NCC FUNDED
RESEARCH PROJECTS

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA

NIGERIAN COMMUNICATIONS COMMISSION

May 2018

Executive Summary

Information about NCC funded projects to be submitted here today are hereby presented in this document. In the next section, you will read about the approaches and processes developed for MOES card and this will be followed by short introduction to the development of Mobile Communication Enabled Walking Stick. This document also provides information about areas of application of the approach developed from these two funded projects, hence, you will see user's manual of some of the products developed by applying the results from these projects.

Hence, going through this document will afford you the opportunity of knowing what we have done and achieved from these two projects. You will observe that we have presented our achievements and methodologies in a narrative form without too much technical details as necessary technical contributions have published in appropriate quarters and some are well documented in thesis submitted by some of the research students that were trained from these projects.

We thank and appreciate NCC for funding these research projects.

NCC Funded Research Projects

2016

Fabrication of GSM Communication Based Walking Cane Robot (GWCR) for Enhancing Ambulation, funded by Nigerian Communications Commission (NCC), **=N=3,096,840**

2015

Seamless Data and Voice Connection Using Multiple Operators Enabled SIM (MOES) card, funded by Nigerian Communications Commission (NCC), **=N=2,961,561.15**

Content

1.0 Our Story

Cognitive Phone and Multiple Operators Enabled SIM (MOES) Cards

The advent of the Global System for Mobile communications (GSM) in Nigeria has revolutionized the country's mobile communication sector. Consequently, the GSM telecommunication industry has recorded tremendous growth since its debut in Nigeria. You will agree with me that mobile communication has become a powerful tool for liberating Nigerians from the shackles of the once powerful, but now extinct, national telecoms monopoly, popularly known as the Nigerian Telecommunication (NITEL). And it has significantly contributed positively in boosting economic activities in all sectors in Nigeria. The technology provided by the currently existing GSM service providers in Nigeria ranges from the progress in the network, from 2G to 3G and to 3.5G today. In addition, because mobile communication has become essential for easing communication, our country has over the years, been flooded with different grades of mobile phones from different manufacturers.

Problem to be Solved

Not quite long ago, we came to the knowledge during our research that, despite the obvious benefits of mobile cellular communication, the increasing poor QoS experienced by subscribers do manifest itself in the forms of: Call failure, call drops, and low received signal strength. These problems have continuously been raising a great deal of worries and uncertainty among the populace and the network providers. In making efforts to solve the problem of poor QoS coupled with the high demand for quality and efficient on-the-go communication capabilities, MNOs have resulted into deployment of mobile cellular network stations in form of Base Transceiver Station (BTS).

But the increase in the number of BTS has not resolved the problems. On the other hand, as subscribers, we have resulted to the use of mobile phones with multiple SIM slots in providing temporary solution to these non-abating problems. Some of us even have more than one mobile phone with the hope of enjoying good QoS using the appropriate SIM or phone where

necessary. In some instances, “porting” of mobile numbers is suggested. “Porting” as used in the community simply means retaining the mobile identity number but changing the network or service provider.

In summary, the problem can simply be solved by asking the following question: how can a subscriber enjoy better mobile communication QoS through seamless transfer of service from one MNO provider to another with little or no disruption to an active communication service?

What We Planned to Achieve

The development of an artificial intelligence based portable device, in form of mobile phones, capable of providing seamless data and voice connections over the existing MNOs, is envisioned as the solution to the QoS-induced problems which are experienced by mobile communication subscribers in Nigeria. The proposed device is expected to provide subscribers with the privilege of enjoying good services from available operators without the added expenses of having more than one phone or a phone with multiple SIM slots. Furthermore, the proposed cognitive phone is expected to guarantee all time access to networks with the best available signal strength and QoS, even while on transit on Nigerian highways and roads.

Our Approach and How Far We have Gone

The seamless data and voice connection involves the development and fabrication of a miniaturised embedded system integrating the existing mobile communication SIM card information and mobile communication hardware with artificial intelligent based MNOs handover software applications. Herewith, I present the evolution of the work till date.

Stage 1

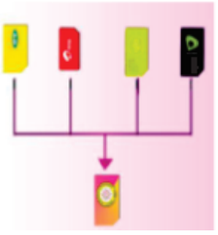
(2013- 2014)

Development of SIM Card Information Extraction Software and Switching Interface System

Stage 2

(2014 – 2017)

Development of Hybrid AI System for Handover in MOES System and Cognitive Phone



Stage 3

(2015 - 2017)

Fabrication of Cognitive Mobile Phone and Evaluation of its Performance

Stage 1. 2013 - 2014:
Development of SIM Card Information Extraction Software and Switching Interface System

The work started from ground zero in 2013 with a team of about twelve researchers comprising eight research fellows and 4 students. Our objectives included: finding a method of extracting appropriate information from SIM card, determining method of categorizing SIM card parameters, and determining relevant pin configuration for SIM Card switching. Let me remind us that SIM is an acronym for Subscriber Identity Module. And SIM is a logical module that runs on an Integrated Circuit Card (ICC) type of smart card called Universal Integrated Circuit Card (UICC). The UICC and the logical application/module running it are commonly referred to as a SIM card. The main purpose of the SIM card is to provide a compact and secure storage of the components required for the GSM/UMTS authentication scheme. This is usually achieved by the authentication and key generation algorithms which make use of the International Mobile Subscriber Identity (IMSI) and the Subscriber Authentication key (Ki). A typical SIM card

with its physical contact interface is as shown in Figure 1

Figure 1: A typical SIM Card

We constructed testbeds and SIM cards with programmable Micro-controller having various Graphical User Interfaces. And we also conducted tests over several months. In our tests, we observed that information contained in a typical SIM card can be categorised into two broad categories namely MNO dependent and MNO independent parameters. Only few of these parameters in the MNO independent cluster are appropriate for MOES work. We also observed that irrespective of the SIM card type and size, the pins' configuration in a SIM always remains the same; however their functions may differ.

From testbed experiments conducted, it was identified that switching from one SIM card to another can be best achieved by switching the clock pin of the SIM card. This produces better results than the use of Vcc pin (C1) and the Input/Output pin (C7). In addition to received signal strength, Channel availability and GPS coordinate can be used for handover criteria in the proposed cognitive phone. This forms the basis of our subsequent research and endeavour in this field.

Stage 2. 2014 - 2017
Development of Hybrid AI System for Handover in MOES System and Cognitive Phone

Handover (also known as Handoff) refers to the process of transferring the point of attachment of mobile phone to the network, from a BTS to another BTS. This occurs as the mobile station moves from the region of coverage of the initial BTS to the coverage region of the target BTS. The process is expected to be seamless, thus ensuring that any ongoing mobile activity is not dropped, and we the users do not experience poor QoS.

In developing this algorithm, we made use of our knowledge of parametric signal modeling. We adopted the use of a two-stage approach with the first stage involving the development of mathematical steps, which in turn involved the k _ step ahead ANN based prediction algorithm. The second stage involved the development of Fuzzy logic based Handover decision making algorithm. The block diagram is as shown in Figure 2

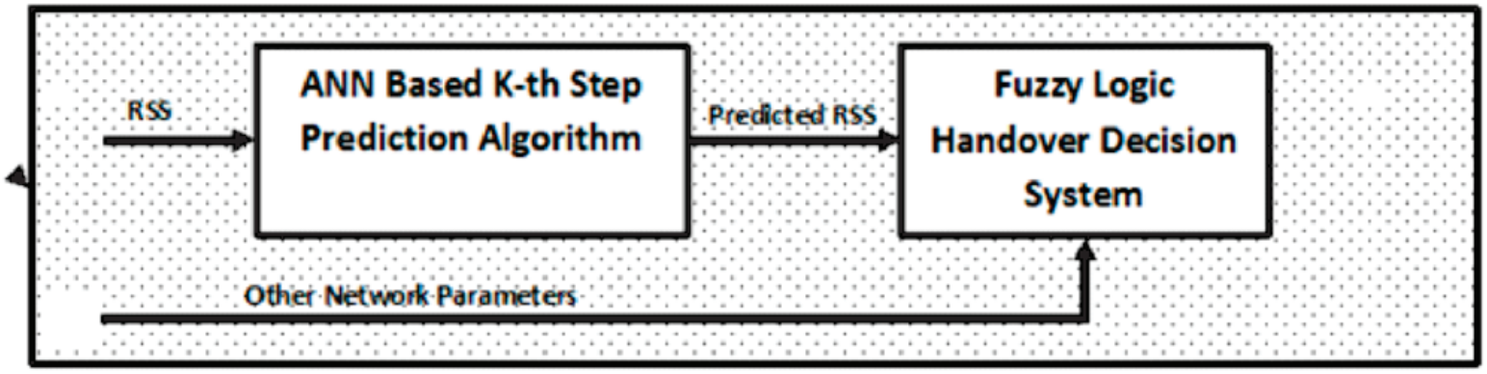


Figure 2: The block diagram of the proposed Hybrid AI based Handover Decision Algorithm

The k _ step ahead ANN based RSS prediction model coefficients are estimated from the synaptic weights. They are also estimated with the coefficients of the adaptive activation function of a properly trained two-layer ANN. The extracted coefficients were used to form a matrix from which appropriate prediction level can be easily obtained via simple matrix multiplication.

Similarly, for the second stage, the developed Fuzzy logic based handover decision algorithm consists of three different stages, namely Fuzzification stage, Fuzzy inference stage and Defuzzification stage. It is from here that the handover decisions are being taken. Details from this work have been published and are freely available online.

Stage 3. 2015 - Till Date

Fabrication of Cognitive Mobile Phone and Evaluation of Its Performance

Since 2015, we have been working tirelessly in fabricating laboratory scale model of this work. We produced our first MOES card in 2015 and evolving over time, we are presently in version 4 of the work. Table 1 shows the evolution and capabilities of each model over the other while Figure 2 shows the MOES card system.

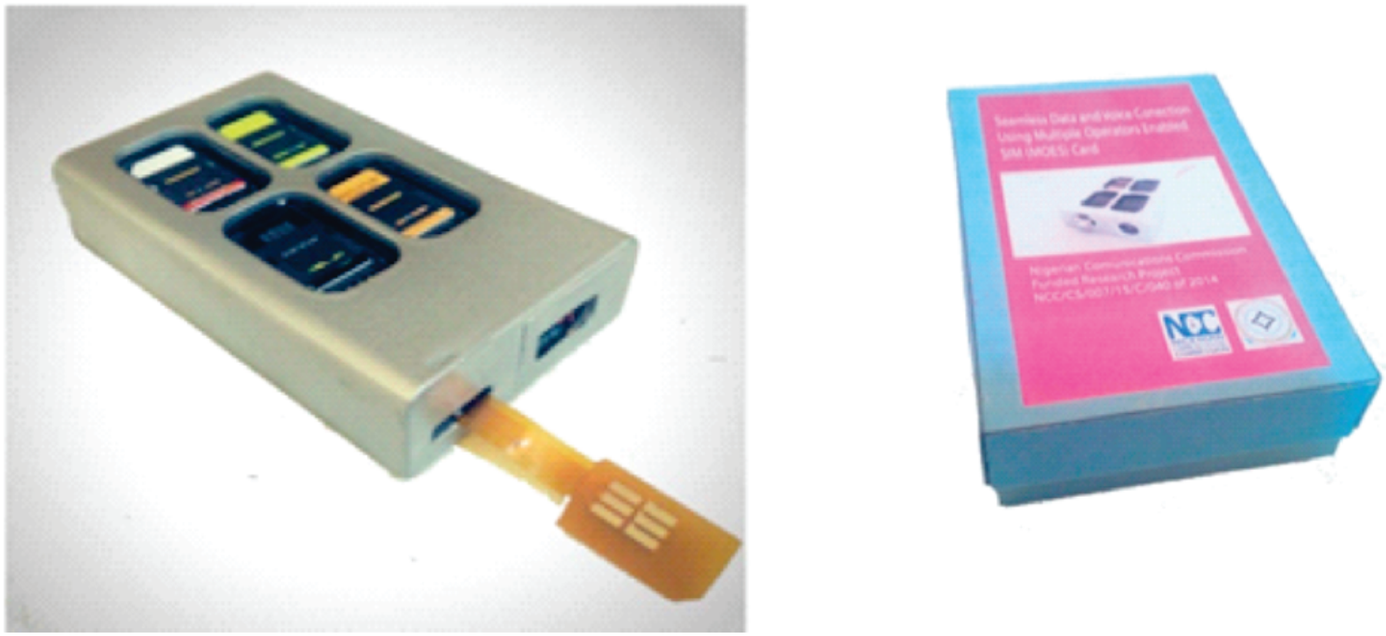


Figure 2: MOES Card System

Table 1: MOES Card Evolution

No	Characteristics	MOES PCB VERSION 1	MOES PCB VERSION 2	MOES PCB VERSION 3	MOES PCB VERSION 4
1	No of SIM	4	4	4	4
2	SIM Type	Macro	Macro	Macro	Mini
3	Board Size	91.44mm x 49.2mm	114.3mm x 49.2mm	110mm x 49.2mm	47mm x 31mm
4	No of Layers	Single Layer	Double	Double	Double
5	On board Microcontroller	No	Yes	Yes	Yes
6	On board Driver circuit type	No	IC 4066	TS3A1459A	TS3A1459A
7	Interface type	Wired	Wired	Wired	Wireless (Bluetooth)
8	DIO Capability	No	No	Yes	Yes
9	AIO Capability	No	No	No	Yes
10	Programming Capability	No	No	No	Yes

In addition, we have applied the concepts from this work successfully to the design and development of Emergency Phone booth system and Tracking system. I am happy to inform us all that the laboratory models of these two designs have been produced and are presently being optimised for production of market ready prototype.

Research Funding, Supervision and Awards

We could not have gone this far without financial funding from the Nigerian Communications Commission (NCC), under research funding NCC/CS/007/15/C/040 of 2014. Similarly, in 2017, we exhibited this research work at the Federal University of Technology, Minna 26th Convocation Research and Development (R&D) Exhibition in 2017 and were given the best research award. I am also pleased to inform us that till date, the work has been used to train over 16 students in Nigeria at both undergraduate and post graduate levels. With some of the findings, we shall soon be completing the patent filing of this work.

