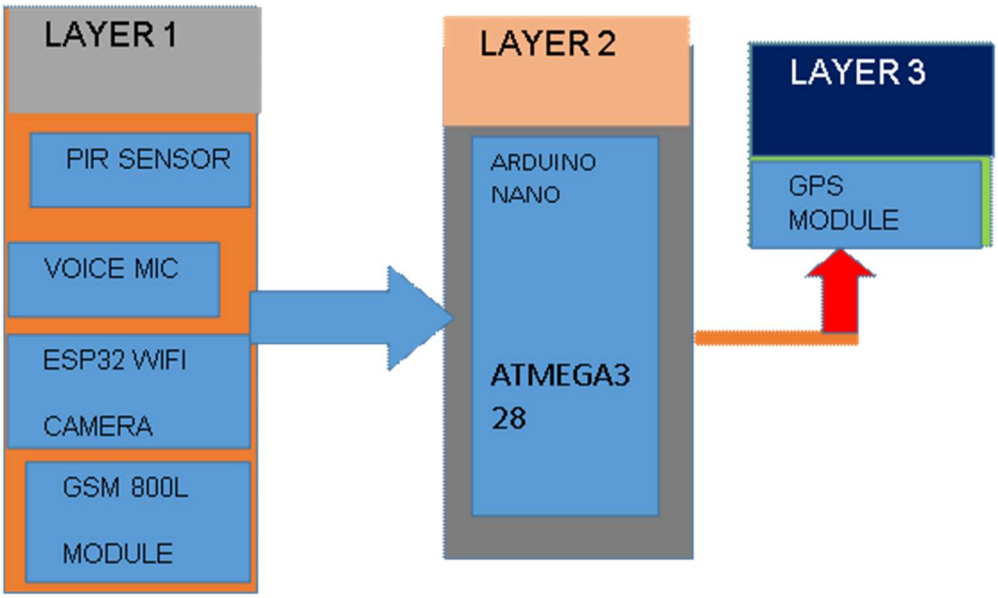

Figure 2: Block Diagram Of The Cloud-Based Anti- Kidnaping Device (CBAD)

The logical level consist of the various logical design needed to make the physical level functional. This level has three layers with sub units as shown in the architecture of Figure 2. These are layer 1, 2 and 3 respectively. Under the first layer, there are four units. These are PIR sensor, Voice Microphone, ESP32 WIFI CAMERA and SIM 800 L Module. The second layer is the Arduino Nano Microcontroller while the last layer is the GPS Module. The first layer is connected to the ATMGAS3 microcontroller and is in turn connected to the GSM module. The PIR sensor in the first layer detects the movement of people. This is a low power with low cost device, pretty and rugged with wide lens range and easy to interface. The Voice Microphone is the transducer that is used for the conversion of sound into an electrical signal. In this work, the dynamic microphone proposed and is connected to a preamplifier for the signal to be recorded or reproduced.

The WiFi Camera has various types but for the purpose of this research, the ESP32-CAM-UFL that is coined from the ESP32-CAM family is used. The justification for this is that it has a low cost development board with the WiFi camera, in addition, it has an inbuilt PCB antenna and suitable for creating IP camera projects for video streaming with different resolutions. Furthermore, it has the advantages of allowing connection of an external antenna and that of giving the ESP module to be used. These features make it useful in wireless Networking and capable of being connected to a cloud based system. The SIM/GPRS 800L Module is built with Dual Band GSM/GPRS engine that has an on-board Regulated Power supply. This allows users to connect wide range unregulated power supply. The Module RS232 interface in it allows connection with the Arduino Nano microcontroller. The GSM/GPRS Modem has an internal TCP/IP stack that enables it to be connected with internet via GPRS. We use this for our SMS, Voice as well as data transfer.

