Gas Leakage Monitoring and Alerting System for Industries

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ABSTRACT

In the modern world, safety is crucial, hence it is essential that effective safety procedures be put in place at workplaces and educational institutions. The safety model that is now in use in businesses and that is also utilized in homes and offices is modified by this study. Designing a dangerous gas detection and warning system using microcontrollers is the major goal of the effort. Every second, dangerous chemicals like propane and LPG were detected and showed in the display. When the typical amount of these gases is exceeded, an alarm is instantly triggered, and an SMS alert is also sent to the appropriate person by the user. This automatic detection and alerting system has a number of advantages over the manual technique, including quick reaction times, accurate emergency detection, and a faster spread of the urgent condition. The biggest issue facing the planet now is air pollution. Because harmful chemicals like CO_2, SO_2, NO_2, and CO are released into the atmosphere, the globe is becoming more polluted. These dangerous gases are dissolved in the air and are unpredictable. Consequently, a device is needed to measure the air quality. Using internet-connected devices like IoT, the air pollution may be monitored. Devices connected to the Internet of Things (IoT) may gather data and use data analysis and prediction to determine if the air quality is excellent or not. such that the Using NodeMCU and IOT-based devices and sensors, the air quality of a specific region can be monitored. The goal of this research study is to comprehend information on environmental variables and also to enable simple integration into any other type of internet-based architecture (IoT) that permits the use of sensors capable of gathering information on sensors related to smart city environment measurements, with the goal of providing data on information relating to environmental.

Keywords: Wireless sensor network, Arduino, Sensors, Arduino, detection system, GSM module.

1. INTRODUCTION

The speed of the globe is accelerating. Businesses across industries are preparing to make up for the two years they missed due to the Coronavirus epidemic now that the pandemic is long behind us. With scalable IOT solutions, it's now possible to embrace excellence and cut back on wasteful spending. This is also true for the oil and gas industry. To provide the greatest customer service possible, many commercial enterprises like hotels and fast-food restaurants use combustible gases, such as carbon dioxide, LPG, ammonia, and so on. There is no denying the usage of such gases. They have, however, also increased the risk to human life and the harm it poses. Businesses working with petrol must take special measures since safety is their first priority. If taken in higher quantities, the gases' poisonous nature can render people unconscious or even kill them. A further catastrophe that everyone, whether they are at home or in a factory, would like to avoid at all costs is gaseous bursts. The Internet of Things (IoT) gadget notifies the end user about environmental factors, such as the location's temperature and gas level, using an Ethernet shield module and an Android application. In order to stop additional gas leaks, the gas detection system continually monitors the environment. An MQ6 sensor is employed for the IoT-powered gas leak detection. In order to stop gases from building up and causing an explosion, it can detect when the pressurised gas system is failing.

2. LITERATURE REVIEW

2.1. EXISTING PROBLEM

2.1.1. LIQUID PROBLEM GAS DETECTION

AUTHOR : OLSSON, G

It is an odourless gas due to ethyl mercaptan is added as an odorant to be easily detected when leakage occurs for safety precaution. LPG is made by refining petroleum or wet natural gas and is almost entirely derived from fossil fuels sources being manufactured during the refining of crude oil as theory emerged from the natural state. It was classified as a hazardous material because of its explosive potentials when under pressure, due to this hazardous property leading to fire explosion. The gas detection process was made by the chemically infused paper that change its color when it's been exposed to gas before the development of the electronics gas detector. The electronics leakage detector was an active approach to initial fault detection in other to achieve the 9 utmost safety of humanity and properties as a whole they introduced an android base automatic gas detection).different approaches have been used alongside several research in the detection of leakage and were also implemented alongside some incident toward some decades. The

existing leakage detection is optical sensor method, cable sensor, negative pressure, vapor sampling, signal processing, mass volume, and pressure point analysis, in which have been implemented using a different framework. Some groups of researchers have classified the technology as two fitting categories, which are software and hardware method but research continues and to technical nature research effort which led them to three group methods.