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Mutolib H., Aibinu A. M.,Adedigba A.P, Folorunso T. A., Salami, M. J.E., & Onwuka E. N. (2017). Realization of Low Cost GSM Signal Booster for Communication Industry.. Accepted for publication at 2017 13th International Conference on Electronics, Computer and Computation (pp. 1-5). 28th-29th Nov. 2017.

Handover in Communication System, Class note, 2016, available online at www.aibinu.com.ng, prepared by AEIRG FUT Minna, Nigeria

2.0

ABOUT FEDERAL UNIVERSITY OF TECHNOLOGY (FUT), MINNA AND NIGERIAN COMMUNICATIONS COMMISSION (NCC)

About FUT Minna

Federal University of Technology, Minna as a specialized university is committed to the training of skilled and innovative work-force that would transform Nigeria's natural resources into goods and services, driven by entrepreneurship, and information and communication technology (ICT), to positively affect the economy and thus the quality of life of her people.

The University strives to become a **world class** and **Nigeria's leading university** recognized for its excellence in capacity building and service delivery.

About NIGERIAN COMMUNICATIONS COMMISSION

The Nigerian Communications Commission is the independent National Regulatory Authority for the telecommunications industry in Nigeria. The Commission is responsible for creating an enabling environment for competition among operators in the industry as well as ensuring the provision of qualitative and efficient telecommunications services throughout the country.

My Vision - NCC's EVC

Prof. Umar Danbatta's Vision and 8-Point Agenda

To take the telecommunications industry to new heights by undertaking constructive engagements with key stakeholders whose activities are quite capable of sustaining growth and promoting an industry that is primed to play a positively determinant role in making Nigeria a connected country.

My 8-Point Agenda

1. Facilitate Broadband Penetration
2. Improve Quality of Service
3. Optimize Usage and Benefits of Spectrum
4. Promote ICT Innovation and Investment Opportunities
5. Facilitate Strategic Collaboration and Partnership
6. Protect and Empower Consumers
7. Promote Fair Competition and Inclusive growth
8. Ensure Regulatory Excellence and Operational Efficiency.

SOURCE: OKOH AIHE: BEYOND TELECOMS REGULATION, DANBATTA AS A DIPLOMAT?

Our Interest

FUT Minna is interested in contributing to the EVC'S vision and agenda in the following areas:

CONSTRUCTIVE ENGAGEMENTS WITH KEY STAKEHOLDERS WHOSE ACTIVITIES ARE QUITE CAPABLE OF SUSTAINING GROWTH

1. Improve Quality of Service
2. Promote ICT Innovation and Investment Opportunities
3. Facilitate Strategic Collaboration and Partnership

SOURCE: OKOH AIHE: BEYOND TELECOMS REGULATION, DANBATTA AS A DIPLOMAT?

NCC Funded Research Projects

These two projects headed by **Prof. Abiodun Musa Aibinu** are among NCC funded projects at FUT Minna

2016

Fabrication of GSM Communication Based Walking Cane Robot (GWCR) for Enhancing Ambulation, funded by Nigerian Communications Commission (NCC), **=N=3,096,840**

2015

Seamless Data and Voice Connection Using Multiple Operators Enabled SIM (MOES) card, funded by Nigerian Communications Commission (NCC), **=N=2,961,561.15**

Summary of our Achievements

From these two funded research projects, we have been able to achieve the following:

No.	Description	Quantity	Explanation
1.	Products/Hardware	5	Development of 5 different market ready products
2.	Software	3	Number of software developed while executing the projects
3.	Publications	6	Contribution to knowledge through publication in conference proceedings and high impact journal
4.	Manpower Development	16	Number of manpower trained from the projects aside the lead researchers and academia that participated in the projects.
5.	Patent and Intellectual Property	4	Number of patentable products from the research projects.

3.0

NCC FUNDED RESEARCH

MULTIPLE OPERATORS ENABLED SIM CARD (MOES)

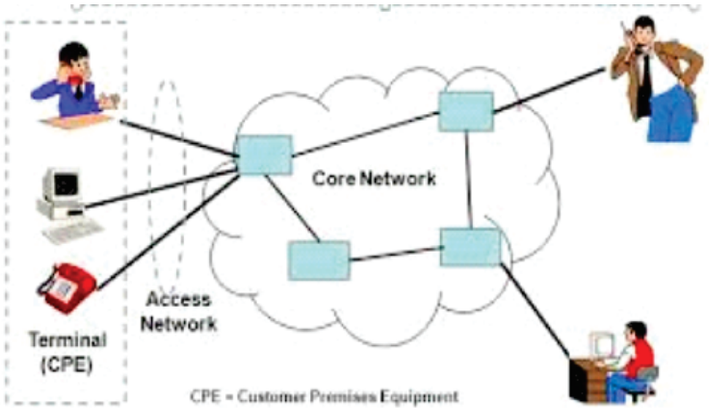
Our Approach

The Problem

The increasing poor QoS experienced by subscribers which manifest itself in the forms of Call failure, call drops, and low received signal strength.

The use of mobile phones with multiple SIM slots in providing temporary solution to these non-abating problems.

Our Thinking



What make up a Network?

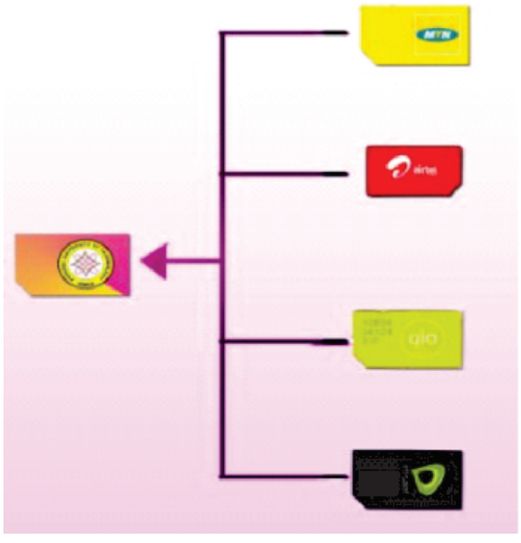
What make up a Mobile Phone?

We believe that by developing a system that can integrate Artificial Intelligence (AI) and embedded system, we can provide solution to the aforementioned problems on either the access network in a mobile network aarchitecture or on the mobile phone architecture itself.

What We Intend to Achieve

The development of an AI based portable device, in form of mobile phones, capable of providing seamless data and voice connections over the existing MNOs

The proposed device is expected to provide subscribers with the privilege of enjoying good services from available operators without the added expenses of having more than one phone or a phone with multiple SIM slots.



The proposed cognitive phone is expected to guarantee all time access to networks with the best available signal strength and QoS, even while on transit on Nigerian highways and roads.

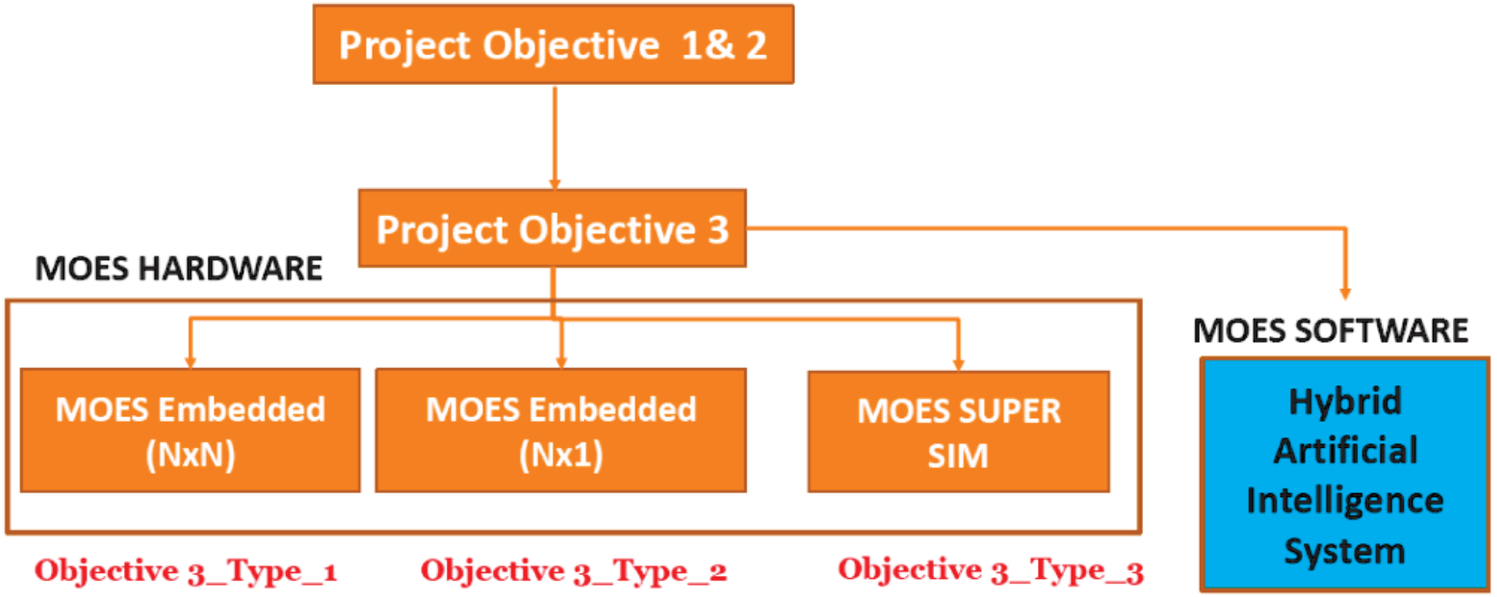
Research Expected Deliverables

Objectives	Statement of the Objectives
Objective One	Develop Software to Identify SIM Information Extraction Technique
Objective Two	Develop SIM Information Extraction Technique
Objective Three	Develop Hybrid MOES, Fabricate Prototype, Test and Evaluate Its Performance
Stage Four	Present One of the Twin Prototype to NCC

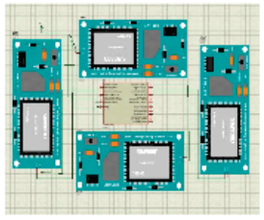
Our Deliverables

Objectives	Statement of the Objectives
Objective One	Software Development Completed. SIM Information Extraction Completed.
Objective Two	New Method of SIM Card Forensic has been developed and a commercially viable product fabricated.
Objective Three	The fabricated E-MOES Systems have been tested, exhibited and applied in the development of various commercially viable products, such as: 1. Development of Multiple Operators Emergency Calling System. 2. Vehicle Tracking using Multiple Operator Enable System.
Stage Four	Tested Prototype to be delivered to NCC on May 21, 2018.

How We Achieved Our Objectives



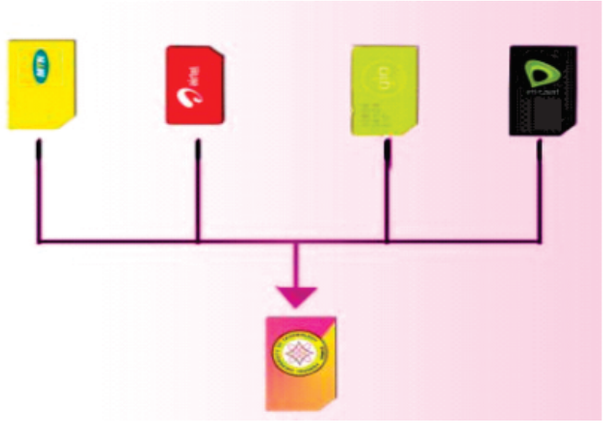
Where We Are



Steps	Description of Activities	Status
Task -1	Extensive study of SIM, USIM, ESIM: pin out; architecture; config& timing fig.	Completed
Task-2	SIM Extraction S/W & Preliminary E-MOES circuit design, simulation and 3D	Completed
Task-3	Components and Equipment ordering.	Completed
Task-4	Design and Development of 1-Mobile Network E-MOES Lab Scale model	Completed
Task-5	Setting up of Mobile Network Simulator Environment	Completed
Task-6	Extensive Testing of the Developed 1-M Network E-MOES Lab Scale model	Completed
Task-7	Design and Development of N-Mobile Network E-MOES Lab Scale Model	Completed
Task-8	Extensive Testing of the Developed N-M Network E-MOES Lab Scale model	Completed
Task-9	Development of Mobile apps and Graphical User Interface for Testing	Completed
Task-10	Integration of Developed GUI with the E-MOES platform	Completed
Task-11	Testing of the GUI and E-MOES models	Completed
Task-12	Printed Circuit Board Design and fabrication for the Lab scale model	Completed
Task-13	3D Casing Design and Fabrication of the Lab scale model	Completed
Task-14	System Integration and testing	Completed
Task-15	Performance analysis of the Lab scale model	Completed

Where We Are

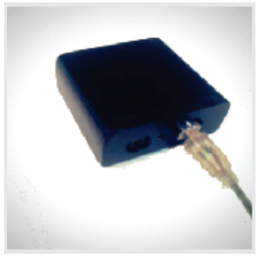
Tasks	Description of Activities	Status
Task-1	Extensive Study of SIM card, UICC and ISO7806; Extraction techniques, Parameters and configuration of SIM, ESIM and USIM	Completed
Task-2	Preliminary Design and Simulation and selection of necessary design parameters	Completed
Task-3	Components and Equipment ordering	Completed
Task-4	Development and Programing of MOES -SS system	Completed
Task-5	Setting up of Mobile Network Simulator Environment	Completed
Task-6	Development of Mobile apps and Graphical User Interface for Testing MOES-SS	Completed
Task-7	Integration of Developed GUI with the MOES -SS platform	Completed
Task-8	Testing of the GUI and MOES -SS models	Completed
Task-9	System Integration and testing	Completed
Task-10	Performance analysis of the Lab scale model	Completed



Super SIM Model

Summary of Achievements from this Project

Hardware

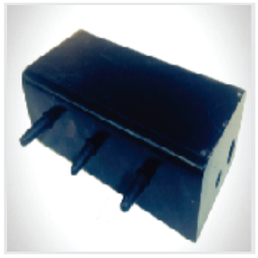


Objective 1 & 2

1. Fabrication of Multiple SIM Cards Reader and Analyzer (MSCR)

Objective 3

2. Fabrication of Multiple Operators Enabled SIM (MOES) card system (3 different types)



3. Tracking System Using MOES Card

4. Fabrication of Emergency Phone Call System MOES Card

Summary of Achievements from this Project

Software

Objective 1 & 2

1. Development of SIM Card Information extraction Software

Objective 3

2. Development of Artificial Neural Network based Autoregressive Model Received Signal Strength Prediction Algorithm.
3. Development of Hybrid Artificial Intelligence Handover Decision Algorithm.
4. Development of Genetic Algorithm based Handover Decision Algorithm.
5. SIM Card Profile Programming Algorithm.

