A Microcontroller Based Drivers Safety Device

Sajid Mubashir Sheikh[1], Mohiuddin Ahmed Talukder[2], Ibo M. Ngebani[3], Edwin Matlotse[4]

Department of Electrical Engineering, Faculty of Engineering and Technology, University of Botswana, Gaborone, Botswana

E-mail: sheikshm@ub.ac.bw, mtahmed0786@gmail.com, ngebanii@ub.ac.bw, matlotsee@ub.ac.bw

Received: 27th April 2023; Accepted: 17th May 2023; Published: 1st July 2023

Abstract: During driving, mobile phone usage or being under the influence of alcohol are some of the factors that lead to car accidents. In this work, an Arduino based driver's safety device that is fitted by the driver's seat is developed. The device is designed to help in monitoring the presence of alcohol by the use of an alcohol sensor as well as the device blocks of mobile signal in the area of the driver's seat. The device uses power from the car battery so that it continuously operates as long as the car is switched on. The use of this device in cars, is hoped to reduce accidents in the coming future.

Keywords: Arduino Uno**,** Internet of Things (IoT)**,** MQ-3 alcohol sensor, RF Module, Voltage Regulator

1. INTRODUCTION

Road accidents result in many deaths per year [1]. There are many factors that can contribute to a person getting into an accident, including theweather, road conditions, and the use of mobile phones while driving, drinking, and driving. Using a mobile phone while driving a vehicle is a significant distraction that can lead to accidents, whether minor or fatal. Combining mobile phone use with drinking while driving poses a triple threat that is highly dangerous and puts lives at risk. The safest option is to avoid using a mobile phone while driving, even for short trips. Additionally, alcohol consumption impairs judgement and coordination, making it more likely to be involved in anaccident. It is crucial to limit alcohol intake when driving. In this work a device that uses the Arduino microcontroller and sensors to detect alcohol as well as to block mobile signals in the driver's seat is developed.

2. LITERATURE REVIEW

The most significant contributor to accidents caused by driving under the influence is the impact of alcohol on driving ability. Being under the influence of alcohol impairs one's ability to react quickly and make sound decisions. This is why it is extremely hazardous toconsume alcohol and operate a vehicle. Many accidents are also caused by youth that due to their attitude or behavior as well as use of alcohol [2]. In Botswana, the Botswana Police department have reported that a high percentage of accidents are due to use of alcohol [2]. The police make use of breath alcohol concentration (BrAC) to determine if a person is under alcohol or not and the amount [3]. Botswana and many African countries really on this method. BAC is a method used to determine the amount of alcohol in the blood represented in percentage form calculated in grams per 100 mL of blood [4].

To detect alcohol, the smell of alcohol can also be used. To do this a gas sensor can be used. There are many types of gas sensors available and in use. These include semiconductor gas sensors, electrochemical gas sensors, solid electrolyte gas sensors, contact, photochemical gas sensors and also polymer gas sensors [5].

Mobile phone usage has also been one of the major causes of accidents. There have been many accidents caused by people who were texting, talking on the phone, oreven listening to music while driving. Mobile jammers have also been used as away to block mobile phone signals. Mobile jammers were developed for official use by Government law enforcement, Police or the military to interfere with communication [6]. Technology developers over the years have also developed mobile jammers that are available in the market [6].

As stated by authors of [7], a mobile phone jammer is a device to stop mobile phones from receiving cellular signals. The jammers use two main techniques namely noise and repeater. The types of noise jammers are spot, sweep, and barrage. In the work of [7] pulse jamming technique was used which is a single transistor oscillator operating in the VHF region. VHF oscillations from the circuit interferes with the FM signals to cancel it out.

According to this authors of [8], the mobile phone jammer creates strong interference forcommunication between the caller and receiver by using the same frequency as a mobile handset. It is effective at preventing network signal transmission. In different countries, mobilephones use different frequency bands. Because different frequencies are used, it is difficult to create a jammer that can cover all frequencies. Table 1 presents a summary of microcontroller based signal jammer systems.