All these blocks are depicted in Figure 3 and further studies on the functions of these units can be found in [16][23][24]. On the second layer is the Arduino Nano Microcontroller proposed for this research. This is a small, compactible, flexible and a friendly circuit microcontroller board that is developed by Arduino.cc in Italy. It is based on ATmega328p (Arduino Nano V3.x) / Atmega168 (Arduino Nano V3.x) and also designed for programming and prototyping. It comes with exactly the same functionality as in Arduino UNO but quite in small size. Another justification for proposing this processor is that it has an open source design that does not require extra hardware to burn programs onto the board. Also, it comes with an operating voltage of 5V; however, the input voltage can vary from 7 to 12V. **The Pin out** contains 14 digital pins, 8 analog Pins, 2 Reset Pins with 6 Power pins.

This allows each of these Digital & Analog Pins to be configured as input or output and at the same time allows them to act as input pins when they are interfaced with sensors. Function Pins like pinMode() and digitalWrite() were used to control the operations of digital pins while analogRead() was used to control analog pins. External power is supplied by connecting it to the LM 2596 DC Bulk converter module **which helps to power all the peripherals that are used in the proposed architecture as shown in Figure 2 and 3. In addition, it regulates the supplied voltage and current against any surge or spike that may arise due to electrical malfunction in the vehicle.** Arduino IDE circuit board shown in Figure 3 uses a simplified version of C++.

