American Journal of Engineering Research (AJER)
e-ISSN: 2320-0847 p-ISSN : 2320-0936
Volume-7, Issue-1, pp-346-352
www.ajer.org
Research Paper Open Access

Prototype Development Of An Oil Fluid Parameters Monitoring System With Sms Alert

Ezeofor C.J.[1], Onengiye M. G.[2]
[1]Electronic Engineering Department, University of Port Harcourt, Rivers State, Nigeria.
[2]Rector, Ken Saro-Wiwa Polytechnic Bori, Rivers State, Nigeria
Corresponding Author: Ezeofor C.J.

ABSTRACT: *This paper presents a prototype development of an oil fluid parameters monitoring system with SMS alert. It has been observed that in many oil servicing/plant Maintenance Company, some personnel are employed to measure and monitor fluid parameters such as flow rate, temperature, pressure drop and level (taking periodic readings). The process is found to be very challenging and rigorous and calls for serious concern. To solve the said problem, developing a system that will reduce stress of manual monitoring of fluid parameters and report the same to the personnel for necessary action is proposed. The proposed system comprises of the hardware and software. The hardware part has four units namely, power supply, input, control and output which was designed using top-down system design approach. The software that controls the entire system is written in C programming language. Thereafter, various units assembled and tested. When the system is functional, the sensors measure various parameters of the fluid and send the signals to microcontroller for processing.Theprocessed data are sent to the display unit and the personnel mobile phone for alert notification. The result gotten is very precise and accurate. Also, simulation was carried out in PROTEUS to analyse the system performance. This system is cost effective and can be deployed in oil servicing company for fluid parameters monitoring.*

Keywords –*Oil Fluid, Microcontroller,PROETUS, SMS Alert,C language*

Date of Submission: 15-01-2018 **Date of acceptance: 9-02-2018**

I. INTRODUCTION

In Oil Servicing/Plant Maintenance Company, the most commonly used form of oil transportation is through oil pipelines. Pipelines are typically used to move crude oil from the wellhead to gathering and processing facilities and from there to refineries and tanker loading facilities [1]. Pipelines require significantly less energy to operate than trucks or rail and have a lower carbon footprint. Pressure wave may occur in pipelines transporting fluids if the velocity of the flowing liquid suddenly changes. Oil workers are employed to manually measure and monitor fluid (oil) parameters (like flow rate. level, pressure,temperature etc.)flowing in a pipeline and the process isalwayschallenging and rigorous. The monitoring and reading of the fluid parameters is done at a periodic time as observed and if not monitored, it can lead to burst and product wastage. The mass flow rate of a fluid can be controlled by controlling the pressure drop over the pipeline which gives only the approximate mass-flow rate because fluid density varies with temperature and pressure in the line [2-16]. By measuring temperature, pressure drop, level, etc. and send them to the operator mobile phone, the mass-flow of the fluid can be controlled.

II. REVIEW OF RELATED RESEARCH WORK

Ravi S. et al. (2016) developed Pipeline monitoring system using Vibroacoustic sensing. In their work, they discovered that Vibroacoustic Sensing is an emerging technique for detection of leaks and foreign particles in fluid transportation pipelines [17]. This sensing is based on the remote identification of fluid transients and pipe shell vibrations produced by interaction with pipe or flow. The system performance is a function of the thermodynamic properties of the fluids, which can be separated into liquid, gases and multiphase mixtures.

