# SMART OIL FIELD MANAGEMENT USING WIRELESS COMMUNICATION TECHNIQUES

**Dr. S.R.BOSELIN PRABHU, ** Dr. E.GAJENDRAN, *** N.BALAKUMAR**

**Assistant Professor, Department of Electronics and Communication Engineering,*
*SVS College of Engineering, Coimbatore, India*
***Professor, Department of Information Technology,*
*St.Martin's Engineering College, Hyderabad.*
****Assistant Professor, Department of Electrical and Electronics Engineering,*
*Tamilnadu College of Engineering, Coimbatore, Tamilnadu, India.*

## ABSTRACT

*This paper 'Managing Oil Field Industry Based on Embedded wireless Communication' explains about the security provided to the oil field industry using the embedded technology. The wireless communication security system adopts two levels. The microcontroller used is PIC (Programmable Integrated Circuit) microcontroller which has the benefit of low power consumption and also aimed to perform direct control to the Oil Field Industry. The system level consists of a wireless receiver and a transmitter which operates with the help of the wireless Zigbee Technology, which directly sends the information to the duty room which is operated by an operator. The sensors used are float sensor, temperature sensor, LPG sensor and PIR (Pyro Infra Red) sensor which continuously monitors the entire Oil Field Industry.*

***Keywords***-*Oil field, wireless embedded systems, wireless communication, Zigbee.*

## I. INTRODUCTION

The international price of petroleum has been kept at a high level in recent years, so production efficiency on domestic oilfield is urgently needed to be improved, new requirements for oilfield information construction is raised. The Distribution State of working environment in oilfield industry is very special, because the oil-well is distributed dispersedly, also the distribution area is very wide, and so there is a possibility of theft in the oil field industry. There is a chance of petroleum being stolen, transmission line being stolen, transformer being stolen, which has become a risk for the management. With Consideration of the objective conditions, restriction of geographical environment, the implementation of safety measures for the oilfield industry is very difficult for the management. The remote wireless monitoring and control system is a perfect scheme. This system can improve the level of oilfield security, enhance the security checking and

strengthen the management by digitalization and getting information. This technique could also reduce the loss of economic of the country in an effective manner [1-6].

*A. PIC Microcontroller*

The microcontroller which has been used for this project is from PIC series. PIC microcontroller is the first RISC (Reduced Instruction Set Computer ) based microcontroller fabricated in CMOS (complementary metal oxide semiconductor) that uses separate bus for instruction and data allowing simultaneous access of program and data memory. The main advantage of CMOS and RISC combination is low power consumption resulting in a very small chip size with a reduced number of pin counts. The main advantage of the CMOS is, it has immunity to noise than other fabrication techniques. A single PIC (master) can control up to five analogue channels. However, there are situations where more channels are needed to supervise the zone. Adding more PICs (slaves), we can increase this number. In these cases, the new PICs will use the SSP for communicating with the master PIC. These communications are always driven by the master.

*B. Sensors*

A sensor is a device that measures a physical quantity and converts it into a signal which can be read by an observer or by an instrument. A thermocouple converts temperature to voltage which can be read by a voltmeter [7-15]. For accuracy, all sensors need to be calibrated. Sensors are used in everyday objects such as touch-sensitive elevator buttons and lamps which dim or brighten by touching the base.

*C. Wireless Communication*

ZigBee is a well-established wireless technology for wireless personal area networking (WPAN), i.e., digital radio connections between computers and related devices. This kind of network eliminates use of physical data buses like USB and Ethernet cables. The devices could include telephones, hand-held digital assistants, sensors and controls located within a few meters of each other. Other standards like Bluetooth and IrDA address high data rate applications such as voice, video and LAN communications. The ZigBee alliance has been set up as “an association of companies working together to enable reliable, cost-effective, low-power, wireless networked, monitoring and control products based on an open global standard”.

## II. THE PIC MICROCONTROLLER

The microcontroller which has been used in this project is from PIC series. PIC microcontroller is the first RISC based microcontroller fabricated in CMOS that uses separate bus for instruction and

data allowing simultaneous access of program and data memory. A single PIC (the master) can control up to five analogue channels. However, there are situations where more channels are needed to supervise the zone. Adding more PICs (slaves), we can increase this number. In these cases, the new PICs will use the SSP for communicating with the master PIC. In these communications, they will interchange actuation data and channel data. Moreover, these communications are always driven by the master. The slave PICs in a RCU do not utilize the USART (Universal Asynchronous Receiver/ Transmitter), because only the master needs to communicate with other control units.