2.1.2.MONITORING SYSTEM FOR DEEP-SEATED LANDSLIDES USING LOCALLYDEVELOPED TILT AND MOISTURE SENSORS

AUTHOR : CHANDRA PANDEY, MANISH VERMA

Landslides pose serious threat in a large number of communities living near steep and unstable slopes in the Philippines. This paper describes the enhancements in the design of an alternative instrumentation for monitoring deep-seated landslides based on tilt and soil moisture sensors. The real time landslide monitoring system is composed of a sensor column buried in a borehole, which can reach up to 40m in depth, in the unstable slope. Each column consists of 0.5-1m segments that contain a tri-axial accelerometer for tilt measurements and a capacitive sensor for soil moisture. In this manner, tilt and soil moisture measurements can be made at a resolution of 0.5 to 1m underground. Sensor measurements from each segment are accessed via Controller Area Network (CAN) protocol and transmitted to a remote host via GSM cellular infrastructure. We also describe the previous deployments in ten different sites in the Philippines as well as share the technical challenges and difficulties faced in deploying the monitoring system in real world setting. The field deployments provided valuable inputs regarding improvements in the sensor design. Furthermore, this paper discusses the experiences in involving the community at risk as part of the synergistic approach in taking progressive steps towards.

2.1.3. ANDROID BASED AUTOMATIC GAS DETECTION AND INDICATION ROBOT.

AUTHOR : CH. MANOHAR RAJU AND N. SUSHMA RANI

They proposed prototype depicts a mini mobile robot which is capable to detect gas leakage in hazardous places. Whenever there is an occurrence of gas leakage in a particular place the robot immediately read and sends the data to android mobile through wireless communication like Bluetooth. We develop an android application for android based smart phones which can receive data from robot directly through Bluetooth. The application warns with an indication whenever there is an occurrence of gas leakage and we can also control the robot movements via Bluetooth by using text commands as well as voice commands. The previous mobile robots are based on heterogeneous technologies like GSM, GPS, internet based etc., but the main disadvantage of those prototypes was the absence of communication in particular areas. So, with the rapid developments and tremendous changes in technology we have lots of techniques to eradicate previous problems. Wireless communication protocols play a vital role in present trends.

3. PROPOSED SYSTEM

The proposed system's air quality microcontroller requires digital input; thus, the analogue output of the sensor was converted to digital form using an ADC and sent as an input to the microcontroller. These values are shown on the constantly. There was a switch pad for entry the crucial factor. The 12 buzzers will sound and a notice will be sent to the webpage on the mobile phone by the microcontroller through the GPRS module if the number of pollutants in the air exceeds the critical value specified. On the website, which is accessible from anywhere in the world, this information is constantly being updated. When the pollution level exceeds the crucial value, a notification was also sent to the website. The signal is received by the mobile phone from the modem and forwarded to the server and the internet. The data that the server receives from the smartphone is analysed. It draws conclusions from the data it has gathered and then distributes those conclusions through the internet. The wireless connection between the base station and the distant sensor node has been made possible by IOT modules. A MCU was utilised to manage every operation on the sensor node while the IOT modules interact via cellular networks. The MCU samples the sensor outputs using a built-in ADC, computes the gas concentrations, and sends the computed data as packets over the IOT.
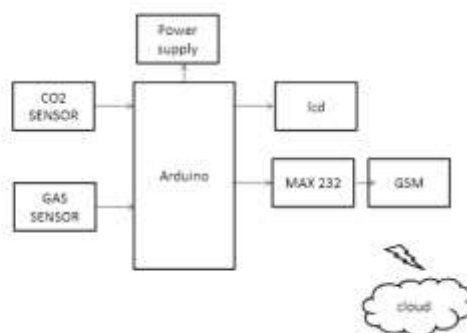
3.1. BLOCK DIAGRAM

Figure 1 : Block Diagram

4. REQUIREMENT ANALYSIS

4.1.HARDWARE REQUIREMENTS

4.1.1.ARDUINO UNO R3

A microcontroller board known as the Arduino Uno R3 is primarily based totally at the ATmega328. It contains 6 analogue inputs, a 16 MHz crystal oscillator, 14 digital input/output pins (six of which may be used as PWM outputs), a USB port, a power connector, an ICSP header, and a reset button. It comes with everything needed to support the microcontroller; to get started, just plug in a USB cable, an AC-to-DC converter, or a battery. The FTDI USB-to-serial driver chip is not used by the Uno, which is how it differentiates from all earlier boards. Instead, it has a USB-to-serial converter constructed in the Atmega16U2 (or Atmega8U2 as much as model R2) chip. The Uno board's revision 2 (A000046) features a resistor that pulls the 8U2 HWB line to ground to make it simpler to enter DFU mode.

