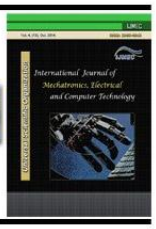
Vol. 5(17) Oct. 2015, PP. 2408-2415

Contents list available at IJMEC

International Journal of Mechatronics, Electrical and Computer Technology (IJMEC)

Journal Homepage: www.aeuso.org

PISSN: 2411-6173 - EISSN: 2305-0543



Construction of a Vision Based Object Detector Car

Olanrele, Oladeji .O. [1*] and Udeh, Gideon .C.[2]

Department of Mechatronics Engineering, The Polytechnic, Ibadan. Oyo State. Nigeria

Digitorch Electronics, Samonda Ibadan, Oyo State. Nigeria

***Corresponding Author's E-mail:** olanreleoluniyi@gmail.com*

Abstract

Mechatronics engineering is fast gaining ground in industries and the automobile industry is not an exception. An introduction of a component in the design of an automobile can improve its ease of operation and comfort. This paper describes the incorporation of ultrasonic sensor and microcontroller into a modeled car, which can be basically divided into three main parts; mechanical structure, electronics circuit and the software. A prototype car chassis with two rear and two front wheels respectively was decided. The two rear wheels would be driven by a motor, whereas the front wheel is meant for turning. The Programmable Integrated Circuit was programmed with the required software using an algorithm that helps the unit to detect object and alerts the driver through sound and display on the human machine interface (HMI).

Keywords: *Ultrasonic Sensor, Integrated Circuit, Automobile, Object Detector, Human Machine Interface; HMI, Intelligent Vehicle.*

1. Introduction

Automobile are normally equipped with both sides and rear mirror to reflect objects for the driver to see as images in other to avoid collision. But the development of object detector car is important due to increase in the number of vehicles, which has an impact on road accidents in the society. According to Zehang et al [1], research has shown that every minute, on average, at least one person dies in a vehicle crash and at least 10million people are injured each year, with up to three million of them being serious injuries. In 1988 a near obstacle detection system was developed at Delco System Operation in Goleta California as a vehicle safety system that would detect and warn the driver of objects that were in the driver's blind zone in the moving vehicle back-up and adjacent lane [2]. Computer Vision is concerned with enabling a computer to see to identify or understand what it sees, to locate what it is looking for, etc. Computer vision is the technology to replace or complement manual inspections and measurements with digital cameras and image processing. The technology is used in a variety of different industries to automate the production, increase production speed and yield, and to improve product quality. Computer vision will increasingly be used in industry for inspection, identification, verification, part location, and other purposes. Vision provides the most general purpose sensory input for intelligent robots. It is likely that roughly 25% of all robots utilize vision over the decades. Vision is also expected to play a large part in military automation, remote sensing, and as aids to the handicapped [3]. The cars and trucks found today have high range of inbuilt safety accessories to protect their passengers. Before it used to be just seatbelts, but now more features have been included which are more advanced and efficient than seatbelts [4]. Warning alerts and alarms are other security systems incorporated in the cars and trucks to alert us about various factors like exceeding speed limit or smoke alarms. These are

Article History:

Received Date: Jun. 21, 2015

Accepted Date: Sep. 09, 2015

Available Online: Sep. 12, 2015

designed to make the passengers aware of crossing the limitations which is important in most of the time and in most cases. In the same way here an embedded system has been designed to make the journey of the passengers inside a vehicle safe and secure with various recently found safety and security measures.

Obstacle detection is a key capability for autonomous vehicles, and an especially important one for vehicles navigation. In essence, obstacle avoidance consists of determining whether the space ahead of the vehicle is clear from obstructions for safe travel [5]. Its goal is to detect all obstacles along the path in time for the vehicle to react to them, while minimizing misclassifications.