## III.SENSORS

A sensor is a device that measures a physical quantity and converts it into a signal which can be read by an observer or by an instrument.

*A. Temperature Sensor*

A Thermistor is a type of resistor used to measure temperature changes, relying on the change in its resistance with changing temperature.

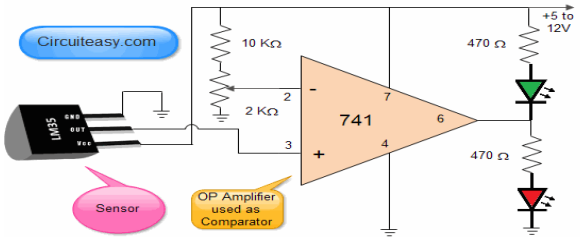


Figure 1: Temperature Sensor Circuit

Here we are using negative temperature co-efficient in which the resistance value is decreased when the temperature is increased. Initially the reference voltage is set to room temperature level so the output of the comparator is zero [16-21]. When the temperature is increased above the room temperature level, the Thermistor resistance is decreased so variable voltage is given to comparator.

*B. Gas Sensor*

Gas Sensor is an ideal sensor to detect the presence of a dangerous LPG leak in a service station, storage tank environment. This unit can be easily incorporated into an alarm unit, to sound an alarm or give a visual indication of the LPG concentration. The sensor has excellent sensitivity combined with a quick response time.

The gas sensor is the special sensor which is designed for to sense the gas leakage. In the gas sensor the supply voltage is given to input terminal. The gas sensor output terminals are connected to non inverting input terminal of the comparator as shown in the fig 2.

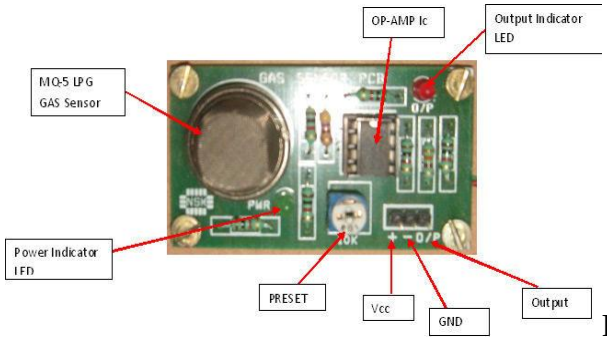


Figure 2: Gas Sensor Circuit

*C. Float Sensor*

Float sensor is the one type of transducer which is used to measure the water level in the tank. It is shown in Fig 3 [22-26].

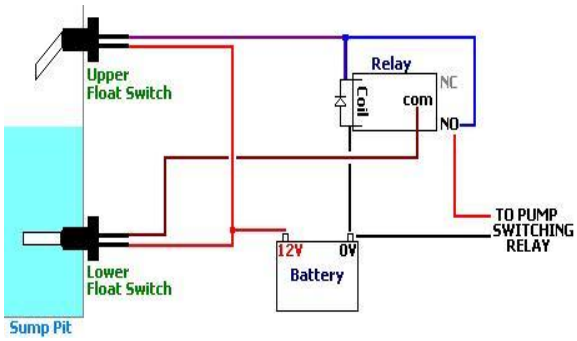


Figure 3: Float Sensor Circuit

The float changes the resistance value depending on the water level. This change is resistance is converted into corresponding voltage signal which is given to inverting input terminal of the comparator. Then the final voltage is given to ADC for converting the analog to digital signal. Then the corresponding digital signal is given to microcontroller in order to find the water level in the tank.

*D. PIR Sensor*

A PIR sensor is one that detects changes in heat radiation with respect to movement and distance. When a heat source passes in front of the sensor, it emits an analog positive or negative voltage swing.

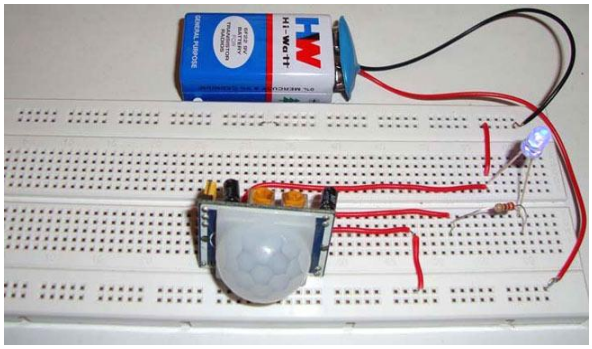


Figure 4: PIR Sensor Circuit

These are connected in anti-phase, so that the output from one device cancels out the signal from the other, and the combined output from them is zero. With someone moving across the monitored area are different, and the sensors are orientated such that heat signal is directed first to one sensor then to the other as the infrared beam sweeps across the device.