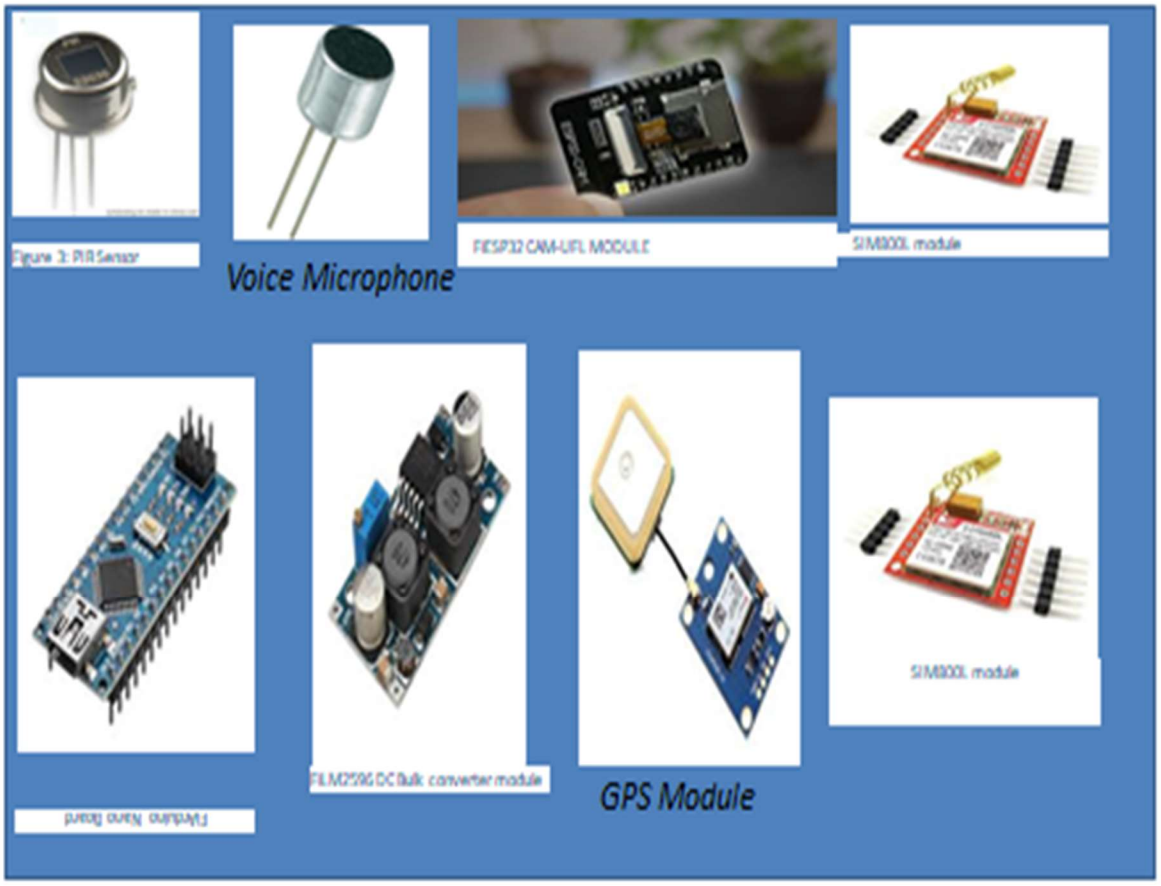

Figure 3: Building layers of our proposed CVBAD

The circuitry level is broken down into three layers as depicted in Figure 4. These are: power layer, the processor and other attached peripherals. The power layer which is the LM 2596 earlier explained. It has a 5 volt regulator. This is used to provide the required voltage that drives the processor and all the attached peripherals. The basic function in this context is to convert 12 volt to 5volt required by the processor and other attached peripherals. The processor is the Arduino Nano micro-controller. This is the heart of the whole system. It co-ordinate and process all various activities taking place in the system. For example, it co-ordinate the information received from ESP cameral, GPS Module etc. It has multiple I/O pins that enable it to communicate in bi-direction mode. The other peripherals include ESP Camera, SIM 800 GSM Module, GPS, PIR sensor and others.

These are interfaced to the processor (Arduino Nano) that co-ordinate their operations by capturing all the activities. The operation is such that users trigger the switch bottom immediately kidnapping activities is suspected. This puts the 5 volts battery into operation to power the processor (Arduino Nano). This then switches on the attached ESP Camera. The image (Picture) observed by this camera is immediately sent to the processor for processing. This is then streamed to the embedded server via the GSM Module which is already connected through a GSM operator. The location of the whole scene is immediately recorded by the GPS Module and sent to the processor for record purpose. An Attached card reader capable of holding storage of 64 Gigabyte is activated to record the audio and video of the event. This Location and other information are sent to the security or the family of the victim(s).