4.1.2.GAS SENSOR

Gas sensors are electronic devices that detect the presence of gases in the air. They are widely used in various industries, including oil and gas, chemical, and pharmaceutical industries, to ensure workplace safety and compliance with regulations. Gas sensors can detect a wide range of gases, including toxic and combustible gases. There are several types of gas sensors, including electrochemical, catalytic, infrared, and photoionization detectors (PID). Electrochemical sensors are commonly used to detect toxic gases such as carbon monoxide, hydrogen sulphide, and ammonia. Catalytic sensors are used to come across flammable gases consisting of methane, propane, and butane. Infrared sensors are used to detect hydrocarbons and carbon dioxide, while PID sensors are used to detect volatile organic compounds (VOCs).

Figure 2 : Gas Sensor

4.1.3. NODE MCU

NodeMCU is an open-supply firmware and improvement package primarily based totally at the ESP8266 WIFI module.. It allows for easy development of IoT (Internet of Things) applications, as it provides a platform for both hardware and software development. The NodeMCU firmware is written In Lua, a light-weight scripting language that is simple to analyse and use.. NodeMCU is widely used for developing IoT applications such as home automation, smart agriculture, and industrial automation. It is distinctly flexible and may be used with a extensive variety of sensors and actuators, making it ideal for various applications. Its compact size and low power consumption make it suitable for use in low-cost, battery-powered devices.

Figure 3 – Node MCU

4.1.4.LCD

LCD stands for Liquid Crystal Display, it is a shape of flat panel display typically utilized in digital gadgets which includes televisions, laptop monitors, and cellular phones. An LCD consists of several layers of material sandwiched between two pieces of glass. The layers include a backlight, a polarizer, a layer of liquid crystal material, and another polarizer. The liquid crystal material in the LCD layer is controlled by applying an electric current, which causes it to change its polarization and either allow or block light passing through it. This creates the images and text displayed on the screen. LCDs offer several advantages over other display technologies, including low power consumption, high contrast ratio, and wide viewing angles.

Figure 4 – LCD

4.1.5.DC MOTOR

A DC motor can be used in a gas leakage monitoring system for several purposes, such as controlling the airflow for gas detection and ventilation purposes. For example, in a gas leakage monitoring system for industries, DC motors can be used to control the speed of the fans that circulate air in the system. This can help to maintain the appropriate airflow rate for accurate gas detection and efficient ventilation. DC motors can also be used in valves and pumps to control the flow of gases or liquids in the system. For instance, in a gas leakage monitoring system, DC motors can be used to control the opening and closing of valves in the gas pipelines to prevent gas leakage or to isolate the affected area in case of a gas leak. DC motors can also be used to control the flow rate of the gas or liquid through the pipelines or pumps.

Figure 5 – DC Motor

4.1.6. DC FAN

A DC fan consists of a rotor, which has several blades that rotate around a central axis, and a stator, which contains the motor and the electronic components that control the fan speed. The speed of the fan is determined by the voltage and current supplied to the motor. DC fans are available in various sizes and configurations, such as 80mm, 120mm, or 140mm, and can have different numbers of blades and shapes. DC fans offer several advantages over other types of fans, including low power consumption, quiet operation, and long lifespan. They are also easy to control using a simple voltage regulator or a pulse width modulation (PWM) controller, which allows for precise fan speed control.

Figure 6 – DC Fan

4.1.7.5V 2 CHANNEL RELAY

It is designed to control two separate circuits using a low voltage signal from a microcontroller or other digital device. The relay has two separate channels, each consisting of an input signal pin, a ground pin, and a set of normally-open (NO) and normally-closed (NC) output pins. When a 5V signal is applied to the input pin, the relay switches the state of the output pins from NO to NC or vice versa, depending on the relay's configuration. The 5V 2-channel relay can be used for a variety of applications, such as controlling lights, motors, or other devices. For example, in a home automation system, it can be used to turn on/off lights or appliances based on a trigger event, such as a motion sensor or a voice command. When using a 5V 2-channel relay, it is important to ensure that the input signal voltage and current are within the relay's specifications, and that the output pins are connected to the appropriate circuits or devices. Improper use or connection of the relay can damage the relay or the connected devices, so it is important to follow the manufacturer's instructions and guidelines.