Obstacle detection is an important task for many mobile robot applications. Most mobile robots rely on range data for obstacle detection [6]. Popular sensors for range-based obstacle detection systems include ultrasonic sensors, laser rangefinders, radar, stereo vision, optical flow, and depth from focus. Because these sensors measure the distances from obstacles to the robot, they are inherently suited for the tasks of obstacle detection and obstacle avoidance.

According to Bertozzi et al [7], intelligent system technologies may provide vehicles with different types and levels of “intelligence” to complement the driver. Information systems expand the driver’s knowledge of routes and locations. Warning systems, such as collision avoidance technologies, enhance the driver’s ability to sense the surrounding environment. Driver assistance and automation technologies simulate the driver’s sensor-motor system to operate a vehicle temporarily during emergencies or for prolonged periods.

A fully intelligent vehicle must work cooperatively with the driver. An intelligent system senses its environment and acts to reach its objectives: its interaction-communication channels have a big influence on the type of intelligence it can display [8]. New uncoordinated technologies could deliver excessive, competing, or contradictory messages and demands that might distract, confuse and overwhelm the driver, overloading his limited cognitive resources and eventually leading to a decrease in his performance and safety.

Baorong et al [9], made study to explore how to realize high performance collision warning system (CWS), providing the precaution against traffic crash in transit. An embedded hybrid adaptive network-based fuzzy inference system (ANFIS) plus quantum-tuned back-propagation neural network (QTBPNN) built anthem platform with Davinci+XScale-NAV270 was employed to realize collision warning system and they also installed motor vehicle event data recorder (MVEDR).

Fadi [10], Wireless 802.11b communication was successful when one modem used a horn antenna and the other used the dish/feed antenna, or when both receiver and sender antennas were 8 dBi collinear antennas oriented vertically. The tested 0.9 mile pipe showed less attenuation for frequencies around 5 GHz. New wireless communication technologies are expected to improve the transmission range.

2. Materials and Methods

The proposed car is an object detector car and a prototyped sensor and microcontroller based intelligent car designed to detect object and alert the driver through sound and screen display. The components used in the construction of this project are listed below:

i. Radio Frequency Transmitter and Receiver
ii. PIC16F877and 16F628
iii. DC Motor
iv. Battery:9v and 12v

v. 5v dc voltage regulator
vi. Capacitors
vii. Resistors
viii. Ultrasonic sensors
ix. Buzzer
x. LCD Display
xi. Diodes
xii. Perspex plastic

2.1. Principle of operation

When the car is powered on and controlled to move either forward, reverse, right or left, the microcontroller sends trigger signals to the sensor's transmitters and also starts a timer. The ultrasonic sensor's transmitters emit ultrasonic wave towards the set target and waits for return echo. Once the wave strikes an object, the object reflects back the wave as echo to the receiver. The receivers send signals to the microcontroller and the microcontroller then stops the timer and calculates the travel time of the wave and converts it to distance. It monitors the distance from the object to the car and triggers the buzzer once it gets to a certain distance at the same time displaying the position and the varying distance on the LCD screen for the driver to take action. Figure 1 below show the operation of the vehicle