Table 1: Summary of Existing and Related Projects

Project	**Microcontroller**	**Methods or Components Used**	**Purpose**	**Sensors used**
Mobile Signal JammerUsing Arduino[6].	Arduino Uno	Arduino, Real time Clock , DS 1307 IC, Liquid Crystal Display, Relay, Signal Isolator	Application of mobilephone Signal Jammerapplied to places where they are forbidden to use mobile phones, Temples, Gas stations, classrooms, prison [6].	none
A Prototype for Mobile Phone Signal Isolator for GSM Network with Preschedule Time DurationUsing Arduino [7]	Arduino Uno	ATmega328, RTC (Real Time Clock- DS1307), Control switches, LCD Display, relay, ULN2003 transistor arrays and antenna.	Able to block signal in the range of 10 to 15 meters [7].	none
Design and implementation of an alcohol meter [5]	PIC16F690	Alcohol Gas Sensor, PIC16F690 , LCD Display	The system was able to work as an alcohol meter with a measuring range of 50PPM to 5000PPM [5].	Alcohol Gas Sensor, TGS-822

Smart Helmet system using alcohol detection for vehicle protection [9]	pic 16f877	limit switch ,encoder and decoder , alcohol gas sensor mq-3 ,pic microcontroller,driver circuit, relay , signal conditioning unit ,ldr light dependent resistor, alarmand buzzer	A helmet is designed in this work that can detect alcohol in the person wearing it [9]	AlcoholGas Sensor MQ-3
ArduinoBased Alcohol Detector [10]	Arduino Pro Mini	ATmega328, MQ-3 GasSensor, 10K Resistors , 1K resistors , 10K Potentiometer, Servo Motor, LED, LCD Display.	The sensor detects the alcohol consumption by thesmell of the breath. The sensor is an analog as well as adigital sensor [10]	MQ-3 Gas Sensor

Our work is different, as we use a combination or hybrid approach to detect both alcohol as well as block cellphone coverage. In addition, the system is designed to be a permanent device that fits in vehicles.

3. METHODOLOGY

The operation of the complete algorithm is shown in the flowchart in figure 1. The system detects for alcohol. If the alcohol sensor takes a reading of below 0.22, the car starts, and then blocks of all mobile signal in that radius. If the alcohol sensor detects alcohol more then 0.22, the car does not start.