Figure 7 – 5V 2 channel Relay

4.1.8. MALE BERG STICK CONNECTOR

I believe you may be referring to a "male Berg connector" or "male Berg stick connector". A Berg connector is a type of electrical connector that is commonly used in electronic devices and computer hardware. It consists of a male or female connector that is typically used to connect cables or circuit boards. A male Berg connector is a connector with pins that protrude from its end, which is designed to be inserted into a corresponding female Berg connector. The pins are usually arranged in a single or double row, depending on the type of connector, and are used to transmit electrical signals or power between the devices. Male Berg connectors are widely used in a variety of electronic applications, such as computer motherboards, disk drives, and power supplies. They are known for their durability and reliability, making them a popular choice in many industrial and commercial applications.

Figure 8 – Male Berg stick

4.2. SOFTWARE REQUIREMENT

4.2.1. Embedded C

An embedded gadget is a software that carries as a minimum one programmable computer (normally withinside the shape of a microcontroller, a microprocessor or virtual sign processor chip) and that's utilized by people who are, withinside the main, unaware that the machine is computer-based. Looking around, we discover ourselves to be surrounded with the aid of using diverse kinds of embedded systems. Be it a virtual digital digicam or a cellular telecall smartphone or a bathing machine, they all has a few sorts of processor functioning interior it .Associated with every processor is the embedded software. If hardware forms the body of an embedded system, embedded processor acts due to the fact the brain, and embedded software program software forms its soul. It is the embedded software program which basically governs the functioning of embedded systems. During infancy years of microprocessor-primarily based totally systems, packages have been advanced the usage of assemblers and fused into the EPROMs. There was once no mechanism to locate what this system turned into doing. LEDs, switches, etc. had been used to test accurate execution of the program. Some 'very fortunate' builders had In-circuit Simulators (ICEs), however they have been too pricey and have been now no longer pretty dependable as well. As time progressed, use of microprocessor-particular assembly-most effective because the programming language reduced And embedded structures moved onto C because the embedded programming language of choice. C is the maximum extensively used programming language for embedded processors/controllers. Assembly is likewise used however particularly to enforce the ones quantities of the code in which very excessive timing accuracy, code length efficiency, etc. are high requirements. Initially C turned into advanced via way of means of Kernighan and Ritchie to healthy into the gap of 8K and to write (portable) working systems. Originally it become applied on UNIX running systems. As it became meant for running structures development, it may control reminiscence addresses. Also, it allowed programmers to jot down very compact codes. This has given it the popularity because the language of desire for hackers too.

4.2.2. ARDUINO UNO

The Arduino Uno may be programmed with the Arduino software. Select "Arduino Uno from the Tools > Board menu (regular with the microcontroller to your board). The ATmega328 on the Arduino Uno comes reburned with a boot loader that allows you to upload new code to it without the use of an external hardware programmer. It communicates the usage of the unique STK500 protocol (reference, C header files). You also can skip the boot loader and application the microcontroller thru the ICSP (In-Circuit Serial Programming) header; see those commands for details. The ATmega8U2 firmware deliver code is available . The ATmega8U2 is loaded with a DFU boot loader, which may be activated with the aid of using connecting the solder Jumper at the lower back of the board (close to the map of Italy) after which resetting the 8U2. You can then use Atmel's FLIP software (Windows) or the DFU programmer (Mac OS X and Linux) to load a brand-new firmware. Or you may use the ISP header with an outside programmer (overwriting the DFU boot loader). See this user-contributed educational for greater information. Rather than requiring a bodily press of the reset button earlier than an upload,

the Arduino Uno Is designed in a manner that lets in it to be reset through software program strolling on a related computer. One of the hardware wafts manipulate lines (DTR) of the ATmega8U2 is hooked up to the reset line of the ATmega328 through a one hundred nano-farad capacitor. When this line is asserted (taken low), the reset line drops lengthy sufficient to reset the chip. The Arduino software program makes use of this functionality to can help you add code with the aid of using definitely urgent the add button withinside the Arduino environment. This approach that the boot loader may have a shorter timeout, because the decreasing of DTR may be well-coordinated with the begin of the upload. This setup has different implications. When the Uno is hooked up to both a pc walking Mac OS X or Linux, it resets on every occasion a connection is made to it from software (thru USB). For the subsequent half 2nd or so, the boot loader is going for walks at the Uno. While it's far programmed to disregard malformed data (i.e. whatever except an ad of latest code), it's going to intercept the primary few bytes of facts despatched to the board after a connection is opened. If a cartoon walking at the board gets one-time configuration or different information while it first starts, make sure That the software program with which it communicates waits a 2d after beginning the relationship and earlier than sending this data. The Uno contains a trace that can be cut to disable the auto-reset. The pads on either side of the trace can be soldered together to re-enable it. It's labelled "RESET-EN". You will also be capable of disable the auto-reset with the aid of using connecting a hundred- and ten-ohm resistor from 5V to the reset line; see this discussion board thread for details.