*E. Control units for the sensors*

The control unit for the sensors and actuators is a device which is based on a PIC (Programmable Integrated Circuit) Microcontroller. Its main functions are measurement of environmental conditions and interaction with the plant by means of its actuators. All these tasks are managed through low-level software developed for the microcontroller. The features of PICs make them well suited for direct control tasks. The PICs have 5 analog inputs connected to an internal 8-bit multi channeled analog-to-digital converter, an USART that allows synchronous and asynchronous communications, a synchronous serial port (SSP) for high-speed communications with other peripheral or microcontroller devices, and several digital I/O lines.5 Signal range from the sensors is adjusted through signal conditioning circuits which are connected to the analogue inputs.

The master PIC sets up communications with the other remote control units (RCU) or with the supervisory and control unit (SCU) through a RF transmission circuit. During communications between units, they interchange messages. This is based on UDP (User datagram protocol) protocol for computer network communications. Each message field, with the exception of the data field, is a byte (8 bits). The size of the data is related to the message type. The source and destination field determine the transmitter and the desired receiver of the message.

Every control unit has an 8-bit identification number (0–255). This number is used to check when a message is aimed at the unit. Thus, a unit only processes messages whose destination field agrees with its identification number. The length field indicates the number of bytes in the

message, excluding the checksum byte. Finally, the link messages allow the sending of messages from a unit towards another remote one, using a third unit which is closer to the first. The maximum number of actuators that can be controlled by a PIC is equal to its number of acquisition channels or sensors [27-28].

The environmental conditions measured by the sensor are used to determine the commands to send towards its actuator. However, the SCU can occasionally control the actuators of RCUs independently from the measurements of the sensors.

*F. Supervisory and control unit*

The supervisory and control unit is composed of a high-performance micro- controller. The main function of a microcontroller is to control, from its remote position, the conditions registered at the measurement points. SCU uses an internal table where it stores the characteristics of each channel: reference values, actuation mode, time for the next communication with a RCU, etc. All this information allows there to be actuation points – where all the actuators are located – which are different from the measurement points.

## IV. ZIGBEE TECHNOLOGY

ZigBee is a wireless communication standard that provides a short-range, cost effective] and networking capability. It has been developed with the emphasis on low-cost, battery-powered applications, such as building automation, industrial and commercial controls, marine wireless, and personal healthcare and advanced tagging.

ZigBee enabled products are rapidly being developed in the market to provide a simple, low cost implementation route.. The inbuilt ADC of PIC microcontroller converts this analog data to digital form. The parallel data received is converted to serial data by the inbuilt USART. The Zigbee at the receiving side receives the transmitted data. It outputs voltage increases by 10mv for each degree of centigrade temperature. Hence we need an analog to digital converter to translate the analog signals to digital numbers, so that the microcontroller can access them.

## V.CONCLUSION

Thus by transmitting the sensed data to the operator, through the wireless transmitter and by taking appropriate action in time, security can be provided to the oil field industry in a perfect manner. The techniques involved in this project provides fast data transfer by means of Zigbee wireless communication technology and also it continuously monitors the industry by means of different sensor, thus it provides security not only to the industry but also to the human life.

## REFERENCES

[1] Keller, Hans J.; Cima, D.i "Achieving High Reliability in Passive Infrared Intruder Alarms with Liihium Tantalate
Pyroelectric Detectors". Proc. SPIE. Vol.395, pp 238-248, Geneva 1983.

[2] US Patent 3.569,709, Martin R.Wank, Application dated Mar.27,

[3] Curtis D. Johnson, Process Control Instrumentation Technology (Prentice Hall, Englewood Cliffs, NJ, 1997).

[4] M. Rodríguez, A. Ayala, F. Herrera and F. Priano, 'Greenhouse automation through computer and Hertzian link', Intl. J. Elec. Enging Educ., 33 (1996), 66–88.

[5] Hamid Ali Abed Al-Asadi, "Temperature dependence of the lasing characteristics of vertical cavity surface emitting lasers," Engineering Journal of Technology University, Vol. 145, 1994.

[6] Boselin Prabhu S.R. and Sophia S., "Environmental monitoring and greenhouse control by distributed sensor Network", International Journal of Advanced Networking and Applications, 5(5), 2014.