Summary of Achievements from this Project

PUBLICATION


ARTICLE IN PRESS

Engineering Science and Technology, an International Journal xxx (2017) xxx–xxx

Contents lists available at ScienceDirect

Engineering Science and Technology, an International Journal

journal homepage: www.elsevier.com/locate/jestch

Full Length Article

Development of hybrid artificial intelligent based handover decision algorithm

A.M. Alibiu[a,*], A.J. Onumanyi[b], A.P. Adedigba[a], M. Oyeyomi[a], T.A. Fokoumso[a], M.J.E. Salami[c]

Objective 1 & 2

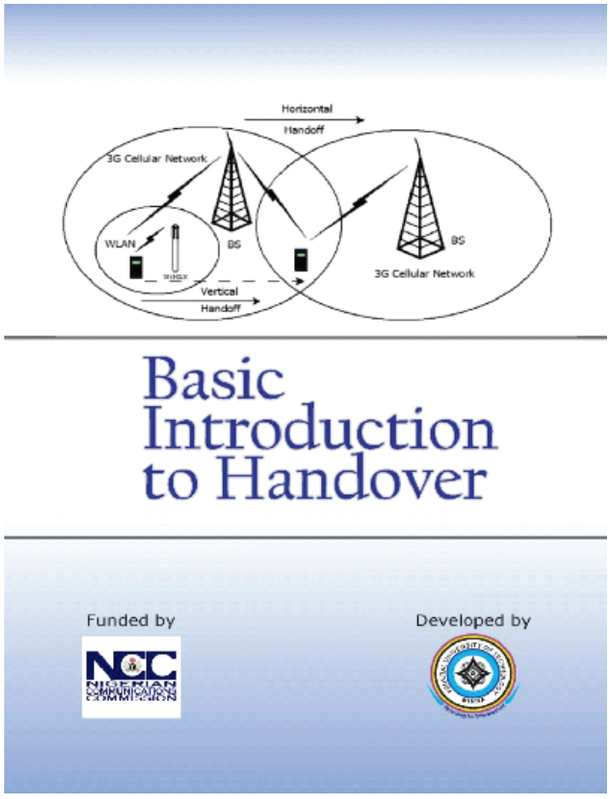
1. Development of Multiple Subscribers Identity Module (SIM) Cards Reader and Analyzer (Acceptance letter is available)

Objective 3

- ✓ Development of Embedded Multiple Operators Enable SIM (E-MOES) Card System for Mobile-Phone Initiated and Executed Handover (Under Review Process in an ISI Rated Journal)
- ✓ Development of Hybrid Artificial Intelligent Based Handover Decision Algorithm (Published in Elsevier Journal)
- ✓ Network Parameter Based Handover Decision Making in Wireless Mobile Communication System: A Review (Under Review Process in an ISI Rated Journal)
- ✓ Development of Multiple Operators Enabled SIM (MOES) Emergency Call System (Under Review Process in an ISI Rated Journal)
- ✓ Realisation of a Low Cost GSM Signal Booster for Communication Industry (Under Review Process in an ISI Rated Journal)
- ✓ Low Cost Antenna Fabrication: Step by Step Approach (Under Review Process in an ISI Rated Journal).

Summary of Achievements from this Project

PUBLICATION (TEXTBOOK)



Objective 1 & 2

- Basic Information to SIM Card (Presently under typesetting process)

Objective 3

- Basic Introduction to Handover
- Basic Introduction to Artificial Intelligence (Presently under typesetting process)

Summary of Achievements from this Project

MANPOWER DEVELOPMENT

Research Outputs: Under Graduate Students

The following under-graduate research projects have been conducted as part of activities towards the realisation of this project:

- ✓ Design and Development of an Emergency Call System
- ✓ Design and Fabrication of a Low GSM Signal Booster
- ✓ Design and Construction of Embedded Multiple Operator Enabled SIM (E-MOES) Card.
- ✓ Realisation of Multiple Operator SIM (MOES) Card Lab Scale Model.
- ✓ Design and Construction of an Operator Selective Interface Circuitry for GSM Modem.
- ✓ Design and Construction of a Mobile Operator SIM Selector Interface.
- ✓ Design and Construction of Multiple Operators GSM SIM
- ✓ Design and Construction of Operator's Selective GSM SIM.

Summary of Achievements from this Project

PATENT AND INTELLECTUAL PROPERTY

Objective 1 & 2

Subscribers Identity Mobile (SIM) Reader

Objective 3

1. Development of Multiple Operators Enabled SIM Card for Seamless Voice and Data Connection.
2. Development of MOES Card
3. Development of Super SIM MOES Card
4. Tracking Device Using MOES Card
5. Multiple Operators based Emergency call System.

Summary of Achievements from this Project

EXHIBITION

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA

P.M.B. 65, Minna, Niger State, Nigeria

Office of the Vice Chancellor

LETTER OF EXHIBITION AWARD

PRO-CHANCELLOR DONATES CASH PRIZE FOR EXHIBITION WINNERS

The Pro-Chancellor and Chairman of Council, of the Federal University of Technology, Minna, Prof. Rufa'i Ahmed Alkali has donated prize monies for the winners of the 26th Convocation Exhibition contest.

The first prize which attracted a cash reward of N50,000.00 went to the Four Sim Card Multiple Operator Enabled Subscriber Identification (MOES) from the Department of Mechatronics Engineering, while the second prize, which attracted a cash reward of N30,000.00 went to the Solar Powered Aquatronics (Auto-Feeder, Auto Water Regulatory) from the Department of Water Resources, Aquaculture and Fisheries Technology and the third prize which attracts a cash reward of N20,000.00 went to the Improved Solar Powered Automobile System from the Department of Mechanical Engineering.

The Exhibition which took place at the Suleimanu Kumo Convocation Square, Main Campus, from 30th January to 1st February, 2017, saw all eight Schools of the University with 115 very innovative products and services on display, which included solar powered refrigerator, multi-

WON BEST OVERALL EXHIBITED PROJECT

FEDERAL UNIVERSITY OF TECHNOLOGY MINNA 26TH CONVOCATION RESEARCH AND INNOVATION EXHIBITION HELD BETWEEN JANUARY 30TH AND 1ST FEBRUARY, 2017.

ALSO EXHIBITED AT

A. **FIRST NIGERIA ARMY RESEARCH AND INNOVATION HELD AT ABUJA FROM APRIL 2ND - 6TH, 2018.**

B. **TRAINING AND DOCTRINE COMMAND RESEARCH EXHIBITION, LOKOJA, APRIL.**

C. **SECOND NIGERIA ARMY RESEARCH AND INNOVATION HELD AT ABUJA FROM APRIL 17TH-20TH, 2018.**

4.0

NCC FUNDED RESEARCH

MOBILE COMMUNICATION ENABLED WALKING STICK

Our Approach

NEW

MOBILE COMMUNICATION ENBALED WALKING STICK (MCEWS)

One of the major reasons identified for increase in number of falls by the aged, senior citizens and people with disability is use of MOBILE Phone

Imbalance sometimes do arise in an attempt to: receive call, initiate phone call, send or read SMS while holding onto the walking stick during a mobile phone call session

Thus leading to increase in fatality experienced by the aged and disabled people

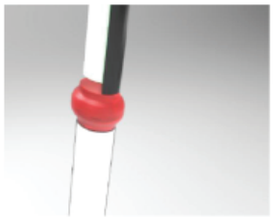
We present a novel solution to solve this problem : The Mobile Communication Enabled Walking Stick (MCEWS)

Our Solution – Mobile Communication Enabled Walking Stick (MCEWS) is made up of:

- Mobile Communication Enabled System
- Fall Detection Algorithm
- Obstacle Detection System
- Phone Call Initiation to Predefined Caregivers or Health Centres
- Real Time Transmission of Vital Signals to Remote Health Workers
- Flash Light
- Bluetooth
- Battery Charging System

Electronic section of MCEWS

+



Seamless Mechanical joint

+

Fall detection Algorithm

+

The angular system with Loudspeaker

+

MCEWS flash light

=

MCEWS at rest

MCEWS in use

If you must walk and talk on phone, then use the Mobile Communication Enabled Walking Stick

5.0 MOES TRACKER

FEDERAL UNIVERSITY OF TECHNOLOGY MINNA, MINNA, NIGER STATE, NIGERIA.

MOES TRACKER APPLICATION

DEVELOPED BY

AEIRG

FUNDED BY

NIGERIAN COMMUNICATIONS COMMISSION (NCC)

MOES TRACKER DOCUMENTATION

Multiple Operators Enabled SIM (MOES) tracker is an advance innovative tracking device that uses the embedded MOES system to track an object. The device to enables wider coverage and increase the security of tracking an asset.

Included in every MOES trackers are:

- A MOES tracking hardware
- A CD containing this documentations and android application.
- A hard copy of this manual.

It is very important that you read this manual before you start using this device in order to enable you get the best from this device.

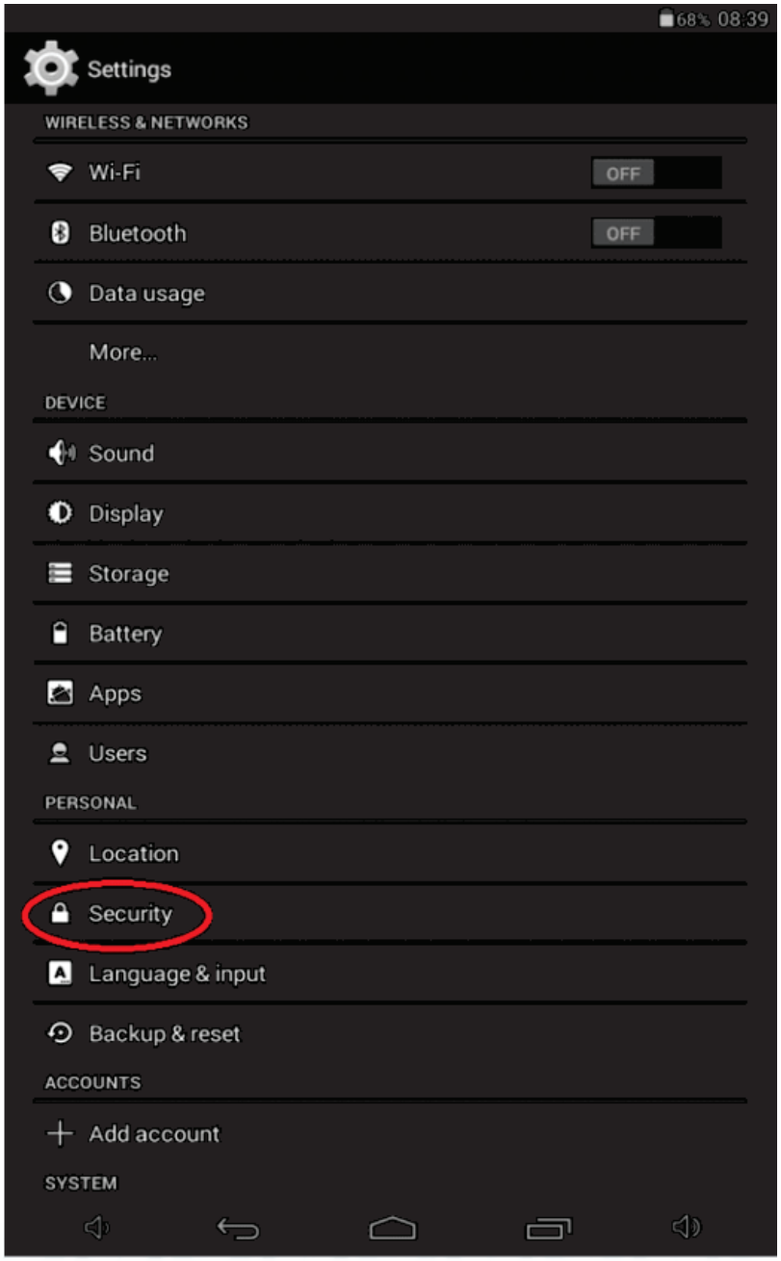
INSTALLATION STEPS

Step 1: Select the menu button on your phone and go in the displayed menus and settings.

When in general settings, then select security.