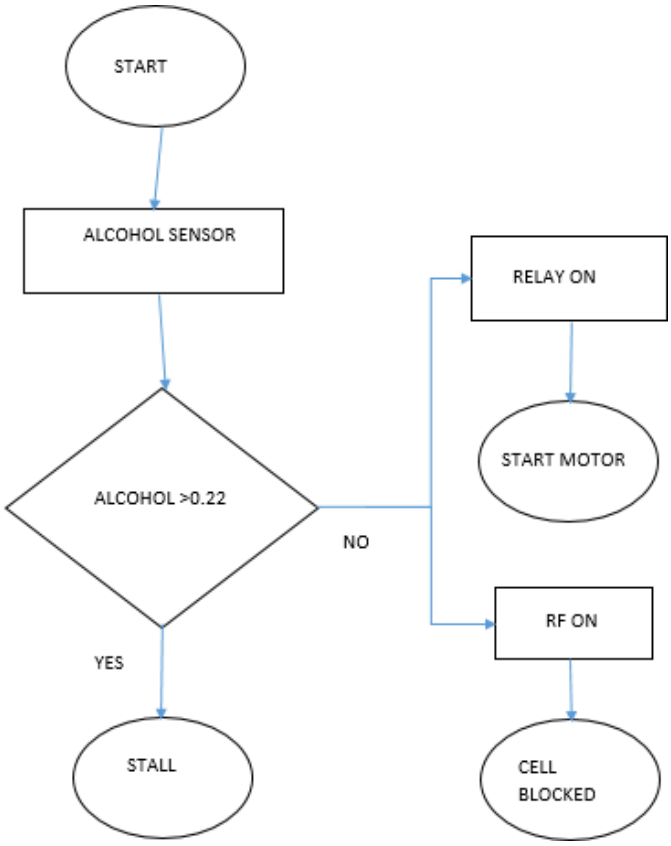

Fig. 1. Flowchart of the system

As the car ignition is put to start the device must be able to power up through the car battery. The power being supplied from the battery must be regulated as there might be fluctuations in voltage as the car is running and on the move. A voltage regulator/ buck converter is therefore, implemented for the power supply to the Arduino by converting 12v to 5v and then initiating the devices. The device is placed near the steering wheel especially the Alcohol sensor where detection of alcohol on the seat is attained. The Alcohol sensor (MQ3) sensor was used which detects alcohol smell (alcohol level above 0.22mg/L) and sends a signal to the Arduino. If there is a smell that goes above the thresholdset then the relay is not activated causing the car start not to start and simultaneously the led on the alcohol sensor lights red indicating the presence of alcohol in the driver's seat. If there is no detection of alcohol that crosses the limit set, the Arduino sends a signal to the Relay (switching it on) and RF module in order to start the motor and transmit signals blocking any mobile network to work while being in the driving seat respectively and since the device uses the car battery to be powered the device will be able to last for long periods.

The central unit of the system is the Arduino board as shown in figure 2. It is a programmable electronic device that can be used to design and develop various types of electronic devices. The board features 14 digital inputs and 6 analog inputs. It does not use the FTDI USB to serial driver.

Fig. 2. Arduino Board

The MQ-3 alcohol sensor as shown in figure 3 is an analog gas sensor that can be used for detecting alcohol. It has a high sensitivity to both alcohol and benzene, and it can be adjusted by potentiometer. When gas is detected, the conductivity increases, and its output signal is proportional to the gas concentration. The sensor features a high sensitivity to alcohol and good resistance to vapor and smoke. It can be used to detect the presence of alcohol in various products. Its low cost makes it ideal for various applications. The sensitivity of the MQ3 is affected by the concentration of the gas and its resistance value. When using this component, it is recommended to adjust the resistance value to reflect the difference between the target gas and the air. When accurately measuring, the alarm point should be determined after taking into account the humidity and temperature.

Fig. 3. The MQ3 alcohol sensor

The receiver and transmitter module (RF Module) was used to block mobile signals as shown in figure 4 of the small radio-frequency devices that can be used to send and receive data between two devices. The receiver module receives the data from the transmitter, while the transmitter sends the data to the receiver. The project only needs the transmitter. The RF Transmitter Receiver Module uses a frequency of 433 MHz. The transmitter is an ASK module using a saw resonator.

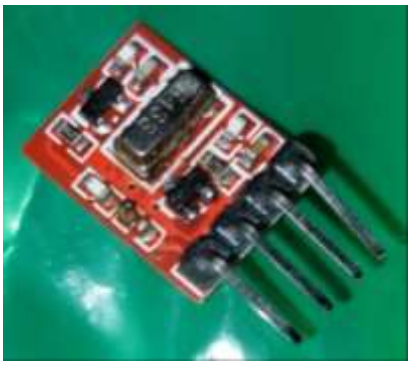

Fig. 4: Rf Module transmitter

A relay as shown in figure 5 is a switch that controls the electronic circuit's opening and closing. It works similarly to an electromechanical switch. When the relay contact is open, it doesn't generate electricity, while when it is closed, it doesn't. However, when energy (electricity or charge) is supplied, the states are prone to change. This was used to allow the car to switch on or not.

Fig. 5. Relay Switch

Transistors were used to energise the 12volt relay so that it can switch on without overloading Arduino. The voltage regulator module used to convert the car battery supply 12v to 5v to power the Arduino microcontroller is shown in figure 6. The schematics of the circuit connected up is shown in figure 7.