While liquid is considered incompressible, Gases and mixtures sustain strong volume variations, thus producing variable flow conditions along the pipelines.Jong-Hong Kim et al. (2015) developed an Autonomous pipeline monitoring and maintenance system using RFID-Based Approach. In their work, they discovered that the existing monitoring and maintenance systems are costly and inefficient because pipelines can be installed in large scale and in an inaccessible and hazardous environment. To overcome these challenges, a novel Radio Frequency Identification (RFID)-based Autonomous Maintenance system for Pipelines, called RAMP, which combines robotic, sensing, and RFID technologies for efficient and accurate inspection, corrective reparation, and precise geo-location information was proposed. One prominent advantage of RAMP is that it can be applied to a large variety of pipeline systems including water, sewer, and gas pipelines [18]. Simulation results demonstrated the feasibility and superior performance of RAMP in comparison to the existing pipeline monitoring systems. Yunana et al. (2017) developed pipeline Infrastructure Vandalism Monitoring Using Wireless Sensor Networks Technique. They discovered that Wireless Sensor Networks are crucial substructure made up of microcontroller, sensing units and communication interfaces that are designed to enable the system possess the capability to measure, collect and responds to phenomenon within the monitored environment. WSN are viewed as an edge between the physical and the virtual world. More so, the demand of fluid transportation from the production point to the region of end users has led to an increase in the number of pipelines that are fabricated globally. Their work presentedanarchitecture deployed to measure the flow rate, pressure and temperature at the inlet and outlet of the pipeline and then send the sensed data to the control centre via their communication links for immediate response [19]. The simulation procedure carried out using MATLAB Simulink environment shows the capability of the system to detect leakage along the pipeline as evident in the flow and pressure measurement trend of the graphical output results.

III. SYSTEM DESIGN APPROACH

The System comprises of Transmitter and Receiver. The transmitter section is made up of power supply, input, control and output units (fig.1). The receiver section is the personnel mobile phone to receive alert of oil fluid data in an interval of time.

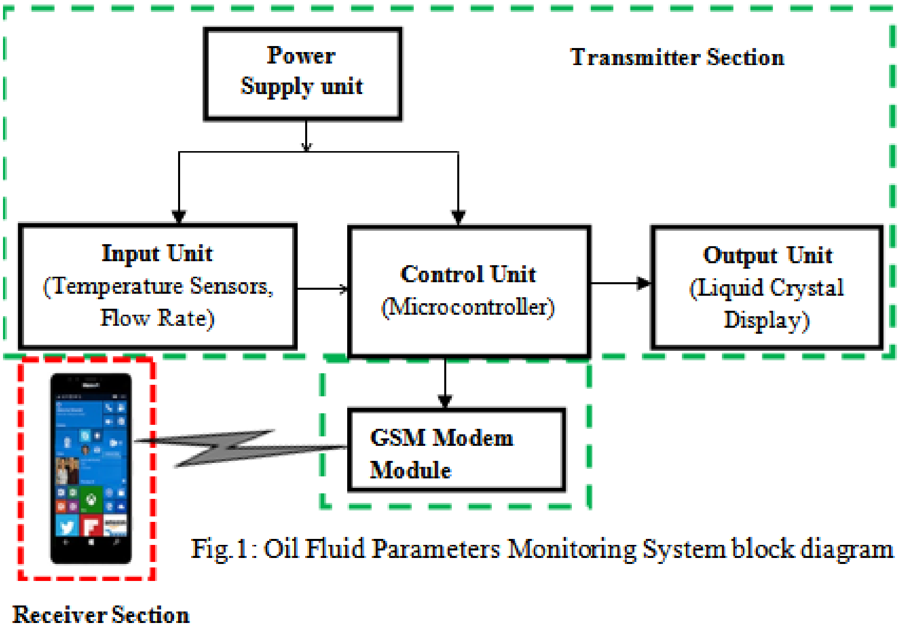

Fig.1: Oil Fluid Parameters Monitoring System block diagram

3.1Transmitter Section

This section shows various modules of the system and the circuit diagram comprising of the modules is shown in fig. 2.

3.1.1: Power Supply Unit: This unit provides power to the entire system. The DC voltages required are +5V and +12V. The +5v and +12 DC voltages for the system was designed based on the voltage required to power each component as specified in the manufacturer's data sheet. Transformer was used to step down the 240V AC mains voltage to about 12V AC. The rectifying diodes were used to converts the AC Voltage to DC voltage.