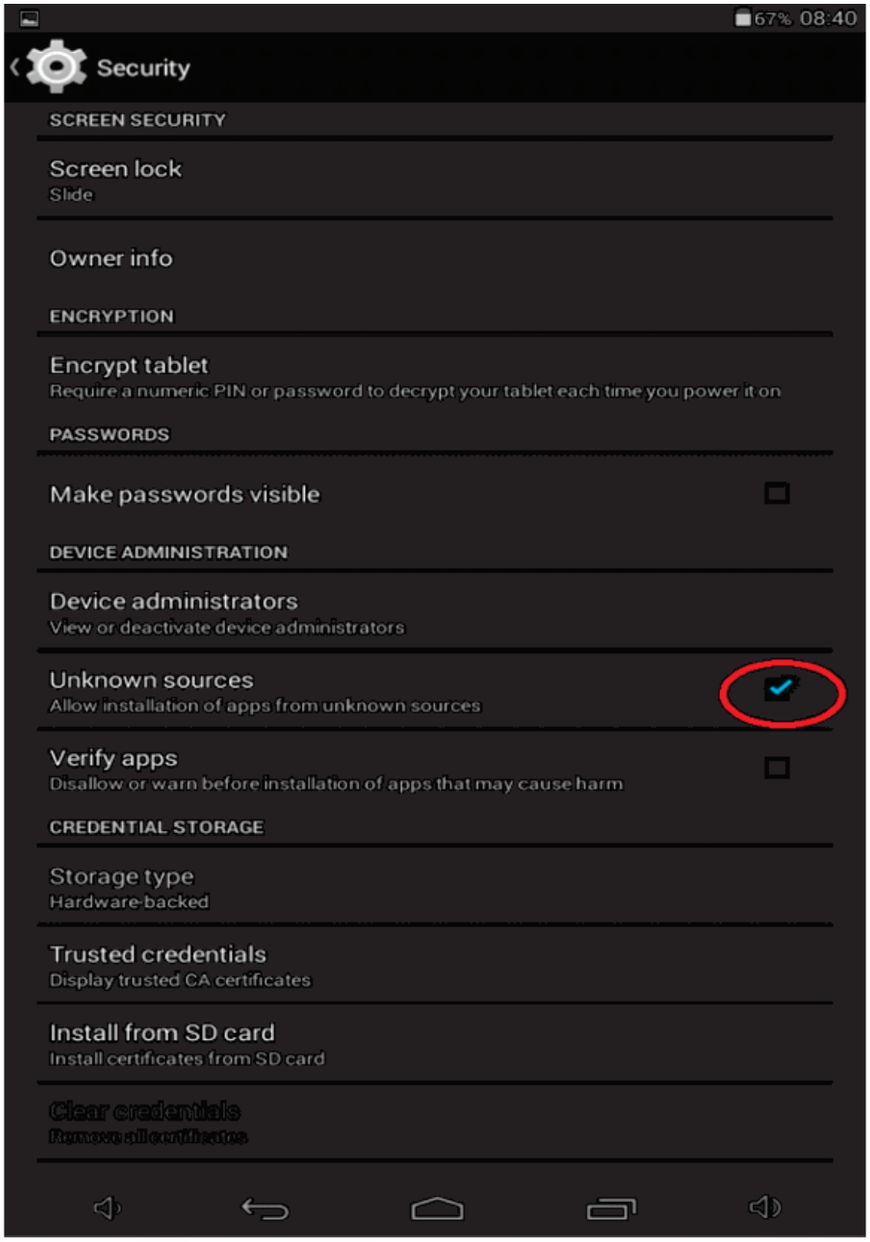
INSTALLATION STEPS

When in general settings, then select security.



INSTALLATION STEPS

Step 2: Select allow installation from unknown sources.



INSTALLATION STEPS

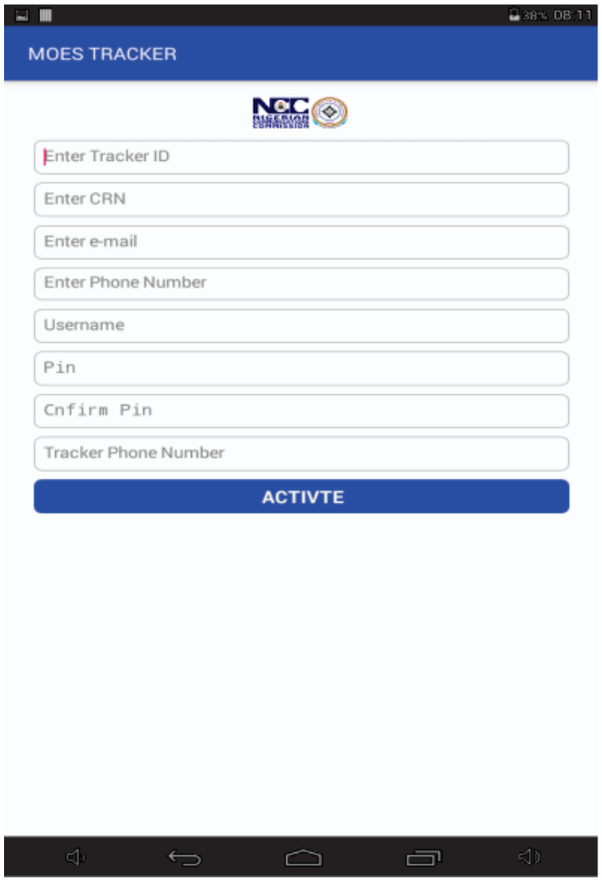
Step 3: Transfer the MOES app to your phone and click to install the app on your phone. The will be as seen below;

INSTALLATION STEPS

The app will show the following on successful installation.

REGISTRATION

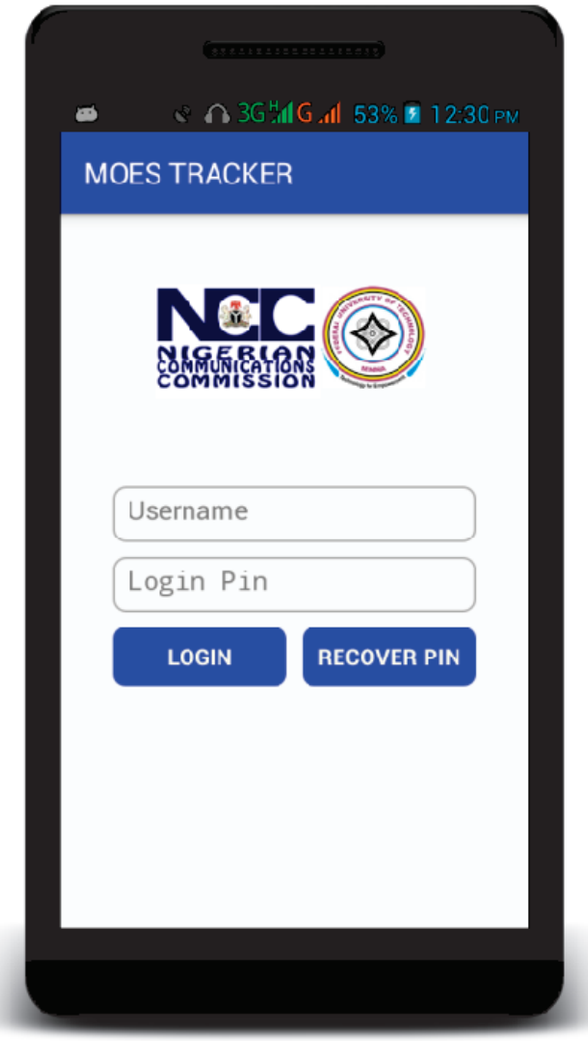
MOES tracking app requires that a onetime registration in other to manage and provide help services to the user of the device. The installation page is only displayed on first time the app is opened or when the app is reinstalled.



Fill the required fields and press activates to get started.

TRACKING A DEVICE

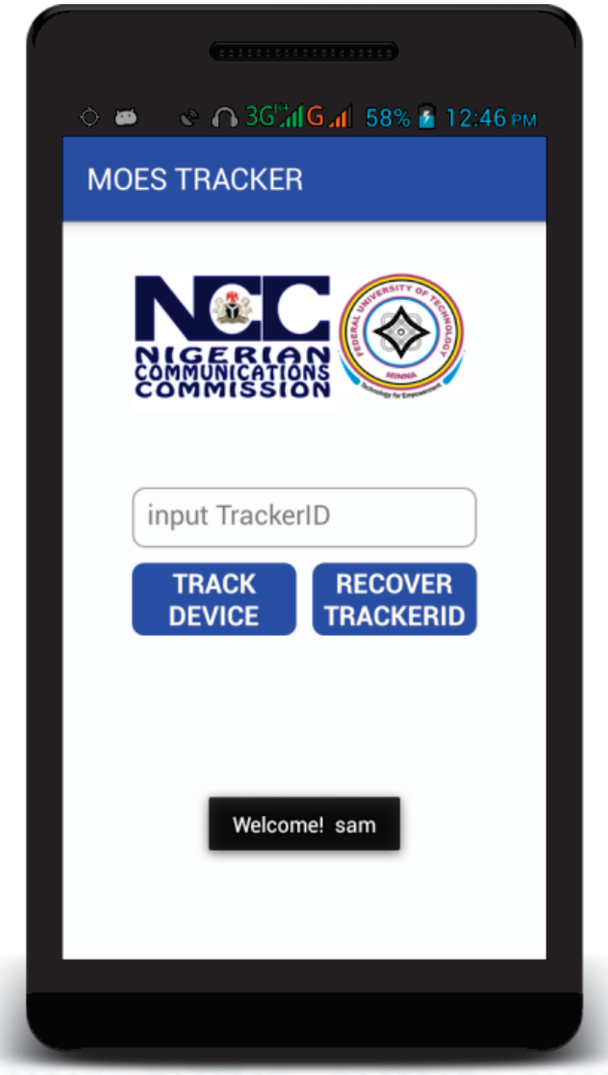
To track the location of your device, login to the MOES tracking app installed on your phone as shown below:



Typed in the username and login pin you created at registration stage.

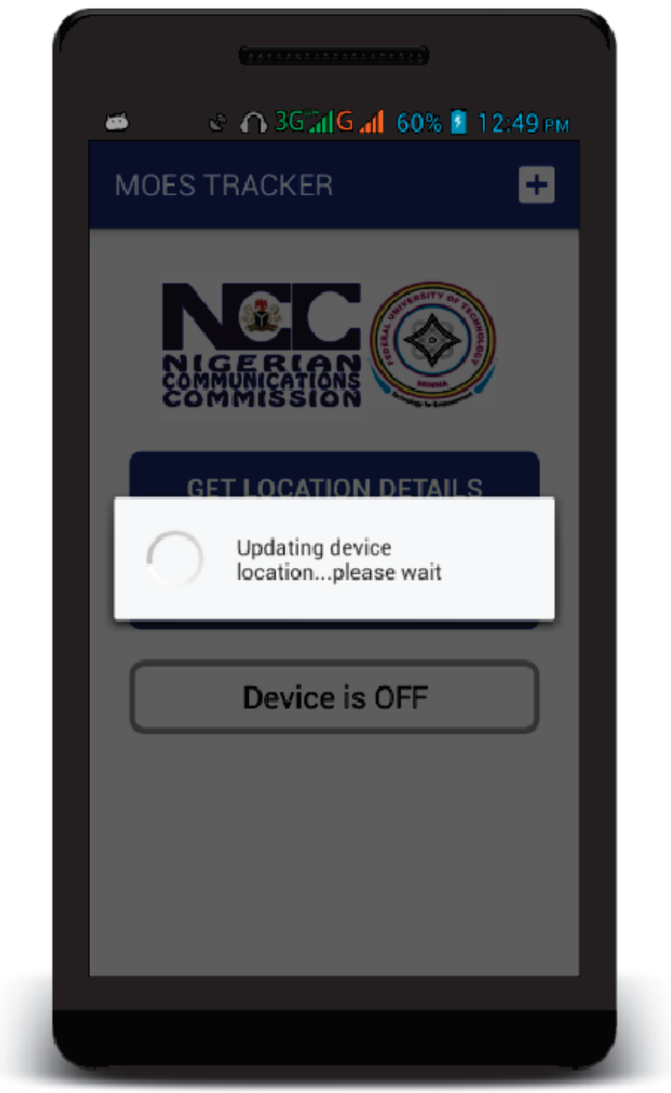
TRACKING A DEVICE

You will see the activity below if login is successful. Now enter the tracker ID for your MOES device and press “TRACK DEVICE” to get the current location of your device. The MOES tracker id looks like SA1234.



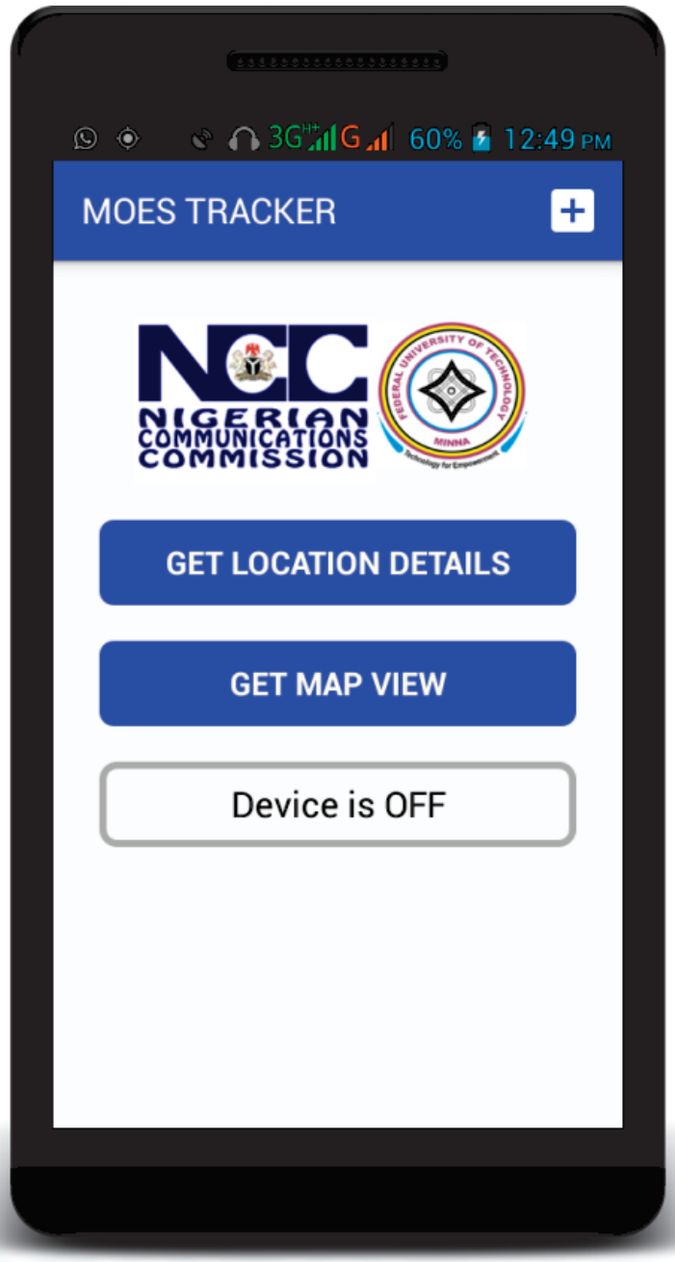
TRACKING A DEVICE

If the provided tracker id is corresponding to the registered devices or any added MOES device, then it will display the progress below showing that app is fetching current device location.