4.3. FUNCTIONAL REQUIREMENTS

To ensure the system works well, it has to support the following functional requirements:

[1]. The user shall be able to receive warning message as quickly as possible

[2]. The user shall be able to turn off the electricity.

[3]. The user shall be able to turn on the air refreshing device.

[4]. The user shall be able to view information of fire station.

[5]. The user shall be able to view nearest fire station.

[6]. The user shall be able to navigate to nearest fire station

[7]. The user shall be able to make call to 998.

[8]. The user shall be able to share his/her location

4.4 NON-FUNCTIONAL EWQUIREMENTS

Non-functional requirements "refer to behavioural properties that the system must have, such as performance an usability".

5. PROJECT DESIGN

5.1. Data Flow Diagrams:

● Each procedure ought to have at the least one enter and an output.

● Each data store should have at least one data flow in and one data flow out.

● Data stored in a system must go through a process.

● All processes in a DFD go to another process or a data store.
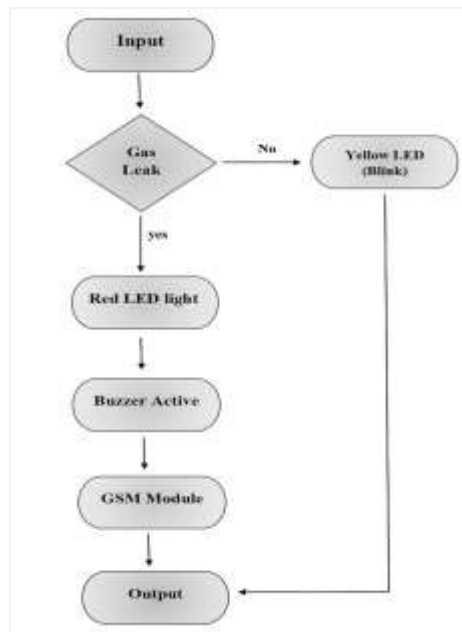
Figure 9 – Data Flow Diagram

6. RESULTS

6.1. Performance Metrics:

We will get the output for the **Gas Leakage Monitoring and Alerting System for Industries**. In the we measure the level of gas flow and location of gas where the gas was leaked and overflow.

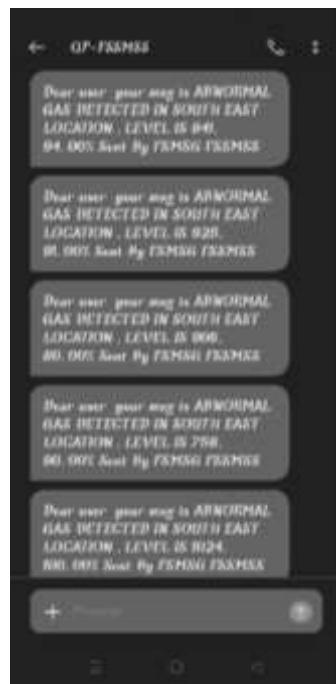Figure 10 – Gas Leakage & Overflow

6.2. ALERT NOTIFICATION

Figure 11 – Notification

7. ADVANTAGES AND DISADVANTAGES

7.1. ADVANTAGES

- The advantage this has over others is that it provides quick response rate and has faster diffusion of the critical situation than the manual methods.
- All the reviewed works aimed at developing systems capable of detecting gas leakages and sending an SMS alert to the user.
- The system enables monitoring of gas leakages in remote locations and thereby leads to a faster response time in the events of a leakage condition

7.2. DISADVANTAGES

- It is little sensitive to smoke then it is not perfectly response for LPG gas detection.
- Its sensitivity depends on Humidity and temperature.
- It increases the cost whereas digital systems reduce the cost of system.
- Toxic Nature and It is Highly Inflammable
- It is Non-Renewable Source of Energy and will eventually die out
- Polluting Water and Earth and Greenhouse Gas Emission