Electrolytic capacitor of 1000µF/35V was used to filter ripples and regulators of 7805 and 7812 were used to regulate +5V and +12V DC as needed.

3.1.2: Input Unit: Three sensors were used to convert the temperature, pressure, and flow rate of the oil fluid parameters being measured into electrical signals and send to the microcontroller for further processing.
Water Proof Temperature Sensor (DS18B20): The **DS18B20** sensor is a three-terminal device used to read the temperature of the fluid in the pipe and communicate the same to the microcontroller.
Flow Rate Sensor (HC-SR04): The water flow sensor is used to measure the flow rate (level of fluid flow) from the reservoir through pipeline to the destination. It has four terminals, the pins-out, Echo and trigger. The V_{cc} and the G_{nd} pin-outs are connected to the 5V and the G_{nd} of the voltage regulator respectively. The trigger pin is used to send a sound out within 10us which reflects back from the surface of the water before the distance is measured.

3.1.3: Control Unit: The microcontroller ATMEGA328is usedto process signals from the sensors and control the all the activities and finally send the processed data to the display unit and mobile operator.
3.1.4: Output Unit:displays the processed signals from the microcontroller and send data to the receiver's end.
The Liquid Crystal Display: this uses 16x2 LCD to display the processed data of the system. The device is integrated in the transmission section for quick view.
GSM Module: This module is used by the system to send data to the receiver's mobile phone anywhere at any time. The microcontroller communicates with the GSM module via the use of its serial port. The serial port has transmission terminal (T_x) and the receiver terminal (R_x). The baud rate of transmission of data is 9600 bits per second. The microcontroller and the GSM module communicate using the same baud rate of 9600 bps.

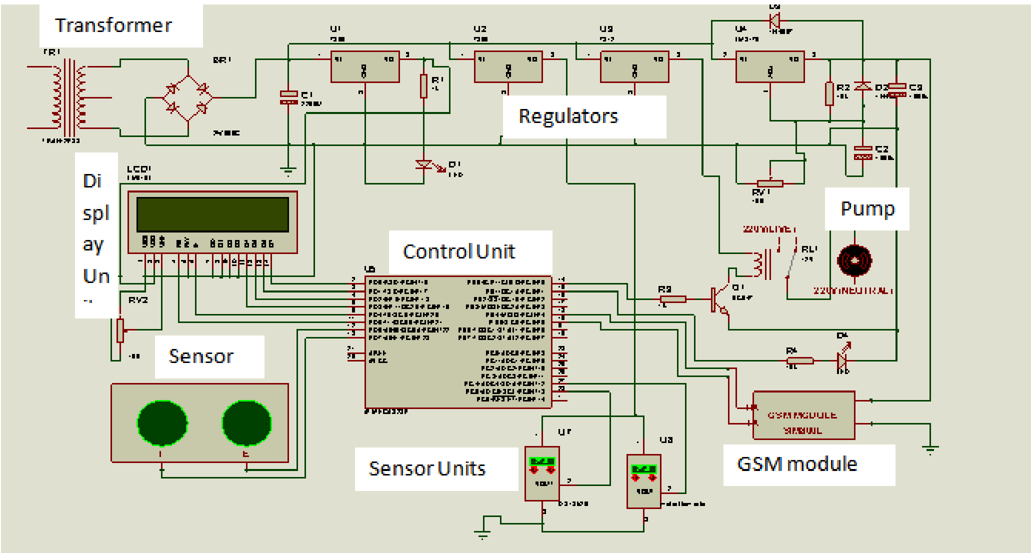

Fig.2:The circuit diagram of the Oil Fluid measuring system

3.2: Receiver Section
This section is used to receiver data from the transmission end by the monitoring operator (fig.3). The operator can be anywhere to receive the data. No limit for receiving the measured parameters for necessary action.