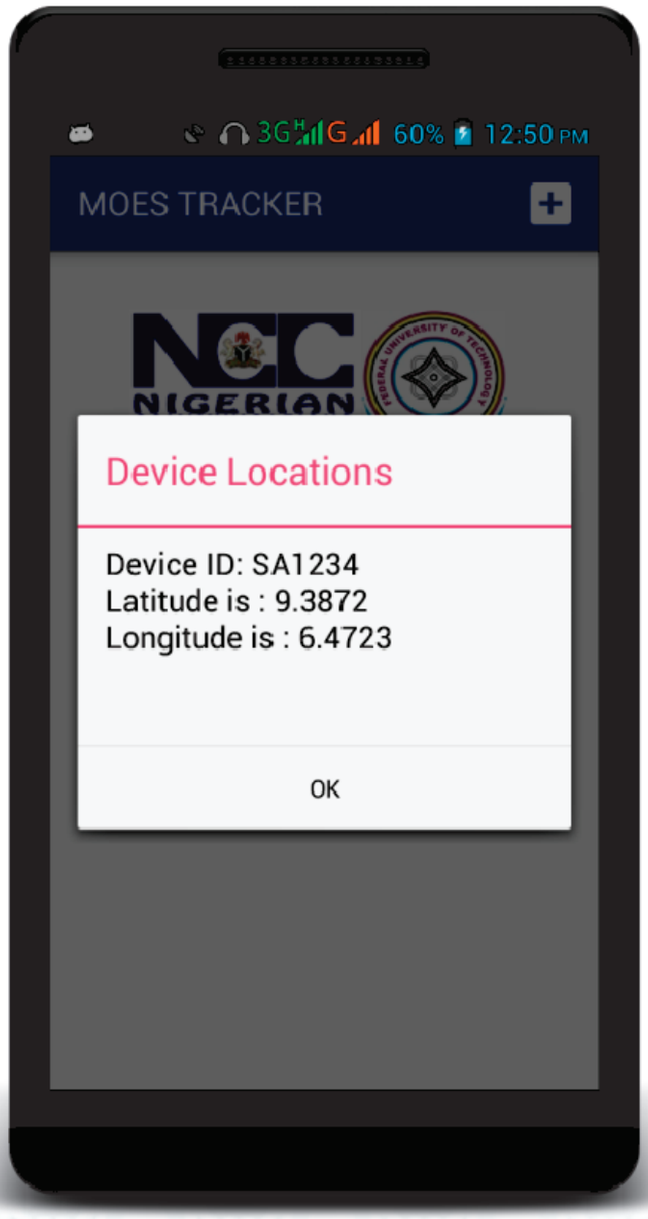
TRACKING A DEVICE

After the progress you will see this home below:



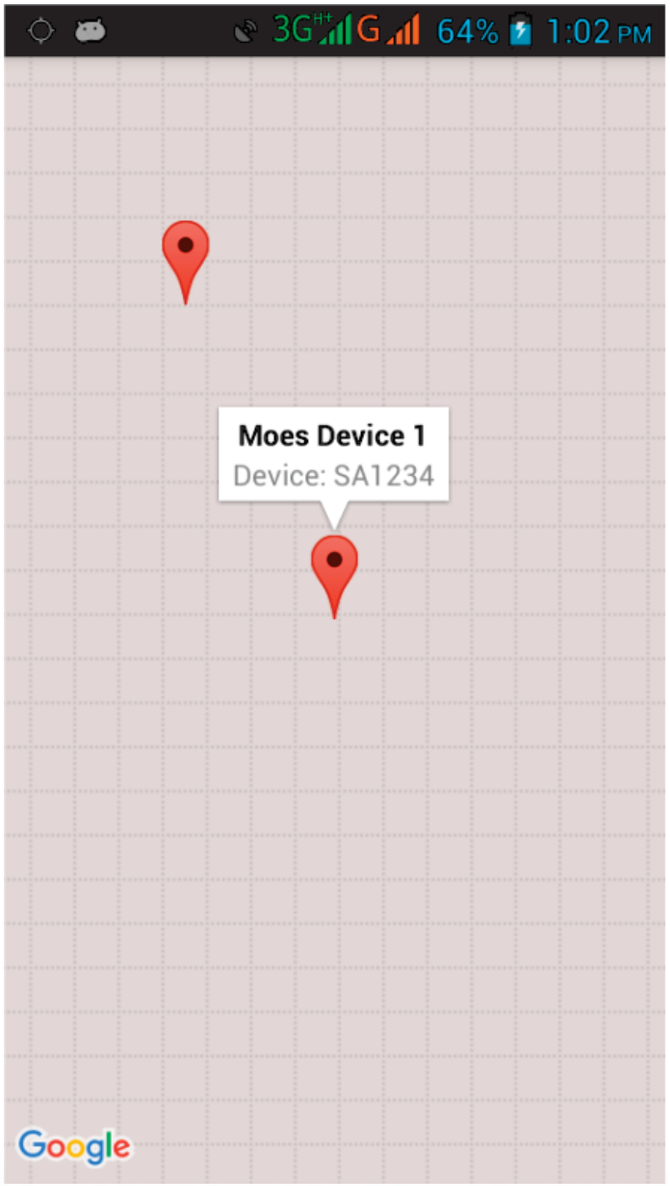
TRACKING A DEVICE

Press the get location details to view device current location as below:



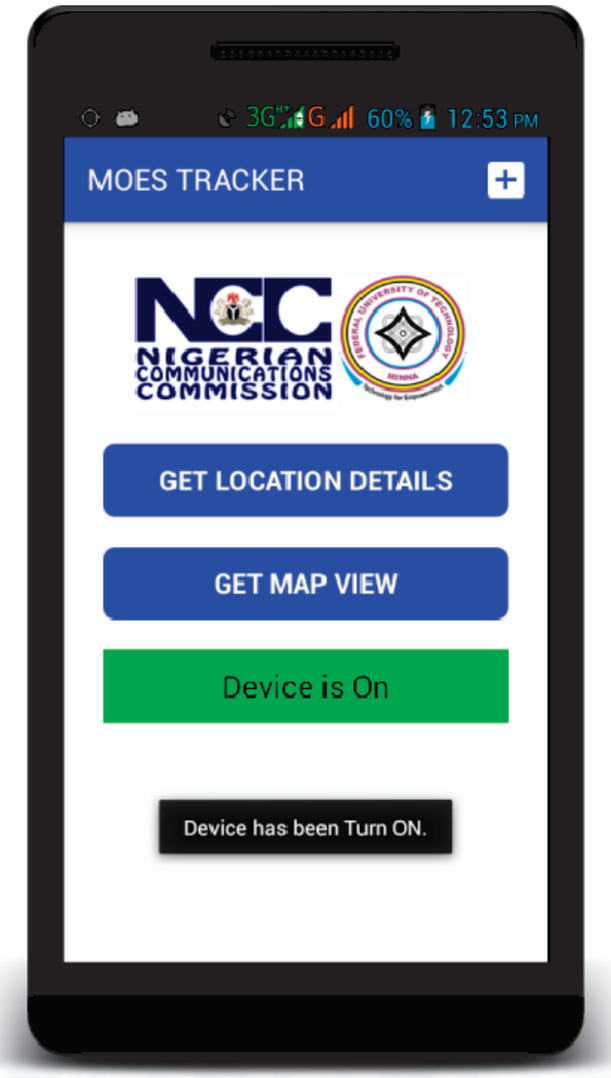
TRACKING A DEVICE

On pressing the get map view you will see a locations populated in google map As below:



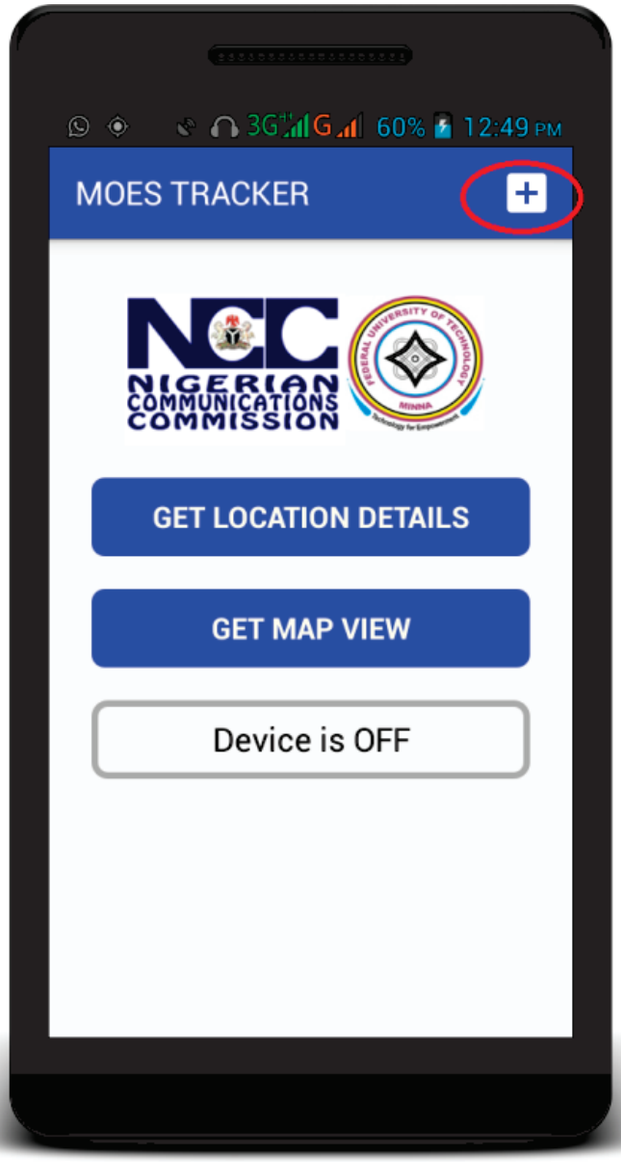
TRACKING A DEVICE

the last button on the home view is the device switch which allow you to take full control of your device. By toggling the OFF and ON you can deactivate your electronic asset from functioning and vice versa. See the image below:



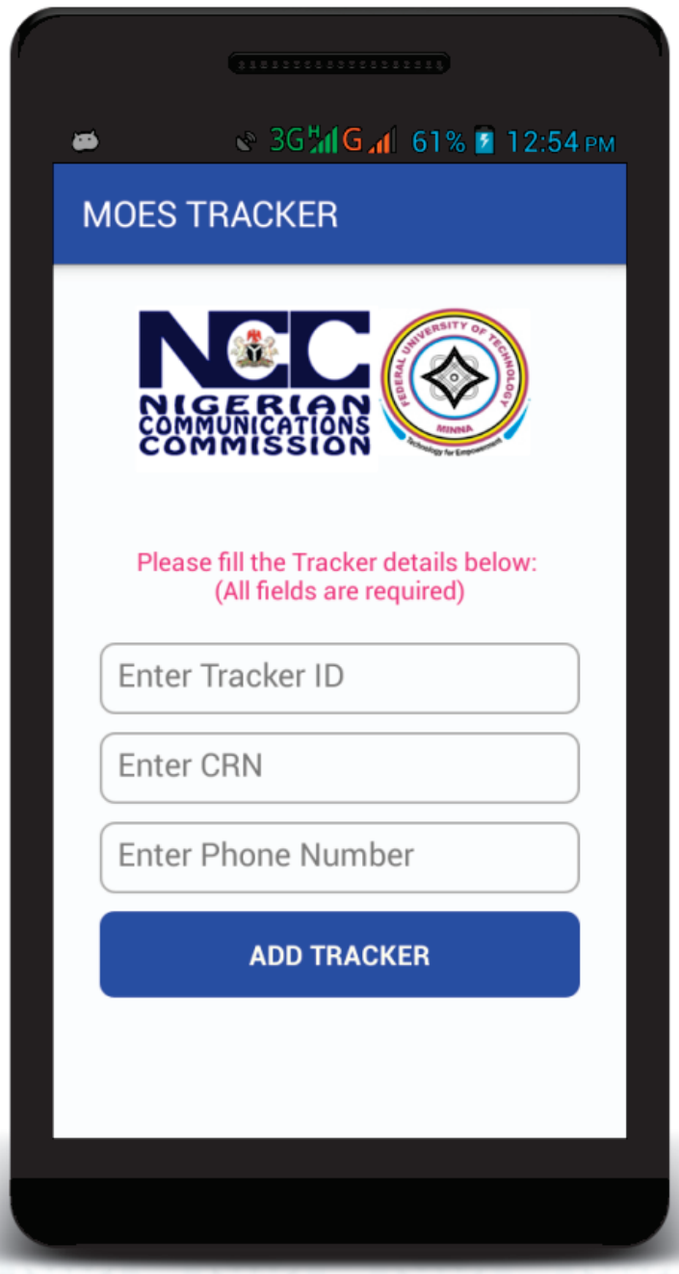
ADDING A NEW MOES DEVICE

To add a new MOES device in case you have more than one assets to track, it is simple just click on the Plus as the right top of the home as shown below:



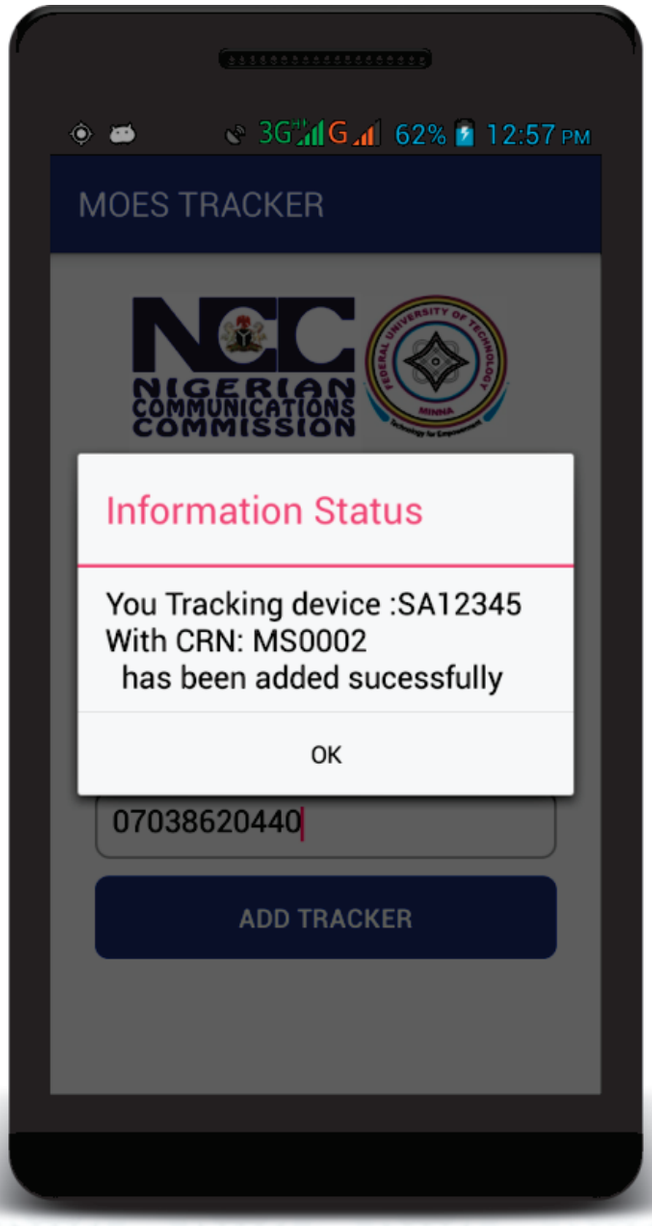
ADDING A NEW MOES DEVICE

Fill the require information as shown below:



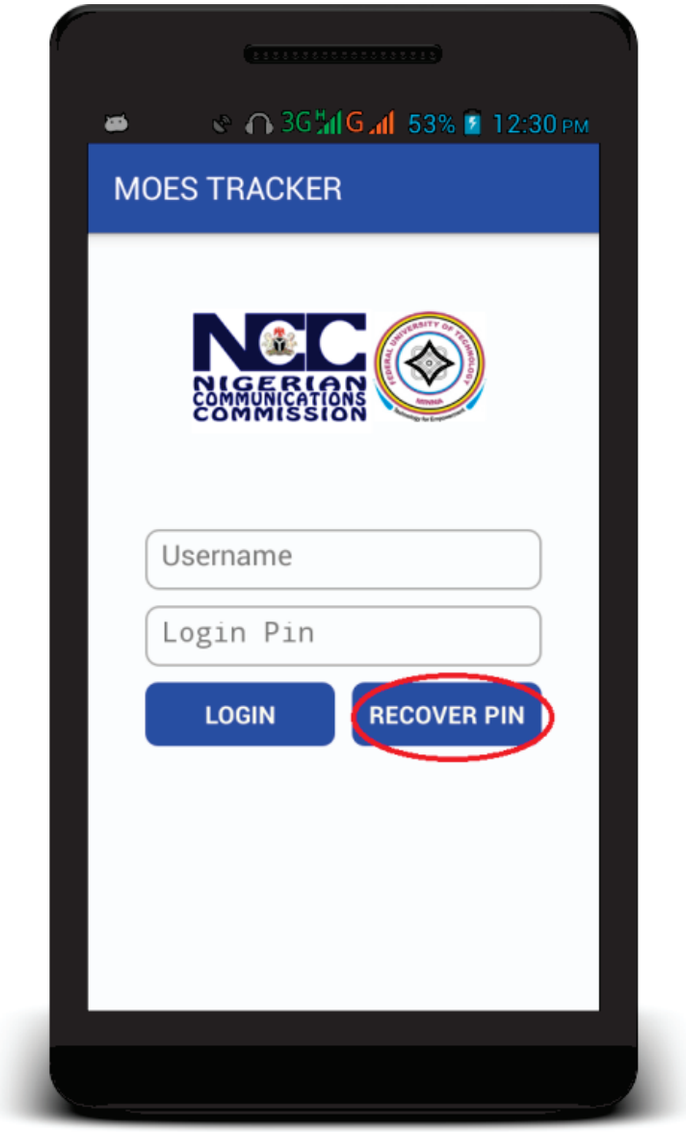
ADDING A NEW MOES DEVICE

Then press add tracker to save your new device. Once it is successful you get the dialog below:



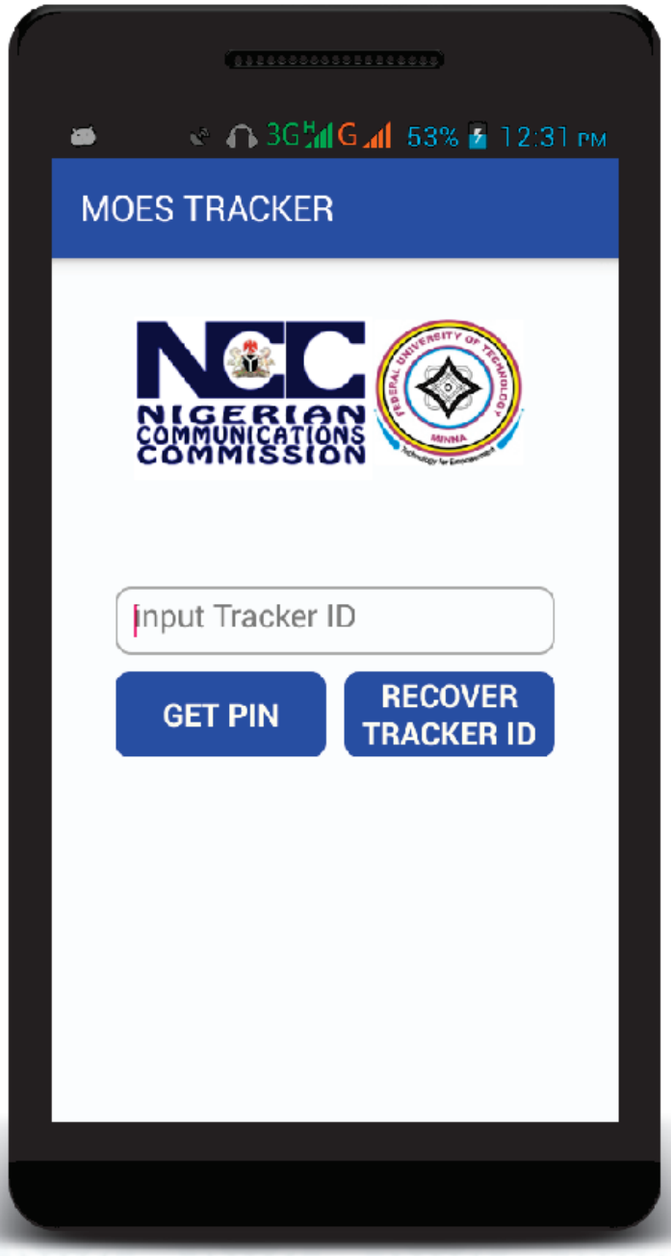
LOGIN PIN RECOVERY

To reset your login pin when forgotten you will need your MOES device tracker id. Once you have your device id then press the recover pin below:



LOGIN PIN RECOVERY

Enter your tracker id as shown below:

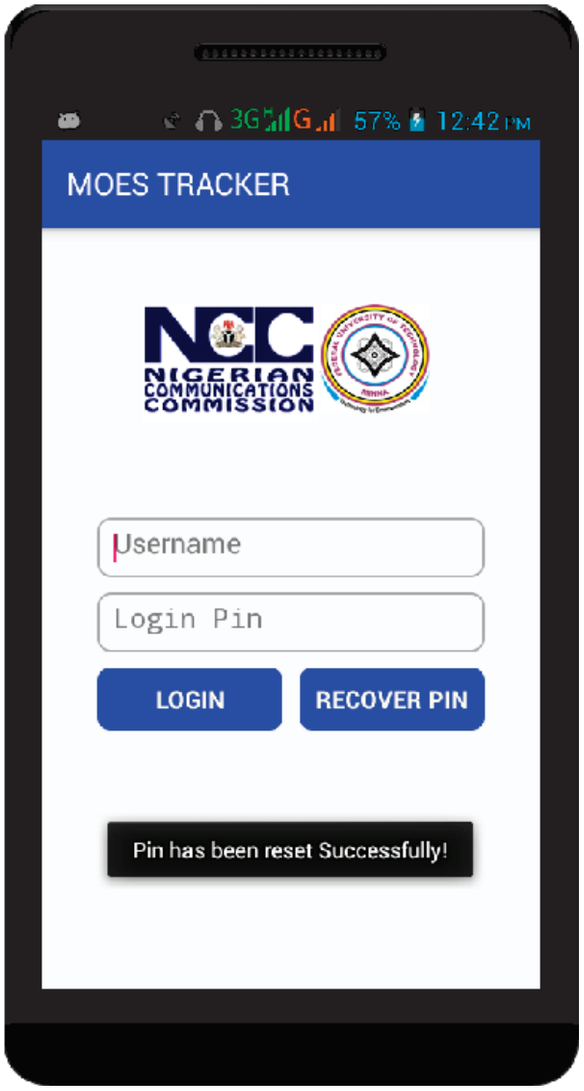


LOGIN PIN RECOVERY

Then select new login pin as shown below:

LOGIN PIN RECOVERY

Then click reset pin, on successful pin reset you will get the dialog below:



Tracker ID Recovery

6.0

MOBILE COMMUNICATION ENABLED WALKING STICK (MCEWS) MANUAL

IWCR Manual

FEATURES

1. Display and Key input Unit

a. Display Unit

The display unit is implemented using a 16×2 Liquid Crystal display (LCD) unit. It provides a means of displaying status and information about MCEWS. These include: Home menu containing base navigation menus for the entire functionalities of MCEWS such as: making phone calls, obtaining location, obtaining light status and making emergency phone call.

Figure 1.0: MCEWS Display Unit

b. Key input Unit

The Keypad input Unit is implemented using a 4×4 keypad unit. It provides the means for users of the MCEWS to make key inputs such as performing menu selection, navigating back to home menu, selecting a menu option and making entry of phone number to be dialed.

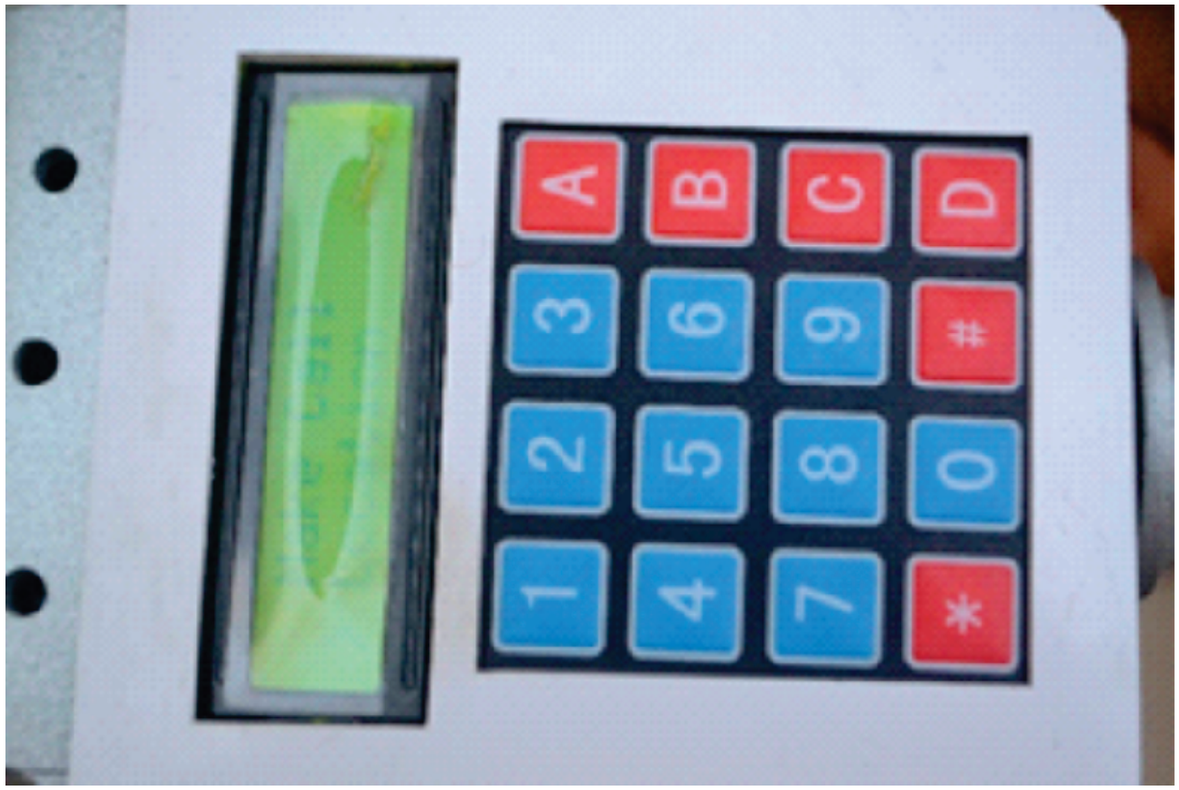


Figure 1.1: MCEWS Keypad input Unit

FEATURES

2. Obstacle sensing Unit

The Obstacle sensing Unit is implemented using two ultrasonic sensors, one positioned almost at a ground level in order to acquire the position of ground obstacles such as stones while the other is positioned about 20cm above the ground sensor so as to acquire the position of obstacles having a height similar to that of the MCEWS and also obstacles which do not have contact with the ground.

Figure 1.2: MCEWS Obstacle sensing Unit

FEATURES

3. Fall Detection Unit

The Fall Detection Unit is implemented using an Accelerometer and a Gyroscope. When a change in position and acceleration occurs, computation on whether a fall has occurred or not is performed from the control panel providing a sound alert to nearby persons and also sends a text message to concerned services.

Figure 1.3: MCEWS Fall Detection Unit

FEATURES

4. Control Panel Unit

The control panel unit is the section on the MCEWS where the main operation of processing and control is performed. It consists of two microcontroller boards providing parallel computing, processing and control task.

Figure 1.4: MCEWS Control Panel Unit

FEATURES

5. Flash Light Unit

This unit is implemented using a parallel arrangement of ultrahigh LEDs. It can aid an old person navigate his/her way through the mid night darkness.