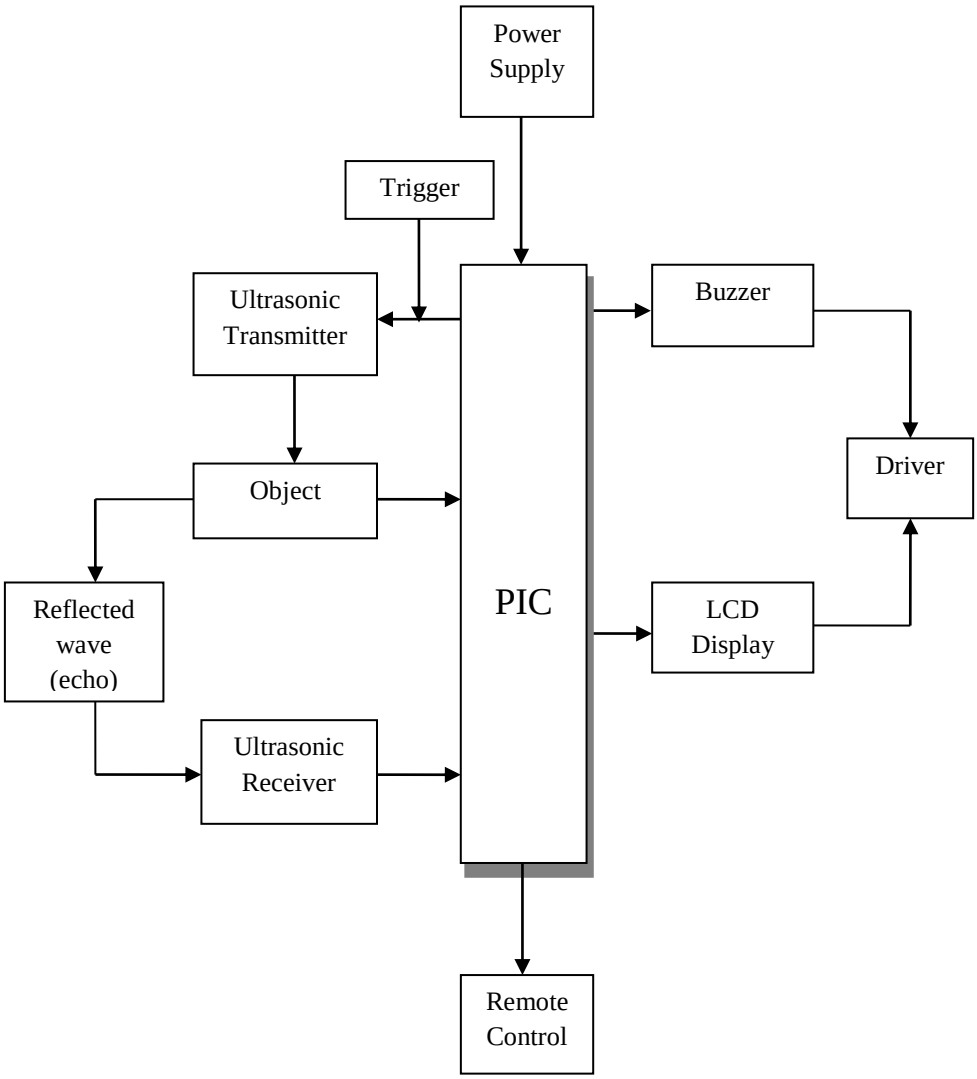


Figure 1: Operational principle block diagram

2.2. Explanation of the various units of the project

2.2.1. The remote control: The remote control is the unit that controls the movement of the vehicle to either forward, reverse, right or left directions. The remote control uses a radio frequency transmitter and receiver which transmits data at 315MHZ. the circuit diagram and the built circuit for the receiver is shown in figure 2 below.