Fig.3: Operator's mobile phone

3.3Transmitter Hardware Modules Assembled
The system modules as described above were assembled as shown in fig.4.

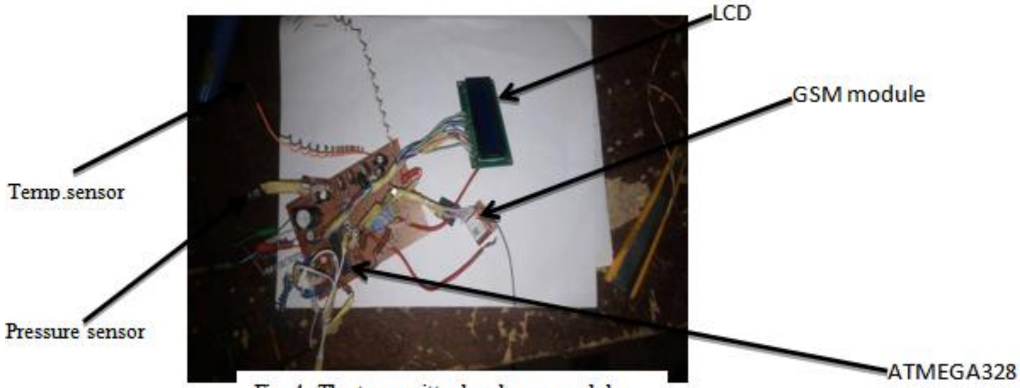

Fig. 4: The transmitter hardware modules

The modules are integrated to meet the research objectives.
3.4 System Algorithm and Flow Chart
The system uses this algorithm below to get data from the sensor, process the data and send to the respective output devices. The flow chart is shown in fig.5

Step 1: The system is switched ON
Step 2: the microcontroller and the timer is activated
Step 3: the size of the reservoir is read as 10L
Step 4: Initial time T_i as 1sand check T_f as 120s
Step 5: Check for the quantity of water in reservoir tank
i.) If the quantity of water is ≥5L proceeds to read time of operation
ii.) If not turns on pump
Step 6: Check if time of operation is equal to 120s,
i.) If yes, it reads parameter
ii.) If no, it keeps checking until the time of operation is 120s
Step 7: Transmit parameter to mobile phone
Step 8: Set time of operation to T_i = 1s, and goes back to read parameter at 120s.

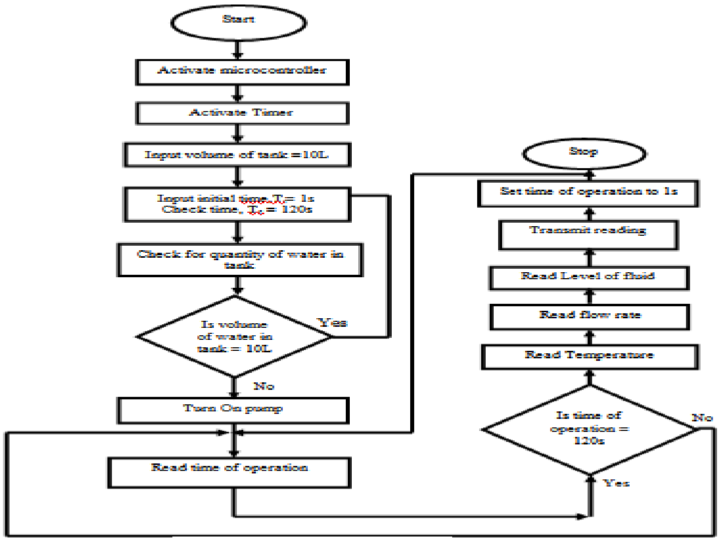

Fig.5: System flow chart diagram

IV. SYSTEM TESTING AND PACKAGING

1.1 System Testing

Various modules of the transmitter sectionwere tested and confirmed ok before mounting on the fluid reservoir. The pressure sensor is mounted on the body of the pipe to sense the pressure drop. Ultrasonic sensor is mounted on top of the reservoir to sense the level of the fluid. The temperature sensor dipped inside the fluid to help read the temperature of the fluid and its surrounding.