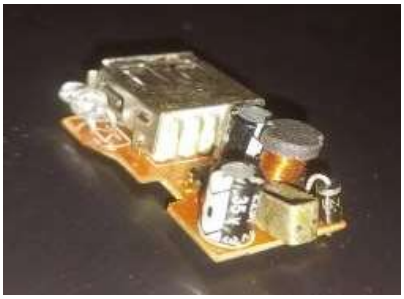

Fig. 6. Voltage Regulator module IC

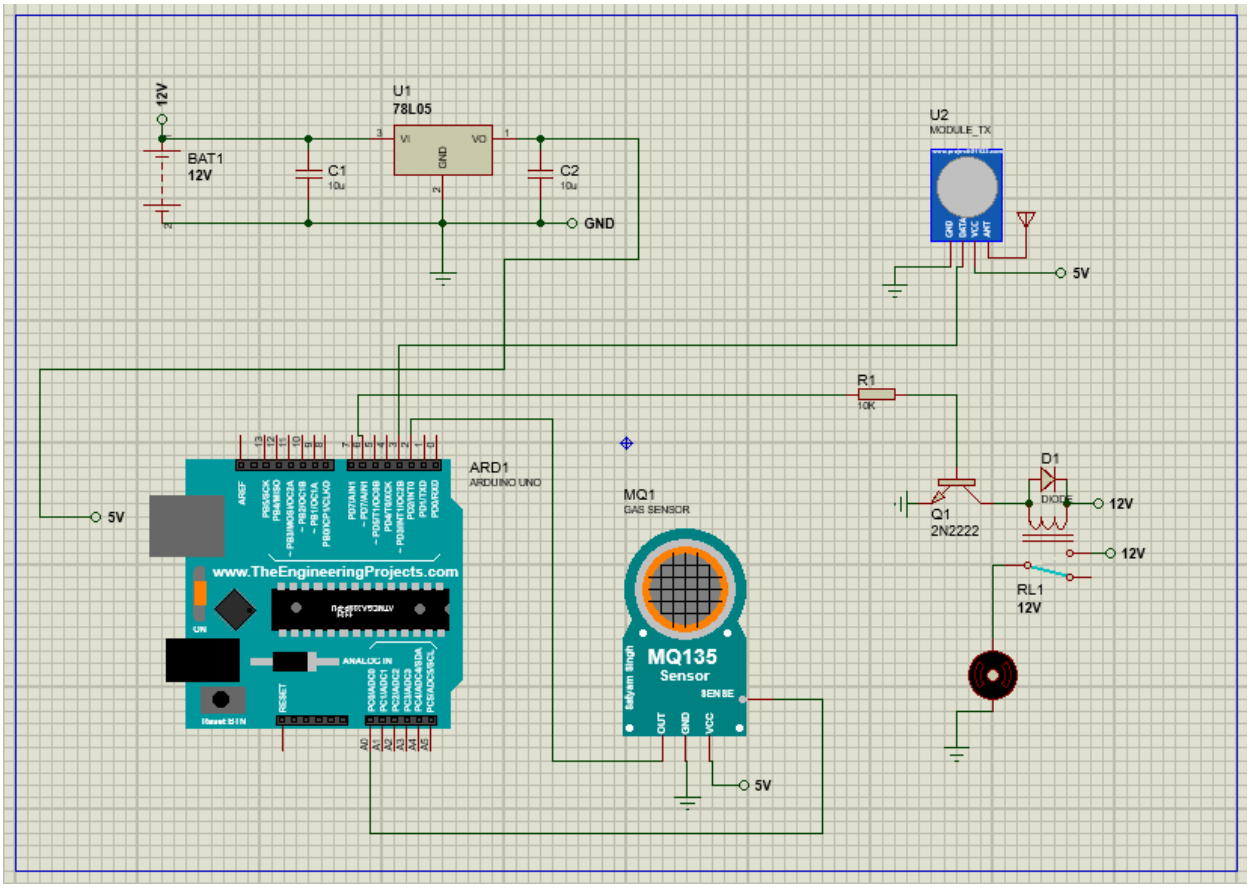

Fig. 7. Schematic diagram of the system

4. RESULTS

The developed prototype is shown in figures 8 and 9 for testing.