[7] Boselin Prabhu S.R. and Sophia S., "Greenhouse control using wireless sensor network", Scholars Journal of Engineering and Technology, 2(4), 2014.

[8] Hamid Ali Abed Al-Asadi, "Temperature dependence of the noise characteristics of Multiisection semiconductor lasers," Science Journal, vol. 7, No. 3, 2001.

[9] Hamid Ali Abed Al-Asadi, "Linewidth characteristics of vertical cavity surface emitting lasers due to external optical feedback," Science Journal, vol. 8, 2001.

[10] Boselin Prabhu S.R. and Sophia S., 'Modern cluster integration of advanced weapon system and wireless sensor based combat system', Scholars Journal of Engineering and Technology, 2(6A), 2014.

[11] Boselin Prabhu S.R. and Sophia S., 'A review of efficient information delivery and clustering for drip irrigation management using WSN', International Journal of Computer Science and Business Informatics, 14(3), 2014.

[12] Hamid Ali Abed Al-Asadi, "Linewidth characteristics of vertical cavity surface emitting lasers due to external optical feedback," Science Journal, vol. 8, 2002.

[13] Hamid Ali Abed Al-Asadi, "Theoretical investigation of spectral linewidth properties of double fused 1.3 um MQW-VCA in reflection and transition modes," Tikrit Journal for Pure Science, vol. 8, No. 2, 2002.

[14] Boselin Prabhu S.R. and Sophia S., 'Mobility assisted dynamic routing for mobile wireless sensor networks', International Journal of Advanced Information Technology, 3(3), 2013.

[15] Boselin Prabhu S.R. and Sophia S., 'A review of energy efficient clustering algorithm for connecting wireless sensor network fields', International Journal of Engineering Research and Technology, 2(4), 2013.

[16] Hamid Ali Abed Al-Asadi, "Vertical cavity amplifiers and its cavity length dependence the

saturation power and quantum efficiency," Tikrit Journal of Pure Science, vol. 9, No. 2, 2003.

[17] Hamid Ali Abed Al-Asadi, "Effects of pump recycling technique on stimulated Brillouin scattering threshold: A theoretical model," Optics. Express, Vol. 18, No. 21, pp. 22339-22347 Impact factor: 3.88, 2010.

[18] Boselin Prabhu S.R. and Sophia S., 'Variable power energy efficient clustering for wireless sensor networks', Australian Journal of Basic and Applied Sciences, 7(7), 2013.

[19] Boselin Prabhu S.R. and Sophia S., 'Capacity based clustering model for dense wireless sensor networks', International Journal of Computer Science and Business Informatics, 5(1), 2013.

[20] Hamid Ali Abed Al-Asadi, "Brillouin Linewidth Characterization in Single Mode Large Effective Area Fiber through the Co-Pumped Technique," International Journal of Electronics, Computer and Communications Technologies (IJECCT), Vol. 1(1), pp. 16-20, 2010.

[21] Boselin Prabhu S.R. and Sophia S., 'An integrated distributed clustering algorithm for dense WSNs', International Journal of Computer Science and Business Informatics, 8(1), 2013.

[22] Boselin Prabhu S.R. and Sophia S., 'A research on decentralized clustering algorithms for dense wireless sensor networks', International Journal of Computer Applications, 57(20), 2012.

[23] Hamid Ali Abed Al-Asadi, "Analytical study of nonlinear phase shift through stimulated Brillouin scattering in single mode fibre with pump power recycling technique,", Volume 13 Number 10, Journal of Optics. Impact factor: 1.99, 2011.

[24] Hamid Ali Abed Al-Asadi , "Architectural Analysis of Multi-Agents Educational Model in Web-Learning Environments," Journal of Emerging Trends in Computing and Information Sciences, Vol. 3, No. 6, June 2012.

[25] Boselin Prabhu S.R. and Sophia S., 'Hierarchical distributed clustering algorithm for energy efficient wireless sensor networks', International Journal of Research in Information Technology, 1(12), 2013.

[26] Boselin Prabhu S.R. and Sophia S., 'Real-world applications of distributed clustering mechanism in dense wireless sensor networks', International Journal of Computing Communications and Networking, 2(4), 2013.

[27] J. M. Angulo, E. Martín and I. Angulo, Microcontroladores PIC, (Paraninfo, 1997).

[28] J. M. Angulo and I. Angulo, Microcontroladores PIC. Diseño práctico de aplicaciones (McGraw- Hill, NewYork, 1997). Microchip, www.microchip.com