1.2 System packaging

The system is packaged in a rectangular box with LCD and mounted on the left side of the reservoir wall as shown in fig.6. Two Plastic rectangular boxes are used as Industrial reservoirs where fluids are pumped in.

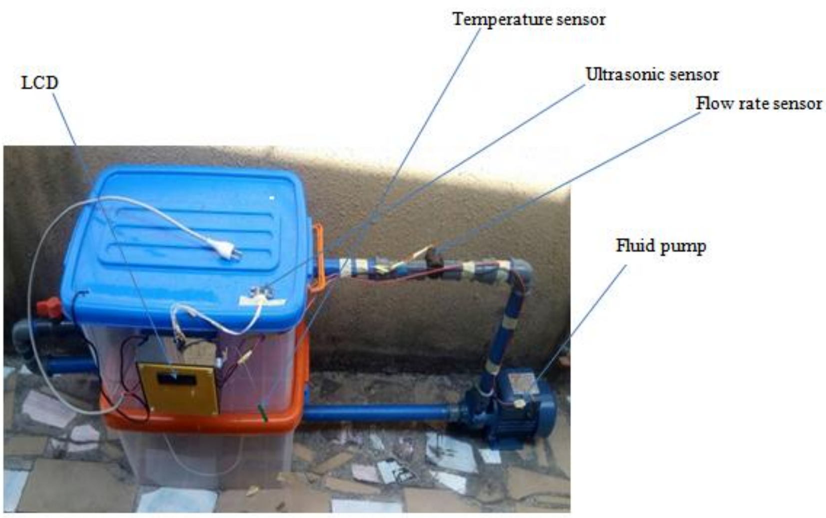

Fig.6: The system installed and tested

V. CONCLUSION

Measurement of oil fluid parameters such as flow rate, temperature, pressures drop, density, fluid level etc. have been a very rigorous process and oil workers get tired of measuring and monitoring these parameters. Implementation of such system that could measure and monitor this process is a welcome development in Nigeria Oil and Gas Industries. This research addresses the conventional measuring process found in the offshore and onshore environmentsto more efficient measuring process that can stand test of time. Oil and Gas and Servicing Industries need this system to encourage accuracy and efficient measuring process in their respective pipeline network environments.

ACKNOWLEDGEMENTS

We would like to express our deepest appreciation to God for making this paper a success. Special thanks to our families for all their moral and financial support throughout the research work. Also our appreciation goes to AJER editors, for their commitment and quick response in attending to journal papers.

REFERENCES

[1]. Akyildiz, I.F., &Stuntebeck, E.P. (2006).“Wireless underground sensor networks: Research challenges.’*Ad Hoc Networking*. 4, (pp. 669–686.)

[2]. Ali, M. S., Metje, N., Chapman D. N.,&Anthony C. J. (2014).“Smart Pipes: Smart Wireless Sensor Networks Pipelines Detection in Water Pipelines.”*JournalofSensor and Actuator Networks.*, 3, (pp. 64-78).

[3]. Ahrary, A., Nassiraei, A., Kawamura, Y., Mikuriya Y., &Ishii K. (2007).‘Concept and Design of a fully autonomous sewer pipe inspection mobile robot “KANTARO” ‘*The International Conference on Robotics and Applications (ICRA)*, IEEE. (pp. 136–143)

[4]. Christin, D., Reinhardt, A., Mogre, P.S., & Steinmetz, R. (2009).“Wireless Sensor Networks and the Internet of Things: Selected Challenges”. *In Proceedings of the 8th GI/ITG KuVSFR.achgesprächDrahtloseSensornetze, Hamburg, Germany.*(pp. 31–33).