Figure 1.5: MCEWS Flash Light Unit

FEATURES

6. Mobile Communication Unit

Just as other mobile phones are made up of a GSM/GPRS module that enables them perform mobile actions such as phone call, messaging, internet access and location finding, this unit possess just the same capability enabling one who is a user of the MCEWS perform mobile phone operation while on the walk.

Figure 1.6: MCEWS Mobile Phone Unit

FUNCTIONALITIES

HOW TO USE

Lighting

1. The flash light located at the trunk of the MCEWS is operated (i.e switched ON and OFF) by the aid of a switch located just right below the head closer to the handle this is to ensure easy operation of the flash light system

Mobile Communication System

1. Accessing the phone capabilities of the MCEWS is done via the menu options provided on the home menus.
2. Selecting a phone system function such as making a phone call to a required inputted number or making a distress call to a fixed emergency line is performed by scrolling up and down using the ↑ (A) and ↓ (B) key while the shift key is pressed.
3. Phone system option can now be selected using the Ok(c) key.
4. Phone number entries are made using the number keys as a prompt saying “Phone Number” appears.

Note: The shift key should be on pressed mode before selection tasks can be performed

7.0 SIM CARD INFORMATION EXTRACTION SYSTEM

A DOCUMENTATION ON THE MULTIPLE SIM CARD READER AND ANALYZER (MSCR) VERSION 1.2

NIGERIAN COMMUNICATIONS COMMISSION
Funded Research Project
NCC/CS/007/15/C/040 of 2014

Mulitiple Operator Enabled SIM (MOES) Card Reader and Analyzer

Funded by

NCC NIGERIAN COMMUNICATIONS COMMISSION

Developed by

FEDERAL UNIVERSITY OF TECHNOLOGY MINNA

A Documentation on the Multiple SIM Card Reader and Analyzer (MSCR) Version 1.2

This is a device for reading pertinent information on SIM card and a tool for Forensic analysis. The developed prototype is different from existing card reader in the market as it can read and analyze more than 1 SIM card at a time. It is based on the principle of Multiple Operator Enabled SIM (MOES) Card system. It can also logged pertinent and necessary information from a SIM card. It has mechanism for auto-detection, auto removal, network quality of service monitoring and data can be exported to various text formating type inclusing .txt, .xls etc..

Clicking on the application icon, load the MOES Card Reader and Analyzer page as seen below. It's sighted main components are as marked in *Figure 1.0* and detailed information are presented herewith.

1.0 Generalized Components of the Multiple SIM Card Reader

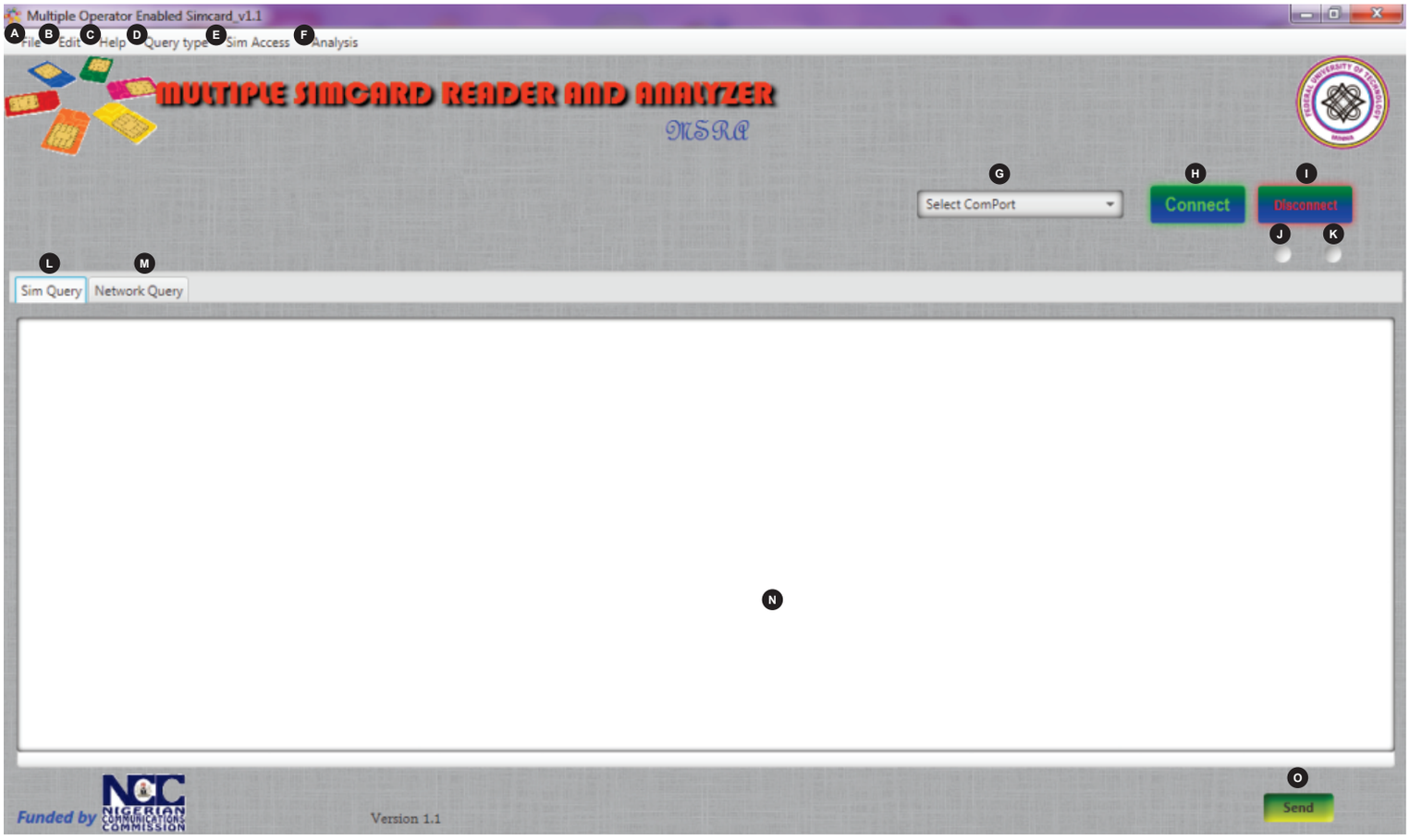


Figure 1.0: MSCR Main Components

A. **File Menu:** This contains items such as Open, Save, Save As and Quit. (See Section 2.0)

B. **Edit Menu:** This contains items such as Clear Screen1 and Clear Screen2. (See Section 3.0)

C. **Help Menu:** This contains the About Item. See Section 4.0 for detailed information.

D. **Query Type Menu:** This contains the SIM and Network Query parameters to be selected. (See Section 5.0, 6.0 and 7.0)

E. **SIM Access Menu:** This allows the user to determine the mode in which the SIM Card Reader operates(i.e. either as a single SIM mode or as a multiple SIM mode). (See Section 8.0)

F. **Analysis Menu:** This provides the user the ability to carry out particular analysis on queried data.

G. **Communication Port Selection Box:** This allows the user to select the communiction port in which the Card Reader is connected to.

H. **Connect Button:** This enables the user to connect the MSCR with the Computer System.

I. **Disconnect Button:** This enables the user to disconnect from the SIM Card Reader after it has been connected.

J. **Connect Indicator:** This provides a Green indication showing that the SIM Card Reader has been connected to the Computer System.

K. **Disconnect Indicator:** This provides a Red indication showing that the SIM Card Reader has been disconncted from the Computer System.

L. **SIM Query Tab:** This is a tab that provides features for retrieving SIM queried information.

M. **Network Query Tab:** This is a tab that provides features for retrieving network related information.

N. **Result Display Screen:** This displays the result of queried SIM and network information.

O. **Send Button:** This sends the selected SIM and Network Query to the SIM Card Reader, so as to retrieve required information. The expected time of information retrieval increases as the number of selected parameters increases.

2.0 File Menu Features and It's Components

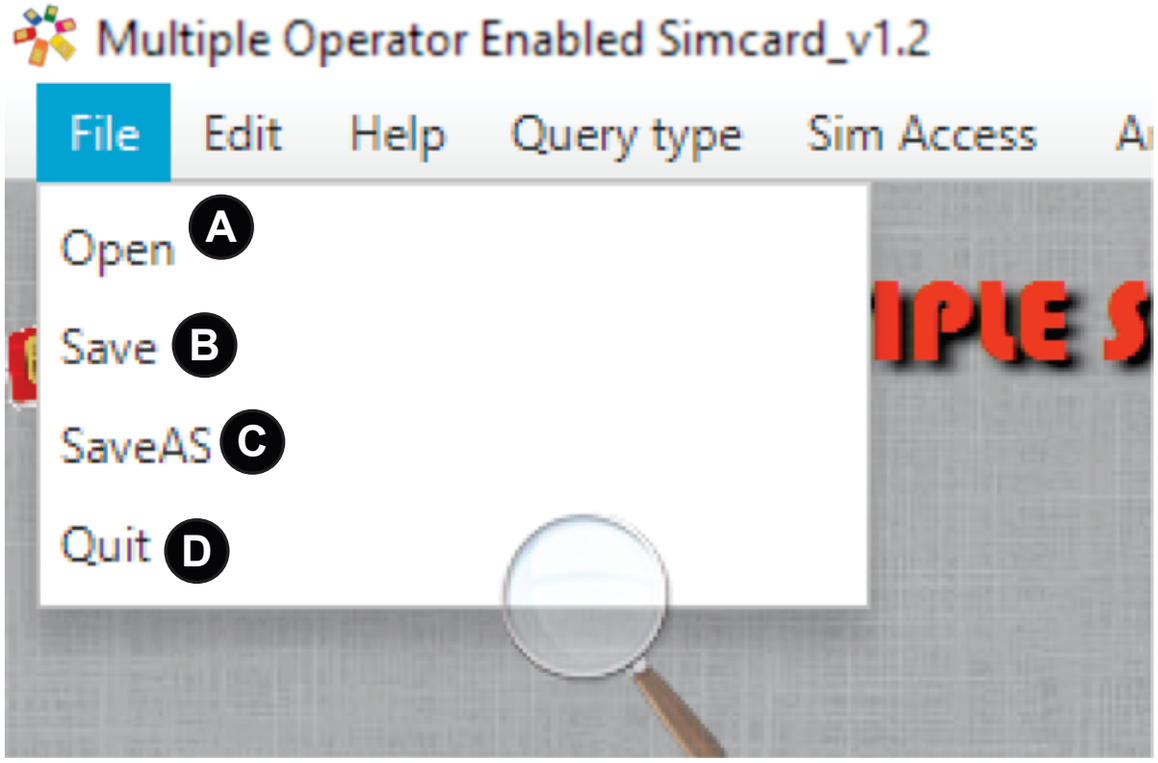


Figure 2.0: File Menu Features

A. **Open:** this menu item enables the user to open a previously saved text file.

B. **Save:** this menu item enables the user to save information displayed on the result display screen. If a text file has been created after clicking on "Save As", on clicking "Save" displayed data would be saved in the previously created

file.

C. **Save As:** this menu item enables the user to create a text file in the desired file directory so that information on the result display screen would be saved in the created text file.

D. **Quit:** this menu item enables the user to close the software application by safely disconnects from the SIM card reader

3.0 Edit Menu Features and It's Components

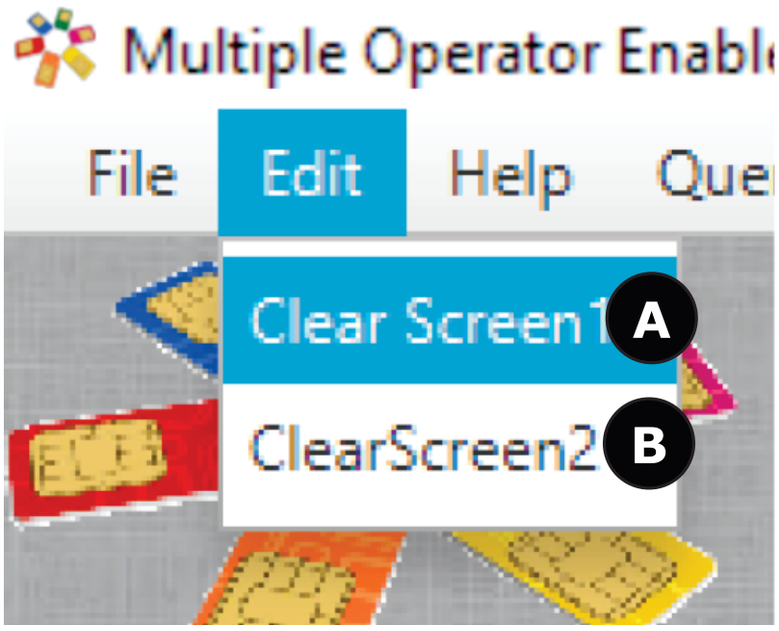


Figure 3.0: Edit Menu Features

A. **Clear screen1:** This enables the user to clear information displayed on the result display screen in the "SIM Query" tab.

B. **Clear screen2:** This enables the user to clear information displayed on the result display screen in the "Network Query" tab.