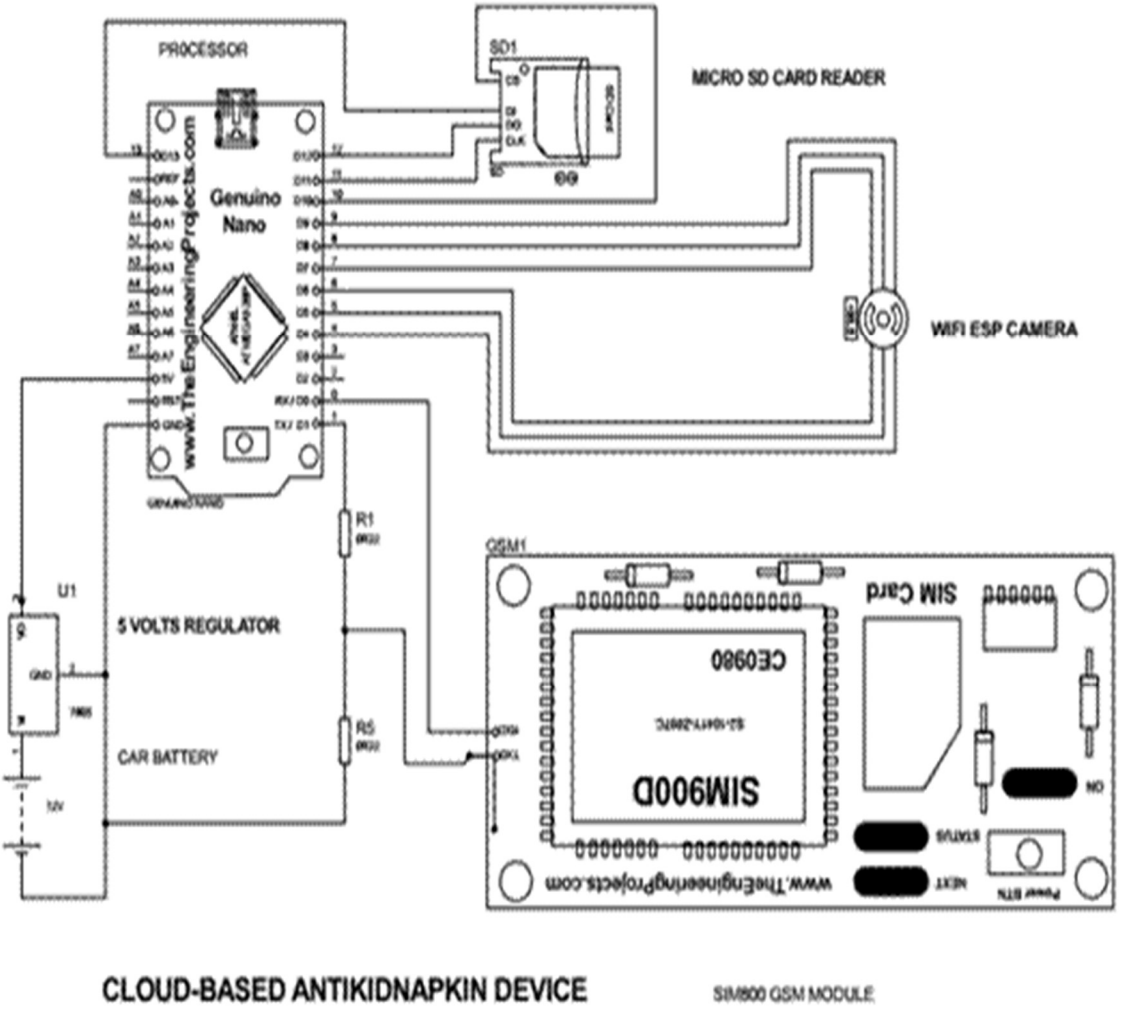

Figure 4: Circuitry Design of the Proposed CVBTAD

4. EXPERIMENTAL SETUP

The prototype demonstration of this work was carried out thrice in Adekunle Ajasin University that provided the internet facilities. A car with registration number LSD329FV and a University bus containing 36 passengers were used with the installed CVBAD. On the first case two passengers left the gate with the car including the driver to the permanent site (Senate Building). On the second case fifteen students were used. On each case, along the road, these vehicles were stopped by students that acted as kidnappers. Immediately the drivers noticed this, they trigger the alarm buttons for record purposes which set alerts to the security unit for rescue operation. The results are discussed under the results and discussion section.

5. RESULTS AND DISCUSSION

The results of the prototyped demonstrations were carried out using three scenes of events: these are: i. Captured event during the day time operation ii. Un-captured event during day time operation and the third is the Captured event during the night time operation. This is due to the fact that most kidnapping activities do occur during the day and these kidnappers do escape. This may be attributed to late communication, inadequate security agents etc. On each of these scenes, the video and audio of the kidnapped operations were recorded immediately the alarm switch is on from the hidden place in the car and the bus by the driver. For example, on the first scene that occurred during the day time, the kidnappers were captured by the cameral and the police was alerted and the dislodge them.
The video and audio of the scene were recorded in the cloud as depicted in Figure 5. On the second scene which also occurred during the day, the kidnappers escaped and the recorded facts (Audio, Video) were sent to the cloud for forensic investigation. The recorded video and audio are shown in Figure 6 and 7 respectively.

Figure 5: Event activity of scene when kidnapper were met during day time operation