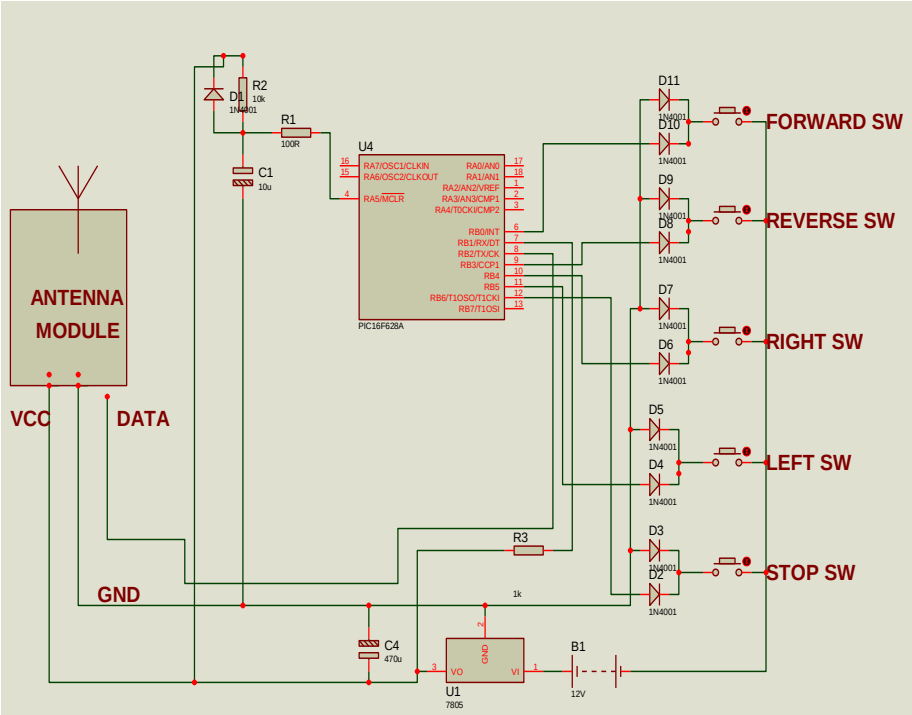


Figure 2: The remote control circuit diagram

The circuit basically consists of a transmitter module, microcontroller, 9v battery, 5v voltage regulator and switches. The 9v battery powers the circuit. The microcontroller sends a distinct data to the module for each of the switches when they are pressed. The voltage regulator regulates the volt entering the circuit to 5 volts which is the normal volt CMOS PIC Microcontroller operates on.

2.2.2. The Main Panel: The main panel is a single circuit board with a single microcontroller that controls the receiver module, the sensor unit, the motor drive unit, the buzzer and the LCD display. The circuit basically consists of 5v voltage regulator that powers the circuit, an external 16MHZ crystal that runs the microcontroller, a 40-pin 8-Bit CMOS FLASH microcontroller with 33 input/output pin (I/O) and transmitter and receiver pins.

Eight pins (O/I pins) from the microcontroller was used for the 16 x 2 LCD display 8-bite data inputs. Six pins (O/I pins) and another Six pins (O/I pins) were used for the trigger inputs echo outputs for the six sensors respectively. Four pins (O/I pins) was used for inputs, for forward and reverse control for the rear motor drive and another Four pins (O/I pins) for turn motor drive. The receiver pin of the microcontroller was used to receive the button data received by the radio transmitter module. The main panel circuit is presented figure 3 below.