Fig. 8. Developed Prototype

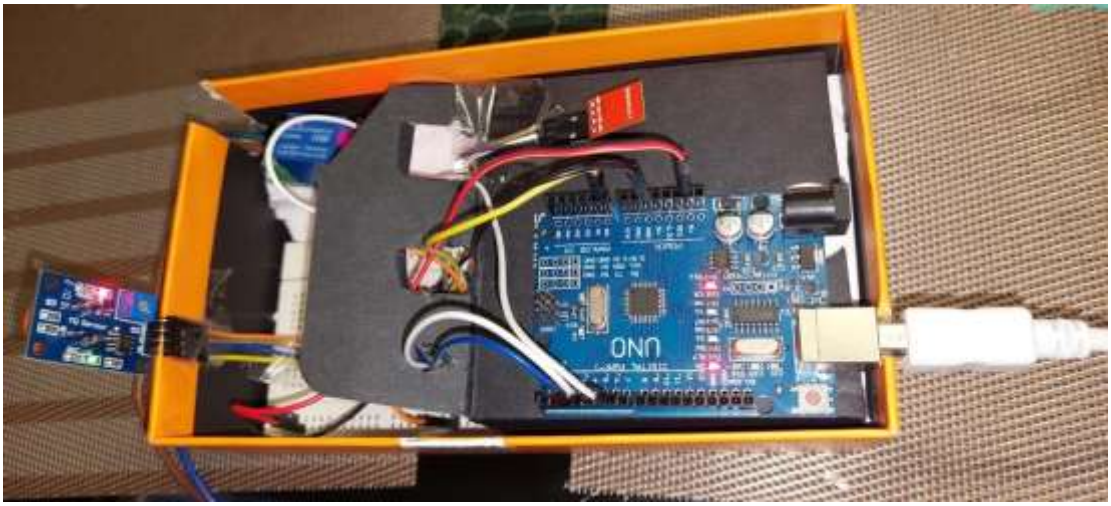

Fig. 9. Prototype showing the internal electronics

The simulation test results are presented in figure 10 and 11. For figure 10, the voltage from the battery 12v is converted to 5v via the regulator and supplies the arduino 5v port, powering the Arduino. The arduino had started with is function of signals being sent to the Alcohol sensor. When the Alcohol threshold had not been crossed the arduino then sent HIGH signal to the Relay and RF module to start the motor and also create a noise wave inorder to stop mobile network. When the Alcohol threshold had been reached the arduino sent LOW signal to the Relay and Rf module and the motor did not operate and the person who now was too drunk to drive can call someone for assistance without the RF modue making a disturbance in network.