Figure 6: event activity when kidnapping escaped during the Day time

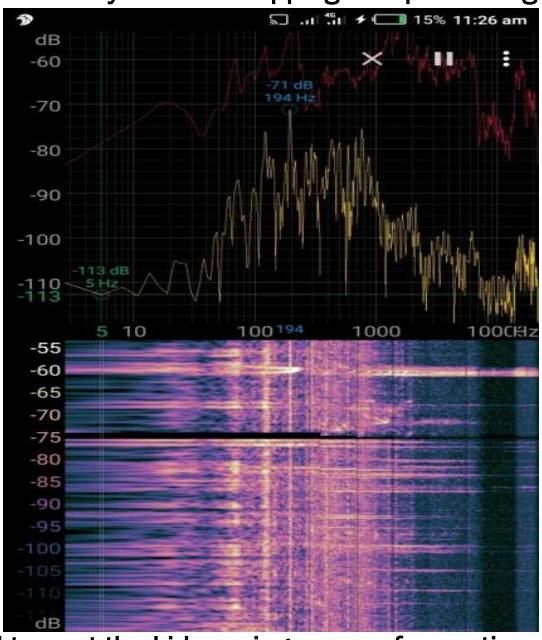

Figure 7: Recorded tape at the kidnapping scene of operation when they escaped

On the third scene, it was recorded at night this is because it is one of the greatest security threats and difficult operation. This may be attributed to inadequate security gargets. The results captured all scenes of events within 30-meter radius of kidnapping operation. In Figure 8, one kidnapper was captured on the video and in Figure 9, the tape event of operation was recorded for forensic investigation because the kidnappers escaped before the arrival of the security men.

Figure 8: Event activity of scene when kidnapper were met during night operation

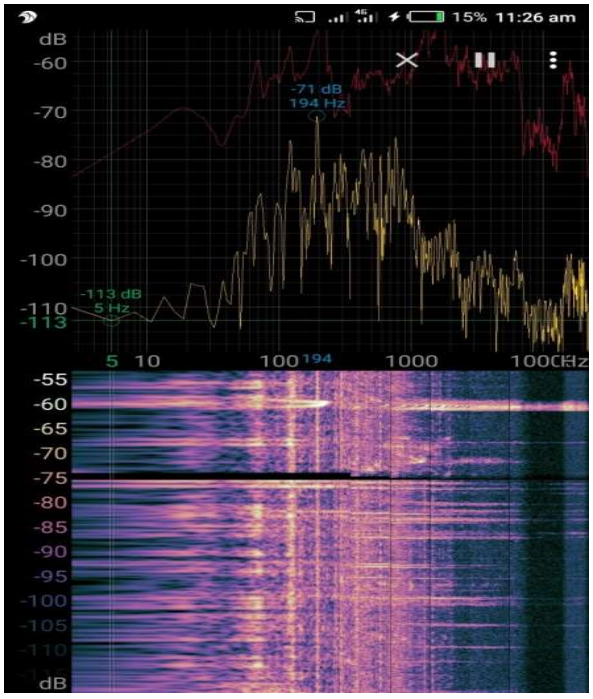

Figure 9: Event activity when kidnappers escaped at night.

6.1. Discussion and Analysis of Results

Image Analysis

In order to analyze our results, we re-performed this experiment with the Arduino Uno microcontroller as against our proposed Arduino Nano Microcontroller . Our metrics of analyses were based on images (video and audio) of the scene of operation and cost of producing these devices. On the issue of images, the audio and video events of operation were compared between the Arduino Uno microcontroller and the Arduino Nano Microcontroller. The comparison table is depicted in Figure 10. We carried out image possessing operations on them by subjecting them to the same condition in our laboratory. The calculation of an element-wise (pixel-by-pixel) difference is done. In other to get the color difference, the vector per point is recorded.

The norm difference was taken. The laboratory results show that the pixel produced by Arduino Nano Microcontroller is better that of Arduino Uno microcontroller. Also the vector per point of Arduino Nano Microcontroller is better than that of Arduino Uno microcontroller. That implies that that there is no clearer view of videos, images and a well detailed audio recording under the Arduino Uno. This needs to be further subjected to rigorous analysis before getting a better output which will invariably involve additional cost. However, our proposed Arduino Nano technology used had **a well recorded audio, 3D video and images both in day and night operation as depicted in Figure 10.**

Arduino Uno microcontroller	Arduino Nano Microcontroller
Captured Event 	Captured Event 