4.0 Help Menu Features and It's Components

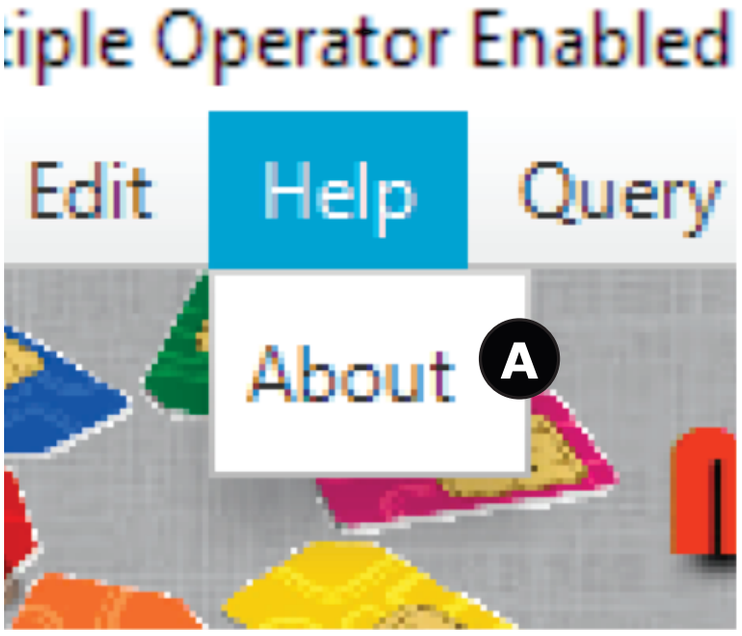


Figure 4.0: Help Menu Features

A. About: This enables the user view documentation content about the multiple SIM Card Reader and analyzer software.

5.0 Query Type Menu Features and It's Components

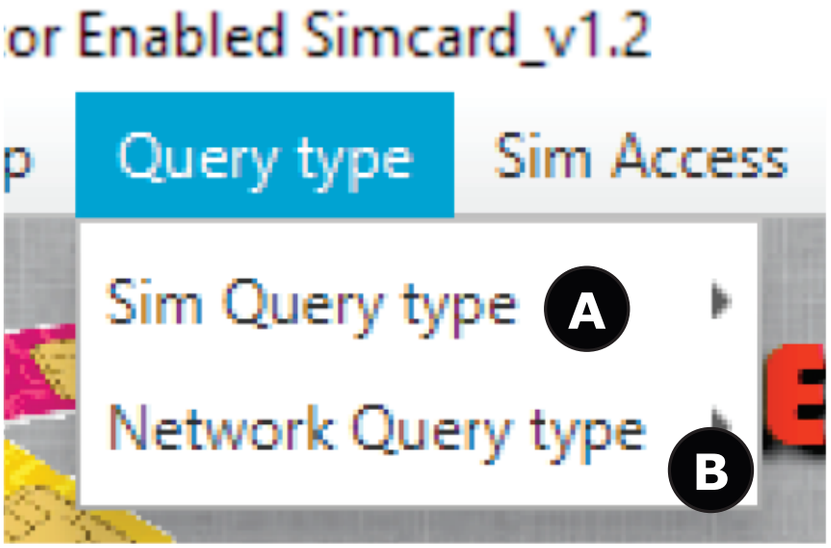


Figure 5.0: Query Type Menu Features

A. **SIM Query Type:** This menu item provides the user various SIM information that can be queried from a SIM Card.

B. **Network Query Type:** This menu item provides the user various network information that can be queried from a SIM card.

6.0 SIM Query Type Menu Features and It's Components

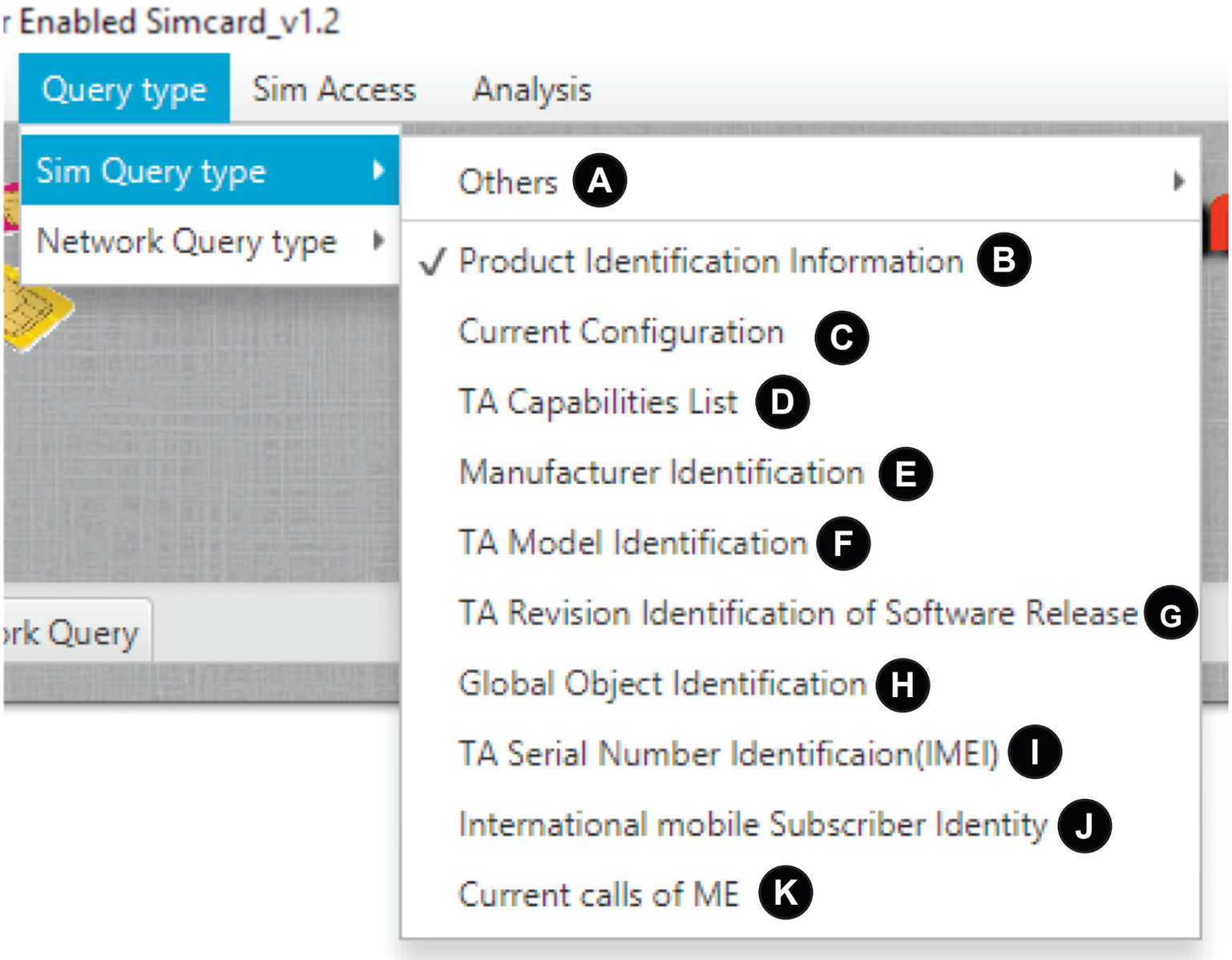


Figure 6.0: SIM Query Type Menu Features

A. **Others:** This menu contains other menu items like “Saved SMS”, “Phone Book Saved on SIM” and “ICCID”. “Saved SMS” menu items when selected retrieves saved SMS on the SIM card. “Phone Book Saved on SIM” menu item when selected enables the reader to retrieve contacts saved on the SIM card while “ICCID” menu item when selected enable the reader to retrieve the SIM card's ICCID (Integrated Circuit Card Identification) number. All information is retrieved after the “Send” button is clicked.

B. **Product Identification Information:** When selected, it enables the reader to retrieve the hardware's product identification information after the “Send” button is clicked.

C. **Current Configuration:** When selected, it enables the reader to retrieve information about the current configuration setting of the hardware after the “Send” button is clicked.

D. **TA Capabilities:** When selected, it enables the reader to retrieve information about the hardware additional capabilities after the “Send” button is clicked.

E. **Manufacturer Identification:** When selected, it enables the reader to retrieve information about the hardware manufacture after the “Send” button is clicked.

F. **TA Model Identification:** When selected, it enables the reader to retrieve information about the hardware (SIM card reader) model after the “Send” button is clicked.

G. **TA Revision Identification Software Release:** When selected, it enables the reader to retrieve information about the hardware's revision of software release after the “Send” button is clicked.

H. **Global Object Identification:** When selected, it enables the reader to retrieve information about the hardware type used in developing the SIM card reader after the “Send” button is clicked.

I. **TA Serial Number Identification (IMEI):** When selected, it enables the reader to retrieve information about the SIM card International Mobile Equipment Identification (IMEI) after the “Send” button is clicked.

J. **International Mobile Subscriber Identity:** When selected, it enables the reader to retrieve information about the SIM card's international Mobile Subscriber Identification number (IMSI) after the “Send” button is clicked.

K. **Current Call at ME:** When selected, it enables the reader to retrieve information about current calls of the SIM card reader if any after the “Send” button is clicked.

7.0 Network Query Type Menu Features and It’s Components

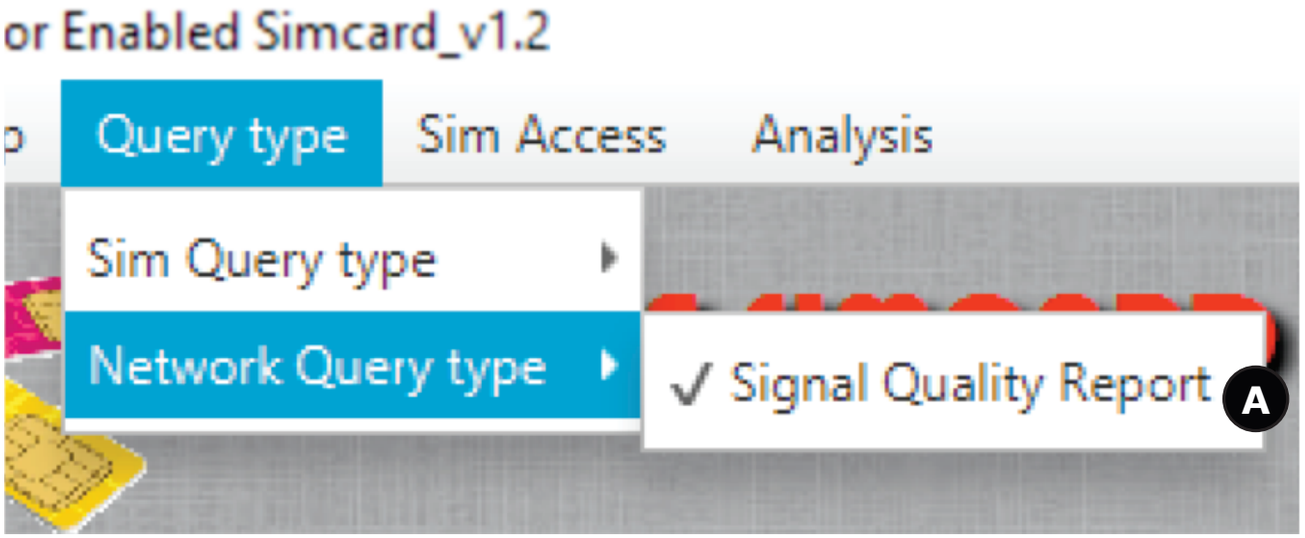


Figure 7.0: Network Query Type Menu Features

A. **Signal Quality Report:** On clicking this menu item a selection is made which enables the SIM Card Reader retrieve a signal quality on clicking the “Send” button. This report includes the Operator Name, Mobile Network Code, Mobile Country Code, Cell ID, and Received Signal Strength(RSS)level.

8.0 SIM Access Menu Features and It’s Components

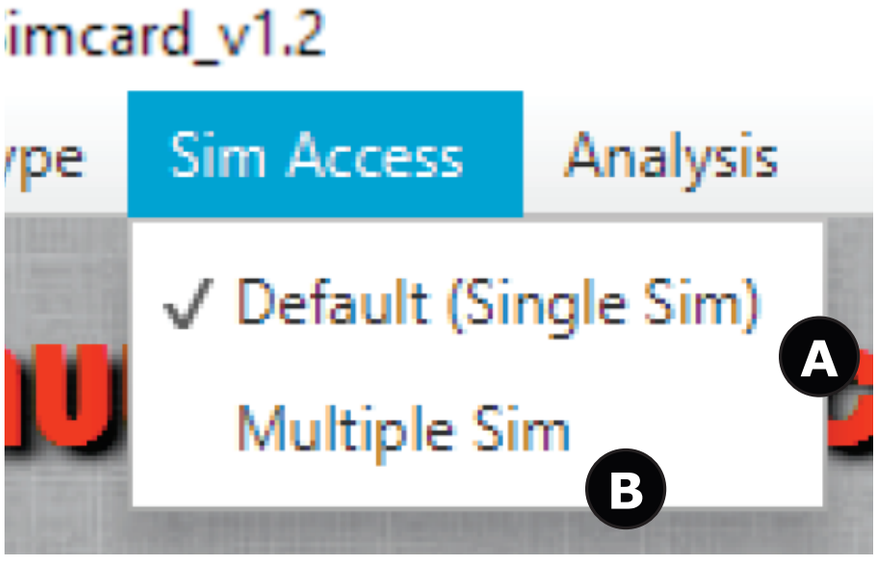


Figure 8.0: SIM Access Menu Features

A. **Default (Single SIM):** On clicking this menu item, it is selected which signifies that the reader is set to only read from a single SIM card (Single SIM Mode).

B. **Multiple SIM:** On clicking this menu item, it is selected which signifies that the reader is set to read from the multiple SIMs placed in the slot (Multiple SIM Mode).

9.0 Analysis Menu Features and It's Components

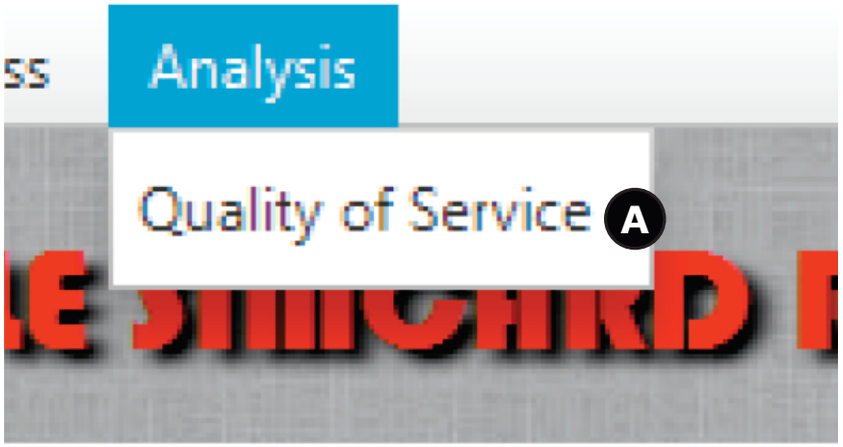


Figure 9.0: Analysis Menu Feature

A. **Quality of Service:** The QoS features will be enabled in MSCR Version 1.3.

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