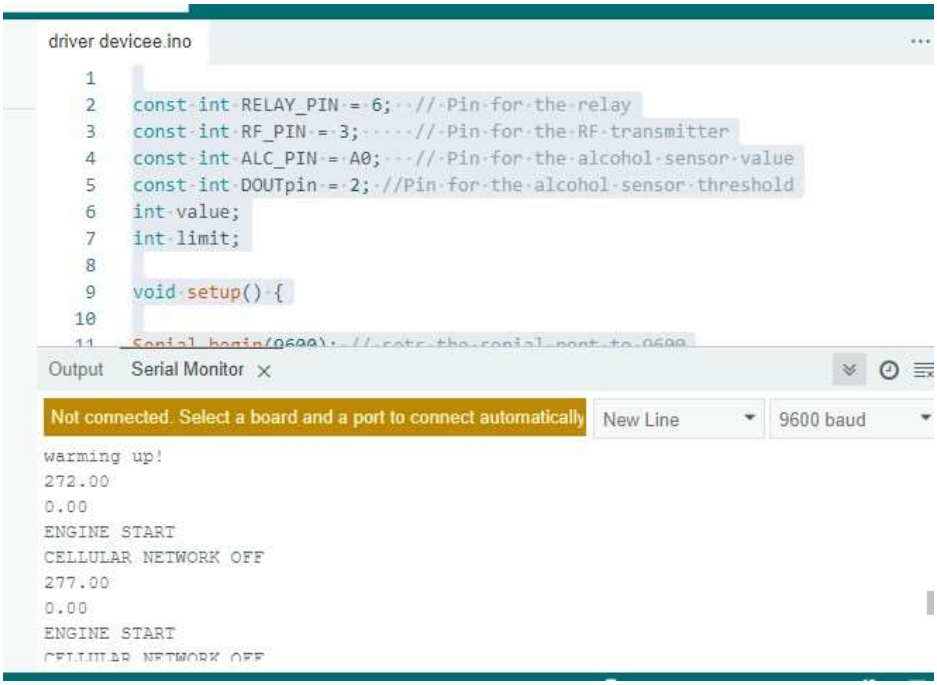

Fig. 10. Response when alcohol is below threshold

Figure 11 shows that when the alcohol level that has been detected is lower than the thresholdset, the motor starts running and the signal from RF module is sent to block signals.

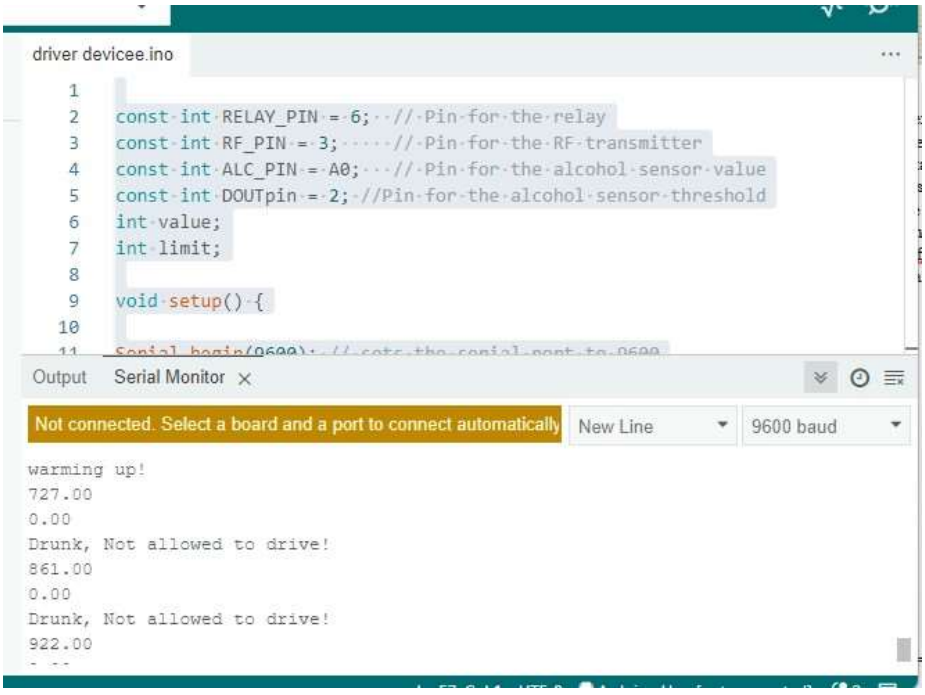

Fig. 11. Response when detection of alcohol and it being of higher than threshold

5. CONCLUSION

The developed prototype is a driver's safety device that detects for alcohol as well as blocks of mobile signals in the driver's area of the car. This system is placed by the steering wheel for maximum alcohol detection. The embedded system is also connected to the vehicle's electronic system to disable the ignition system in case it detects that the driver is drunk and blocks mobile network as the when the car switches on when no detection of alcohol. This technology if developed in a final product has the potential to greatly reduce the number of accidents caused by drunk driving and mobile phone usage.

REFERENCES

[1] L. Thatayamodimo, "Botswana: Road Traffic Accidents Main Cause of Deaths," 2019. [Online]. Available: https://allafrica.com/stories/201905090220.html. [Accessed: 10-Jan-2023].

[2] P. Bothoko, "Alcohol-Related Crashes Cause Concern," 2021. [Online]. Available: https://www.mmegi.bw/news/alcohol-related-crashes-cause-concern/news. [Accessed: 13-Jan-2023].