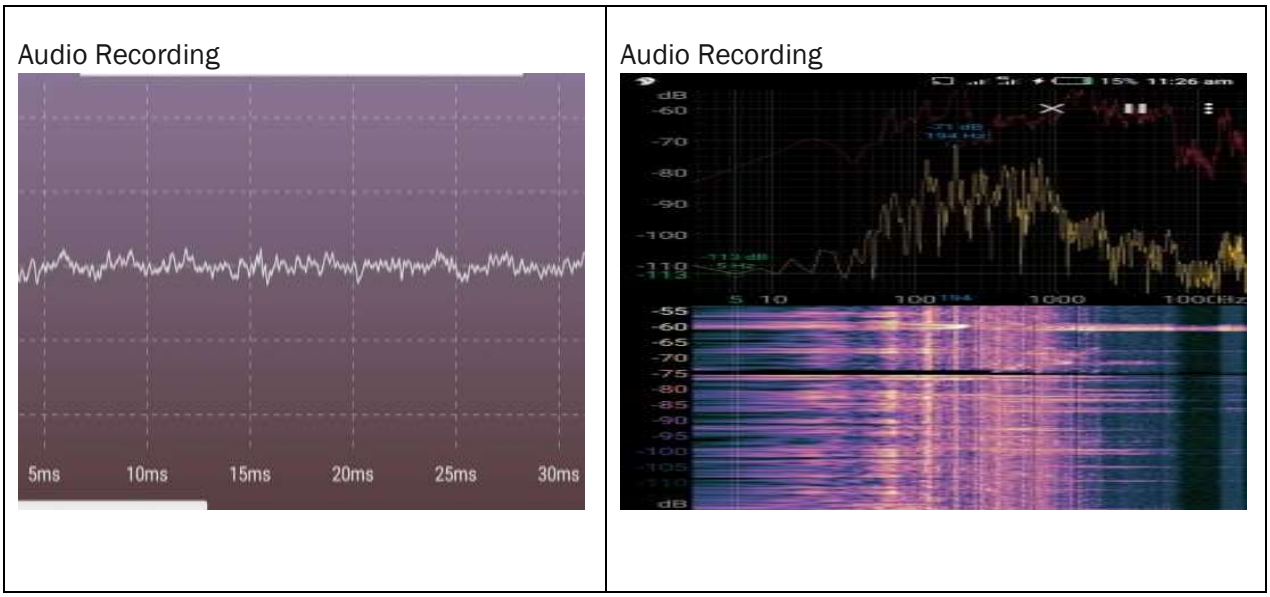

Figure 10: Arduino Uno microcontroller and Arduino Nano Microcontroller images

Cost Analysis

The cost comparison of the Arduino Uno microcontroller used in previous researches and the Arduino Nano microcontroller table proposed in this research as of February 2021 is depicted in Table 1. It is noted that the total cost of the new device (Arduino Nano) is #104,000 which is slightly higher than the cost of Arduino Uno (#98,500) used by the past scholars. However, the advantage of this technology is that it is installed on the car as against the Arduino Uno that is wearable. For example, in Table 4.3, two types of motors were considered, A car and a luxurious bus. The car has 5 passengers while the bus has 50 passengers. In the car, only one Arduino Nano was used to capture event at the cost of #104,000 as against the five used by Arduino Uno at the cost of ₦492,500. The bus used only four Arduino Nano at the cost of four hundred and sixteen thousand naira (#416,000.00). However, in the wearable scene, 50 Arduino Uno microcontroller were used to capture 50 passengers at the cost of #4,925,000 with a deference of #4,509,000 as depicted in Table 3. That implies that the cost ratio of the proposed system is about 1:5 in a car and about 1:12 in a bus.