8. CONCLUSION

An embedded machine for risky fueloline detection has been implemented; right here most effective gases (LPG and Propane) were detected for demo purpose. The fueloline sensors and the crucial degree of the respective fueloline need to be known, after which this machine may be applied for Detecting numerous gases both in home place consisting of locations of tutorial institutions, residential and commercial regions which avoids endangering of human lives. This gadget offers short reaction fee and the diffusion of the vital state of affairs may be made quicker than the guide methods. Checking from claiming ph from claiming Water usage touching on sensor. Those frameworks may display screen water private pride automatically, moreover it sends word with commissioned character and does not require relatives on duty alternately bodily participation. Thereabouts those water nature trying need with be additional economical, helpful and quick. Those frameworks need useful adaptability toward swapping those relating sensors and evolving the

pertinent projects. This framework camwood be used to screen other water calibre parameters such as turbidity, temperature, broken down oxygen levels. This project will stretch out to figure the temperature of the water and the turbidity of the water (how clean the water is) and also the ph levels of the Water. In this manner this framework displays all of those elements additionally at final it sends the ones statistics or statistics Likewise a SMS with tell the ones sanctioned persons.

9. FUTURE SCOPE

The gas leakage monitoring and alerting system can be integrated with other systems such as fire suppression systems, ventilation systems, and emergency response systems to provide a more comprehensive safety solution for industrial environments. The system can be enhanced with machine learning algorithms to analyse historical data and provide predictive insights, such as identifying patterns or trends in gas leak incidents or predicting potential gas leaks based on real-time data. A wireless sensor network can be used to expand the monitoring area of the system, allowing it to cover a larger area and providing more comprehensive gas leak monitoring capabilities . The system can be enhanced with advanced alerting and reporting features, such as sending alerts to mobile devices or a central monitoring system, generating automated reports, and providing real-time data analytics . The system can be enhanced with remote control and automation features, such as the ability to remotely control the gas leakage monitoring system, adjust the gas threshold level, or activate/deactivate the alarm or ventilation system . The system can be enhanced with energy-efficient components, such as low-power sensors, energy-efficient displays, and power management features to reduce energy consumption and operating costs. These future enhancements can provide a more comprehensive, efficient, and effective gas leakage monitoring and alerting system for industries, ensuring the safety of workers and preventing potential accidents.

REFERENCES

- ZulhaniRasin and Mohd Abdullah International Journal Engineering & Technology, "Water leakage Monitoring System Using Zigbee Based Wireless Sensor Network", 2005.

- Misiunas, D., Lambert, M., Simpson, A., Olsson, G. "Burst detection and location in water distribution networks," Water Science and Technology: Water Supply, 5(3–4), 71–80. (2005).

- Bowling, Michael. "Leakage testing method for a plate heat exchanger." U.S. Patent 6,062,068, issued May 16, 2000.

- Daadoo, M., Tarapiah, S., &Atalla, S. (2016). Evaluating Efficiency of Multi-Layered Switch Architecture in All-Optical Networks. International Journal of Applied Engineering Research, 11(22), 11030-11036.

- Daraghmi, Y. A., &Daadoo, M. (2016). Intelligent Smartphone based system for detecting speed bumps and reducing car speed. In MATEC Web of Conferences (Vol. 77, p. 09006).EDP Sciences.

- MotazDaadoo, Shadi M.A Atallah and SaedTarapiah. "Development of Low-Cost Safety Home Automation System using GSM Network ."European Journal of Scientific Research ISSN 1450-2267 Vol. 53 No 3 November, 2016, pp.338-353.

- MotazDaadoo, SaedTarapiah and Shadi M.A Atallah. "Analysis and Performance of a Low-Cost Multiple Alarm Security System for Smart Home Based on GSM Technology and Controlling Based on Android Smartphone." European Journal of Scientific Research ISSN 1450-216X / 1450-202X Vol. 143 No 2 November, 2016, pp.136-165.

- Daadoo, M., & Daraghmi, Y. (2015, August). Searching of optimum characteristics of multi-layer switching architecture in all-optical networks. In Heterogeneous Networking for Quality, Reliability, Security and Robustness (QSHINE), 2015 11th International Conference on (pp. 50-55). IEEE.

- Tarapiah, S., Atalla, S., Hashim, K. F. B., &Daadoo, M. (2016). Mobile Network Planning Process Case Study-3G Network. Computer and Information Science, 9(3), 115.