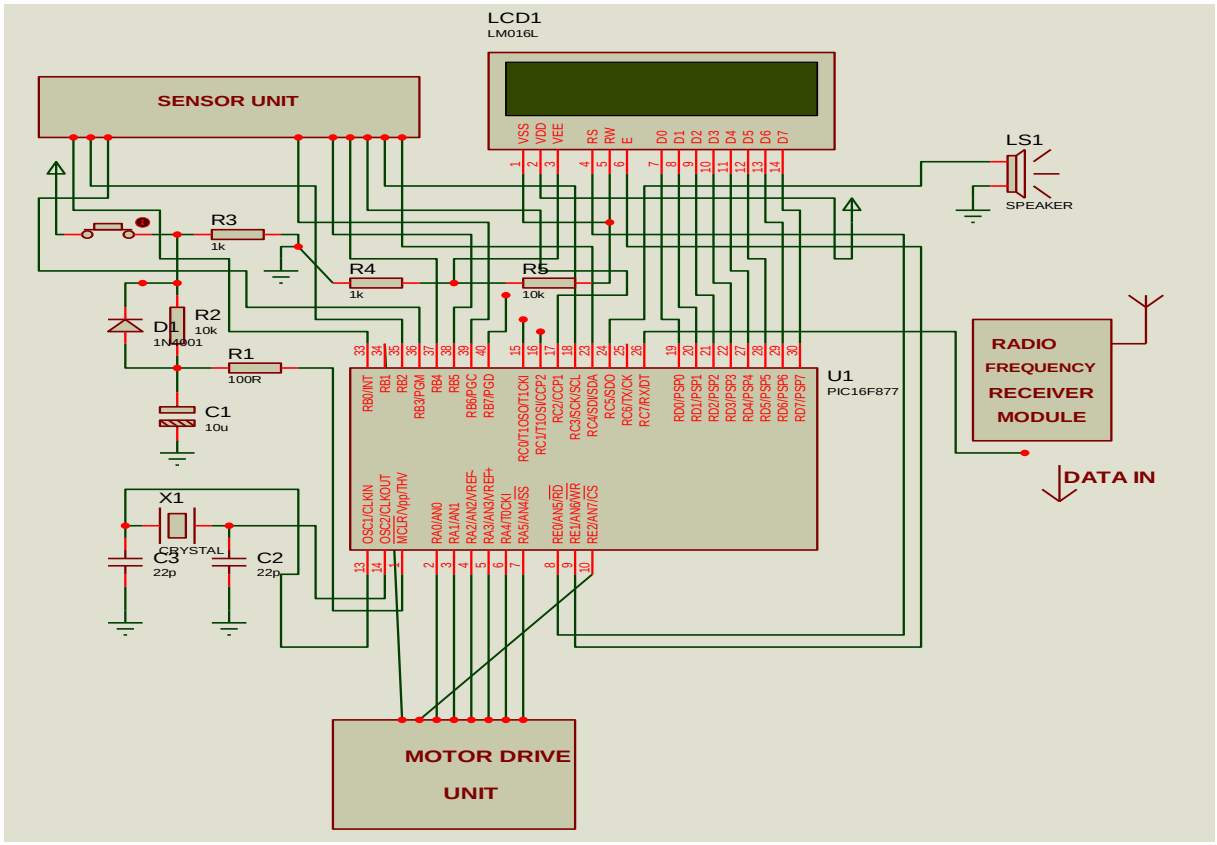


Figure 3: The main panel circuit diagram

2.2.3. Motor drive unit: The motor drive unit drives the two motors base on direction of signal it receives from the microcontroller. The circuit consists of the drives, each consisting of four (4) inputs from the main panel microcontroller and two outputs for each motor. One of the panels drives the rear motor for forward and reverse directions. While the second drive controls the turn motor for right and left turning. The two drives changes the motors directions by interchanging there polarities. Figure 4 below shows the circuit diagram of the dc motor drive.