Table 1: Cost Analysis Based on a car and a fifty Setter Bus Arduino Uno and Arduino Nano Microcontroller

ARDUINO UNO	(Cost)	ARDUINO NANO	(Cost)
Power Pack	15,000	Power Pack	15000
ESP32 Wifi Camera	0	ESP32 Wifi Camera	10500
WIFI Module	10,000	Wifi Module	10000
Wi-Fi Socket	2000	Wifi Socket	2000
LM2596	5,000	LM2596	5,000
GPS Module	12,500	GPS Module	12,500
SD Card Module	6,000	SD Card module	6000
RTC Timer	5,000	RTC Timer	5000
SIM800L Module	8,000	SIM800L Module	0
Level Shifter	0	Level Shifter	8000
Mic Unit	3,000	Mic Unit	3000
Arduino Uno	20,000	Arduino nano	15,000
Accessories	12,000	Accessories	12,000
	98,500		104,000

Table 2: Cost Analysis Based on a car and a fifty Setter Bus

Technology	Car No of passenger	No used	Cost per Microcontroller	Total Cost	Bus (no of passenger)	No used	Total Cost
Arduino Uno	5	5	₦98,500	₦492,500	50	50	₦4,925,000
Arduino Nano	5	1	#104,000	#104,000	50	4	₦416,000
Difference			₦6500	₦338500			₦4,509,000

6. CONCLUSION AND FUTURE WORK

Nigeria has been facing diverse challenges in recent time, ranging from security, political and others. The political and some other form of these challenges seem to have been gradually addressed but efforts have proven to be abortive when it comes to that of security due to persistent rise in crime rate in Nigeria. The reasons may be attributed to unemployment, poverty, religious and political crises and others. This security challenge includes robbery, raping, kidnapping and others. Currently, kidnapping in Nigeria which tops the list has now become a major problem today. Several approaches have been used to address the kidnapping challenge; one is the inclusion of the use Joint Task Force, political solution, and religious approach by the Federal Government. In addition, Scholars have come up with several vital ideas; for example the use of wearable devices.

However, these ideas have not yielded significant result. Some reasons attributed to this include lack of good technology to capture the scene of event to identify the kidnappers and fetch out these culprits. Others are due to cost and negative effects on health by these wearable devices and unavailability of good Cloud Infrastructure. To resolve this issue, a cloud based anti-kidnapping device is proposed in this research. This device is based on Arduino Nano Microcontroller and other peripherals as the building blocks which help in **gathering, sharing and monitoring in the context of kidnapping in Nigeria.** The prototype demonstration of this work was carried out in Adekunle Ajasin University that provided the internet facilities. The technology was able to capture all scenes of events within 30-meter radius of kidnapping operation. These results were evaluated with the known current technology using Image and cost. The captured events produced a better audio-video and face detection images during the day and night than the current technology. The audio, video and the face detection were recorded in the cloud for forensic investigation. In addition cost analysis shows that the proposed technology is better that of the wearable technology with cost oratio of 1:5 and 1:12 in car and a bus respectively. It must be stated that issue like energy sustainability, internet availability, forensic investigation, and user awareness were left for future discussions.