[5]. Giunta G., Bernasconi G., & Del Giudice S. (2013) “Vibroacoustic Monitoring of Gas-Filled Pipelines”. *ASNT Fall Conference and quality testing show, Las Vegas, Nevada, USA.*

[6]. Giudice, S., Rovetta, D., Schiavon, R.,&Zanon, F. (2011b). “Third Party Interference and Leak Detection on Buried Pipelines for Reliable Transportation of Fluids.” *10th Offshore Mediterranean Conference, Ravenna, Italy.*

[7]. Kingajay, M.,&Jitson, T. (2008). “Real-time laser monitoring based on pipe detective operation.”*Proc.World Acad. Sci. Eng. Technol.*, 44.(pp. 127–132).

[8]. Kim,J-H. (2008). “Design of a fully autonomous mobile pipeline exploration robot (FAMPER). Master’s thesis.” *Department of Computer Science, Louisiana State University*,(http://etd.lsu.edu/docs/available/etd-11112008-121037/)

[9]. Kim, J. H., Sharma, G., &Iyengar, S.S. (2010) FAMPER: A fully autonomous mobile robot for pipeline exploration.*The International Conference on Industrial Technology (ICIT).* (IEEE).(pp. 517–523)

[10]. Kwon, Y. S., Lim, H., Jung, E. J., &Yi, B.J. (2008). “Design and motion planning of a two-moduled indoor pipeline inspection robot”. *The International Conference on Robotics and Applications (ICRA).* (IEEE). (pp. 3998–4004)

[11]. Khulief, Y.A., Khalifa, A., Ben Mansour, R.,&Habib, M.A. (2012)“Acoustic detection of leaks in water pipelines using measurements inside pipe”. *J. Pipeline Syst. Eng. Pract*3, 47–54.

[12]. Liu, Z., Kleiner, Y. (2012) “State-of-the-art review of technologies for pipe structural health monitoring*” IEEE Sens. J., 12*, 1987–1992.

[13]. Mohamed, N., &Jawhar, I. (2008). Fault tolerant wired/wireless sensor network architecture for monitoring pipeline infrastructures”. *The Second International Conference on Sensor Technologies and Applications (SENS*ORCOMM). (IEEE).(pp. 179–184)

[14]. Nakhkash, M. (2004) “Water Leak Detection Using Ground Penetrating Radar*”. In Proceedings of the 10th International Conference on Ground Penetrating Radar, Delft, The Netherlands, 21–24 June;*(pp. 525–528.)

[15]. Ravi, S.,KarthikRajS.,Sabareesan S.,& Kishore R.(2016) “Pipeline Monitoring Using Vibroacoustic Sensing”. *International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056, Volume: 03 Issue: 01 | Jan-2016*. (pp.1095-1099)

[16]. Jong-Hoon Kim et al (2015).'Autonomous pipeline monitoring and maintenance system: a RFID-based approach', School of Computing and Information Sciences, College of Engineering and Computing, Florida International University. Kim et al. EURASIP Journal on Wireless Communications and Networking (2015) 2015:262

[17]. Yunana, Kefas et al (2017).' Pipeline Infrastructure Vandalism Monitoring using Wireless Sensor Networks Technique', International Journal of Computer Science and Telecommunications [Volume 8, Issue 2, March 2017].

[18]. Sinha, S.K., &Knight, M.A. (2004)"Intelligent system for condition monitoring of underground pipelines". *Comput. Civ. Infrastruct. Eng. 2004, 19, 42–53*

[19]. Tao, J., Peiwen,Q., &Zhengsu, T. (2004) "Development of magnetic flux leakage pipe inspection robot using hall sensors". *The International Symposium on Micro-Nanomechatronics and Human Science (MHS).*(IEEE,2004), (pp. 325–329

Ezeofor C.J."Prototype Development Of An Oil Fluid Parameters Monitoring System With Sms Alert" American Journal of Engineering Research (AJER), vol. 7, no. 1, 2018, pp. 346-352.