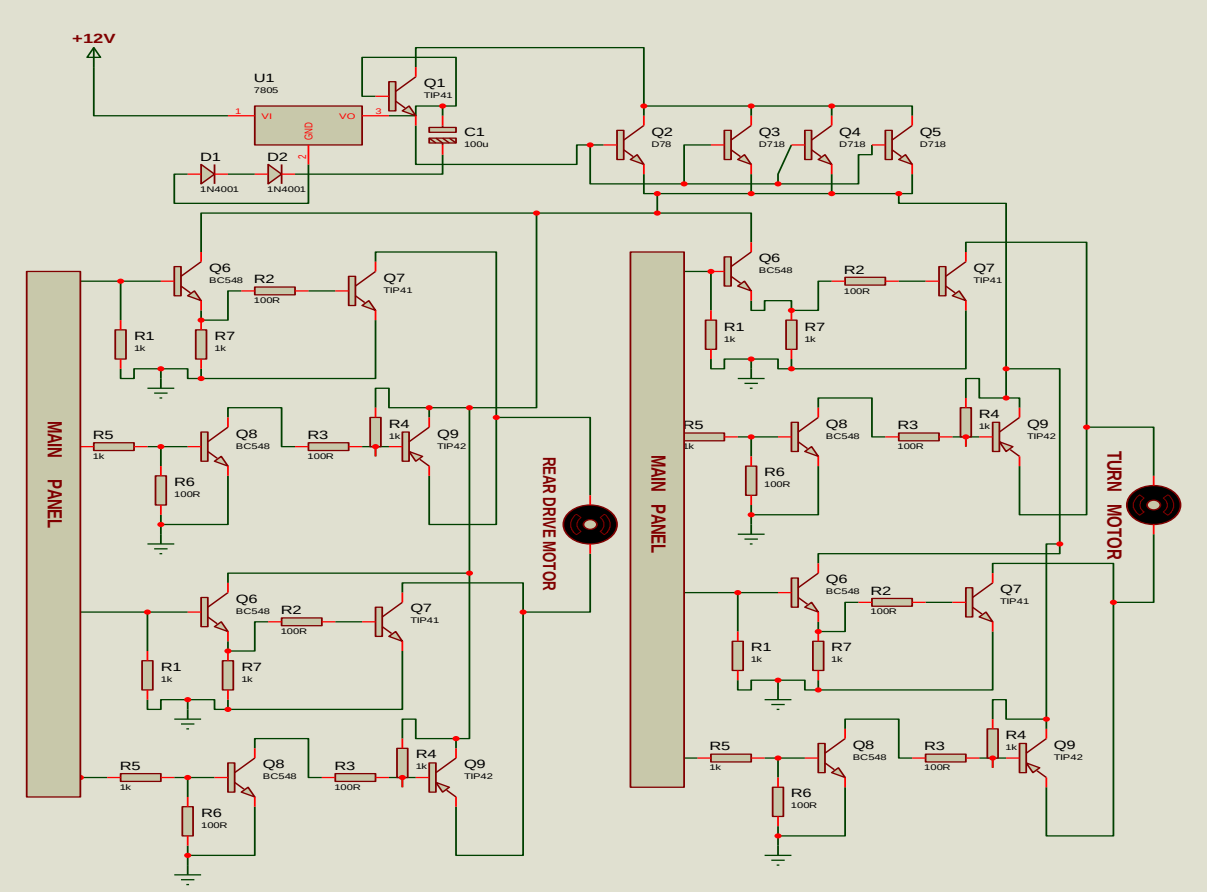


Figure 4: The DC motor drive circuit diagram

2.2.4. The chassis: Plastic chassis model without any electrical board inside was used. The chassis has four wheels, two DC motors; the rear motor drive and the steering motor. The rear drive motor is coupled with speed reduction gear arrangement, while the second motor is used for turning the front wheels. Normally open switches were attached to the motor to stop when it has turned to a required direction. The chassis parts and the assembling is as shown in figure 5 below.

Figure 5: The car chassis

3. Circuits Testing and results

Each of the sub circuits of the project were tested to ensure that they are working properly before being coupled together.

3.1. The Sensory unit

The sensor which is the object detector system of the project was tested using oscilloscope. The sensor was powered with 5v dc supply through its VCC and Ground. The sensor also has a trigger pin that takes in clock input (timing instruction) which triggers the sensor to emit ultrasonic wave. During the test, the trigger pin was triggered manually by intermittently applying 5v dc to it and it was observed through the oscilloscope display screen that the signal wave length was longer than when the sensor senses an object. As the object approaches the sensor the signal length decreases further.

3.2. The remote control

The remote control was tested and it was observed that the signal from the transmitter can get to the receiver at any to the receiver, without even the transmitter being pointed directly to the receiver. It was also observed that the transmitter can transmit up to a distance of 500cm.

3.3. The DC motor drive circuit

The dc motor drive circuit was tested for direction change. Signal states of **0110** and **1001** was made to drive the forward and reverse respectively and the right and left turn respectively. During the test, the logic states signal was inputted to the drive and it responded accordingly by changing the directional movement of the dc motors.

Figure 6: The complete project.

Conclusion

Rate of vehicle accident, crashes, injuries and death as a result of human factor is on the high side. Hence this research work was carried out to improve vehicle safety as it detects the presence of object and alert the driver of the collision risk. An object detector car is a vision based vehicle detection system and it an area which various research can be focused on in the future. Automobile companies, government agencies and institutions should work in harmony to make a lasting progress in this area of research. The object detector car was tested after completion and it responded very well. The sensor triggers the buzzer when an object is 10cm from the car.