[3] M. MF and D. KM, "Breath-alcohol analysis: uses, methods, and some forensic problems--review and opinion," *J Forensic Sci*, 1979.

[4] T. U. of Telodo, "Blood Alcohol Content." [Online]. Available: https://www.utoledo.edu/studentaffairs/counseling/selfhelp/substanceuse/bac.html. [Accessed: 14-Jan-2023].

[5] J. Shi, "Design and implementation of an alcohol meter Bachelor ' s Thesis in Electronics Bachelor ' s Thesis in Electronics," University of Gavle, 2013.

[6] A. R. Gopal, P. N. Reddy, Y. S. Sai, and K. Kumar, "Mobile signal jammer using arduino," Gokarahu Rangaraju Institution of Engineering and Technology, 2013.

[7] N. Gawai, S. Hospital, and V. Pandit, "A Prototype for Cell Phone Signal Isolator for GSM Network with Preschedule Time Duration Using Arduino," *Int. J. Res. Appl. Sci. Eng. Technol.*, no. August, 2015.

[8] ElectronicsHub, "Mobile Jammer Circuit," 2018. [Online]. Available: https://www.electronicshub.org/mobile-jammer-circuit/. [Accessed: 15-Jan-2023].

[9] S. Sobhana, S. R. Sowmeeya, M. Srinathji, and S. Tamilselvan, "Smart Helmet," in *IOP Conference Series Materials Science and Engineering*, 2020.

[10] "Alcohol Detector Using Arduino & MQ3 Sensor." [Online]. Available: https://iotprojectsideas.com/alcohol-detector-using-arduino-mq3-sensor/. [Accessed: 08-Jan-2023].

Authors' Profiles

Dr. Sajid M. Sheikh is an academic, researcher and consultant. He is currently a Senior Lecturer in the Department of Electrical Engineering, Faculty of Engineering and Technology, University of Botswana (UB). He is also the Postgraduate coordinator at UB and Cisco Instructor and the academy coordinator at the UB-FET Cisco Academy. He holds qualifications of PhD in Electrical Engineering from University of Stellenbosch, MSc in Electronic Systems Engineering from UB, BEng in Electrical and Electronic from UB, CCNA 1, 2, 3 and 4 Instructor qualification Courses from UB-FET Cisco Academy as well as IT Essentials Instructor qualification Course. He is also an IEEE Senior Member and Member of Botswana Institute of Engineers (BIE). He is a registered Professional Engineer (PrEng) with Engineering Registration Board (ERB) (Botswana). He has published many international journal papers, conference papers and book chapters in the area of Internet of Things innovation product prototype designs; wireless mesh network protocol design for bandwidth constraint networks; and Web radio.

Mohiuddin Ahmed Talukder holds a BEng in Electrical and Electronic from the University of Botswana, Foundations of User Experience (UX) Design from Coursera and Introduction to Data Analytics from Coursera. He is a Student Member of Botswana Institute of Engineers (BIE).

Dr Ibo Ngebani is a Senior Lecturer at University of Botswana. He hold qualifications of Bachelor's degree in Electrical Engineering (Communications) from Queens University, Kingston, Ontario, Canada in 2003, Master's Degree in Electrical Engineering from the University of Botswana in 200 and Doctorate Degree (PhD) in Information Science and Communications Engineering in 2015 from Zhejiang University in Hangzhou, China. He has industrial and academic experience. He has work for many organisations such as Botswana Power Corporation (BPC), UB and others. His research is in wireless Communications, Signal Processing, Artificial Intelligence (AI), Big Data Analytics and Cloud Computing.

Prof. Edwin Matlotse is an Associate Professor at the University of Botswana in the department of Electrical Engineering as well as the current Head of Department. He holds qualifications of BEng in Electrical and Electronic Engineering from University of Botswana (UB), MSc in Electrical Power from the Bath University, U.K., and a PhD degree from Bath University, Bath City, U.K.

His research is mainly in renewable energy, power system voltage study, analysis and economics.