REFERENCES

[1] J. Chidi, "Kidnapping in Nigeria : An Emerging Social Crime and the Implications for the Labour Market," vol. 4, no. 1, pp. 133–145, 2014.
[2] U. E. Inyang, D. J. & Abraham, "The social problem of kidnapping and its implications on the socio-economic development of Nigeria: A study of Uyo metropolis.," *Mediterr. J. Soc. Sci.*, vol. 4, no. (6), p. 531–544.
[3] S. E. Otu and M. U. Nnam, "Does theory matters: Constructing an integrated theoretical framework to describe kidnapping for ransom in Nigeria," *Aggress. Violent Behav.*, vol. 40, no. February, pp. 29–38, 2018.
[4] O. C. Akinyokun, K. G. Akintola, G. B. Iwasokun, C. O. Angaye, and S. A. Arekete, "Design of a framework for combating human trafficking and kidnapping using smart objects and," vol. 7, no. 1, pp. 45–52, 2018.
[5] G. E. Ordu, "Kidnapping, Security Challenges and Obstacles to the Control of Hostage Taking in Nigeria," pp. 0–12, 2017.
[6] B. Dar, B. Ibrahim, and J. I. Mukhtar, "An Analysis of the Causes and Consequences of Kidnapping in Nigeria," *Int. MULTI-DISCIPLINARY J.*, vol. 11, no. 48, pp. 134–143, 2017.
[7] M. K. Noor-Mohamed, "The definitional ambiguities of kidnapping and abduction, and its categorisation: The case for a more inclusive typology.," *Howard J. Crim. Justice*, vol. 53, no. 1, pp. 83–100, 2014.
[8] V. O. Matthews, S. Osafehinti, E. Adetiba, D. Ike, and S. N. John, "A Covert Kidnapping Alert and Location Identifier (CKALI)," pp. 162–166, 2013.
[9] "Nigeria as kidnap capital," *Newspaper, The Punch*.
[10] J. Hazen, J. M. & Horner, "Small arms, armed violence, and insecurity in Nigeria: The Niger Delta in perspective. Geneva: Small Arms Survey," 2007.
[11] "Mapping efforts against armed violence in Nigeria. Interim Report by the AOAV and National Working Group on Armed Violence (NWGAM).," *Action on Armed Violence*, 2013.
[12] PremiumTimes, "Police arrest three men for alleged kidnapping, killing 5-year-old boy," *PREMIUM TIMES Special Publications On Nigeria Democracy @ 20*, Nigeria, 12-Jul-2019.
[13] S. Folarin, "Abducted post-UTME candidate recounts ordeal in herdsmen's den," *Punch Newspaper*, 01-Aug-2019.
[14] O. S. Abdulkabir, "Causes and Incisive Solutions to the Widespread of Kidnapping in Nigeria Current Administration: Under Scho- lastic Scrutiny," *J. Polit. Sci. Public Aff.*, vol. 5, p. 258, 2017.
[15] Sameer Darekar, "'Tracking System Using GPS and GSM: Practical Approach,'" *Int. J. Sci. Eng. Res.*, vol. 3, no. 5, pp. 1–4, 2012.
[16] A. Alamri, W. S. Ansari, M. M. Hassan, M. S. Hossain, A. Alelaiwi, and M. A. Hossain, "A Survey on Sensor-Cloud : Architecture , Applications , and Approaches," vol. 2013, 2013.
[17] R. R. Sujitha, "CHILD KIDNAP PROTECTION USING RFID AND GSM TECHNOLOGY."
[18] R. Pavithra and M. S. Devi, "Design and Implementation of a Rescue System for the Safety of Women by using Arduino Controller," *Int. J. Adv. Res. Ideas Innov. Technol.*, vol. 4, no. 2, pp. 329–333, 2018.
[19] M. Kassim, S. H. Salih, and S. Shahbudin, "Adaptive distance alert safety system (adass) on child tracking using arduino," vol. 11, no. 23, pp. 14014–14020, 2016.

[20] V. R. Pandikumar S, "Internet of Things Based Architecture of Web and Smart Home Interface Using GSM," *Int. J. Innov. Res. Sci. Eng. Technol.*, vol. 3, no. 3, 2014.
[21] F. Z. Maksood, M. Saif, and A. Yarubi, "Prototype for a Personal Safety Gadget using Arduino Uno Prototype for a Personal Safety Gadget using Arduino Uno," no. November 2015, 2016.
[22] A. J. V Neto, Z. Zhao, J. J. P. C. Rodrigues, S. Member, H. B. Camboim, and T. Braun, "Fog-Based Crime-Assistance in Smart IoT Transportation System," *IEEE Access*, vol. 6, pp. 11101–11111, 2018.
[23] S. Corbellini, E. Di Francia, S. Grassini, L. Iannucci, L. Lombardo, and M. Parvis, "Cloud based sensor network for environmental monitoring," *Measurement*, vol. 118, no. September 2017, pp. 354–361, 2018.
[24] K. K. Pate and S. M. Patel, "Internet of Things-IOT : Definition , Characteristics , Architecture , Enabling Technologies , Application & Future Challenges," *Int. J. Eng. Sci. Comput.*, vol. 6, no. 5, 2016.