References

[1] S. Zehang, B. George, and M. Ronald, On – Road Vehicle Detection Using Optical Sensors: A Review. The University of Nevada, Reno under an Applied Research Initiative (ARI) grant, and in part by NSF under CRCD grants No.0088086 (2004).
[2]W.C. Ronald, Development of the First Near Obstacle Detection System (2004). https://history.gmheritagecenter.com/wiki/index.php/Development_of_the_First_Near_Obstacle_Detector_Systems. (Accessed on September 8th, 2014).
[3] A.F Elnaz and G. Bashir, Artificial Intelligence and Robotic From the Past to Present. International Journal of Mechatronics, Electrical and Computer Technology (IJMEC). © Austrian E-Journals of Universal Scientific Organization (2013).

[4] V. Ramya, B. Palaniappan, and K. Karthick, Embedded Controller for Vehicle In-Front Obstacle Detection and Cabin Safety Alert System. International Journal of Computer Science & Information Technology (IJCSIT) Vol 4, No 2. (2012).

[5] F. Gustavo, H. Bradley, B. Marcel, and S. Sanjiv, A Practical Obstacle Detection System for Autonomous Orchard Vehicles. 2012 IEEE/RSJ International Conference on Intelligent Robots and Systems. Vilamoura, Algarve, Portugal. (2012).
[6] U. Iwan and N. Illan, Appearance-Based Obstacle Detection with Monocular Color Vision. Proceedings of the AAAI National Conference on Artificial Intelligence, Austin, TX. (2000).
[7] M. Bertozzi, A. Broggi, A. Fascioli, M. Cellario, A. Lombardi, and M. Porta, Artificial Vision in Road Vehicles. Proceedings of the IEEE, vol. 90, No. 7. (2002).
[8] M. Cellario, Human-Centered intelligent vehicles: Toward multimodal interface integration, IEEE Intelligent System., vol. 16, no. 4, pp. 78–8. (2001).
[9] C. Baorong, Y. Chung-Ping, F.T. Hsiu, and L. Jian-Jr, Applying Embedded Hybrid ANFIS/Quantum-Tuned BPNN Prediction to Collision Warning System for Motor Vehicle Safety, Eighth International Conference on Intelligent Systems Design and Applications (2008).
[10] Fadi, N.S. 2015. Modelling of Wireless Acoustic In-Pipe Robot Communication Through the Steel Pipeline. International Journal of Mechatronics, Electrical and Computer Technology (IJMEC). Vol. 5(16) Jul. 2015, pp 2229-2238. © Austrian E-Journals of Universal Scientific Organization

Authors

1. Mr. Olanrele, Oladeji .O. is a graduate of University of Ibadan, Nigeria. He had his Bachelor Degree (B.Sc) and Masters of Science (M.Sc.) in Industrial & Production Engineering 2010 and 2015 respectively. He joined the services of The Polytechnic, Ibadan in 2012 as a Teaching Assistant in the department of Mechatronics Engineering. He served the Department in various capacities such as Examinations Convener since 2012/2013 session till date.

Mr. Olanrele, O.O has many publications in the learned journals and international conference proceedings especially in area of production management and operation design. Mr. Olanrele, O.O is a graduate member, Nigerian Society of Engineer, Institute of Productivity and Quality Management, Member International Society of Bionic Engineering and Member European Centre for Research Training and Development UK.

2. Mr. Udeh, Gideon .C. is a graduate of The Polytechnic, Ibadan, Nigeria. He has his National Diploma (ND) in Mechatronics Engineering in the year 2014 with a distinction, making him one of the institutional overall best students. He is versed in circuit design and programming. He joined the service of Digitorch Electronics in the year 2015 as a trainee.