

# Measurements in Sensor Network based Oil Monitoring Control

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## ABSTRACT

Wireless Networks gained great attention in recent years. In this paper, the proposed Sensor Network Based Oil monitoring system a demo design is proposed. Our system takes the measurements of fluid levels by installed sensors in fluid storing tank. This system works with the 3 oil tanks (tank A, B, C) having same types of sensors stored in tanks to sense the data (level of oil). All three information regarding three levels will be send via RF transmitter. Sent out signals will be received by RF receiver that will be connected to other processor via RF decoder at recording and display end. This is system, which will be connected to computer system's serially via RS-232 interface to send the measured data or information into computer system to display measurement in form of bars and to record measured data in computer's database. The Aim of this study is to illustrate how much accurate the level of oil in particular tank during different Temperature conditions and how much variations will be there in the measurements at that time.

## Keywords

Wireless Network, Intelligent System, Fuzzy Logic, Artificial neural networks, Radio Module, Wireless Communication.

## 1. INTRODUCTION

Method behind the system is to take the measurements of fluid levels by installed sensors in fluid storing tank. When fluid level touches the sensors, an appropriate electrical signal will be send to processor installed on remote site. This processor will decide what to do now. It will trigger RF encoder to modulate this signal and will transmit information via RF transmitter. Likewise, there will be three sensors installed in tanks to make it three tier sensing mechanism. All three information regarding three levels will be sent in same way as stated above. Sent out signals will be received by RF receiver that will be connected to other processor via RF decoder at recording and display end. This is system, which will be connected to computer system's serial via RS-232 interface to send the measured data or information into computer system to display measurement in form of bars and to record measured data in computer's database.

These signals are brought to processor connected outside the computer via RS-232, and will be transmitted to remote site controlling circuits via Radio encoders and RF transmitters.

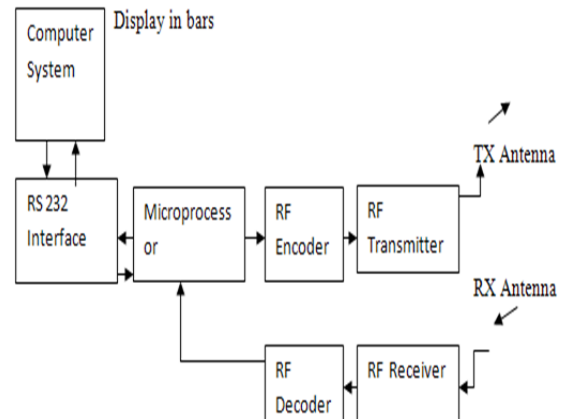


Figure 1: Block Diagram Of the System

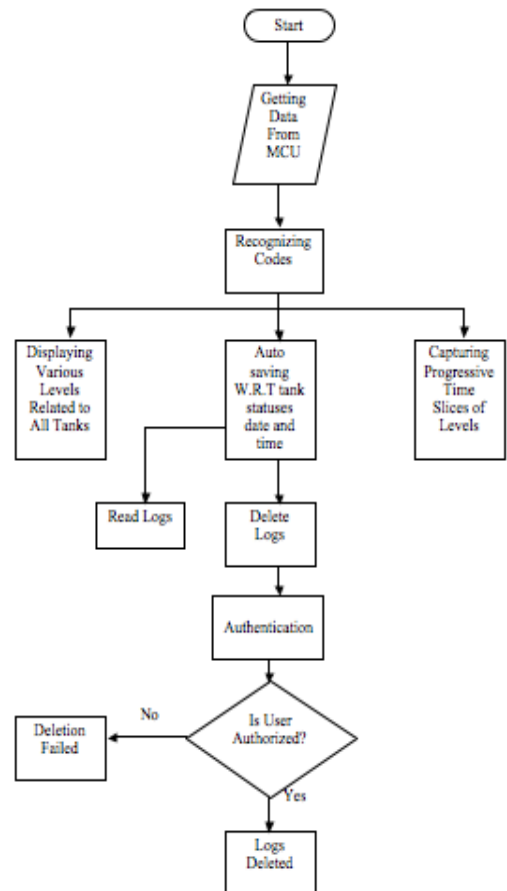


Figure 2: Data Flow Diagram of the System

## 2. SYSTEM DESCRIPTION

System is having three sections:

- 1) Transmitter Section
- 2) Receiver Section
- 3) Software Designed

1) Transmitter Section: Transmitter Section is designed with One Step-Down Transformer which convert AC voltage to DC voltage and then current passed out through diodes which allow the current to pass in one direction and after that there is a voltage regulator which gives the voltage to the system according to the requirement and then there is a capacitor which filter out the voltage and then voltage goes to the RF Encoder and RF Encoder Activates, RF Encoder starts receiving sensed data from the RF Encoder which is further attached to the RF Encoder, Microcontroller receive the sensed data from the connected three oil level sensing units made up of 9 transistors and 27 resistors.

This system captures a reading of 3 oil tanks up to 3 levels via transistorized NPN sensors whose probes are dipped into oil. It contains PU (processing unit) next to the sensors which processes a measured data accepted from sensors via input-output port and then makes codes which defines a particular tank with particular level at receiving end. The signal containing codes are then spotted by RF receiver which hands over the signal to decoder. RF decoder here uses PCM approach to decode the signals into digital form for further processing. It transforms the signals into 4-bit digital data codes and put them into PU. PU recognized these codes one at a time that to which tank that it belongs and for which level that it speak.

**Transmitting Site: -**

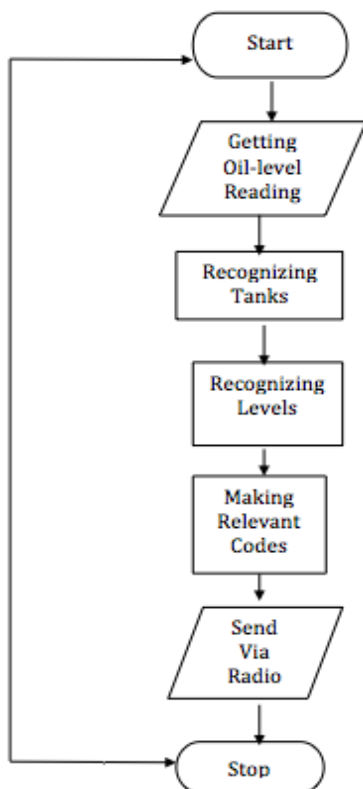


Figure 3: Working of Transmitter Site

2) Receiver Section: This Section is designed with one step down Transformer which convert AC to DC voltage and then there is a voltage regulator which provides the required voltage to the system after that voltage goes to the microcontroller and then microcontroller starts receiving sensed data information one by one from RF Decoder which receives data from the RF encoder sending site in the form of 4-bit data. In this section microcontroller send the received information to the MAX-232 chip to transfer sensed information to the software via RS-232 serial port interface and then the data further transfers to the display screen for showing the results.

**Receiving Site:**

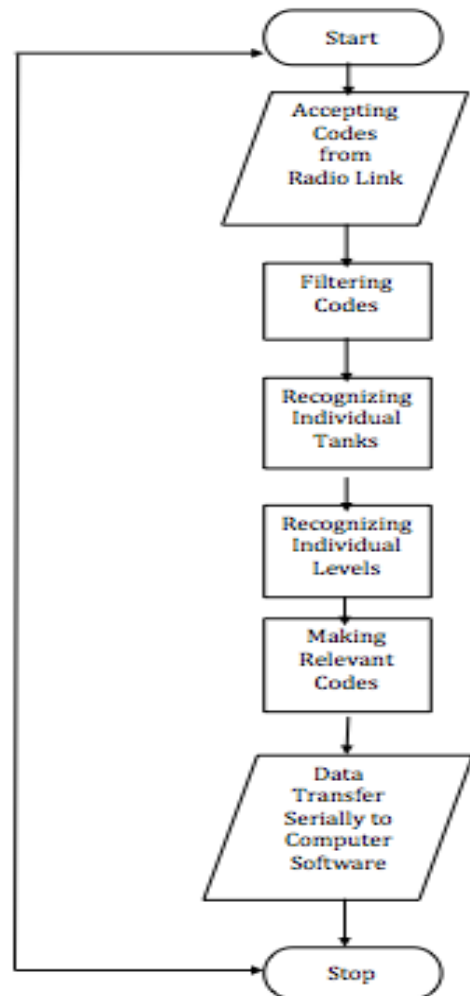


Figure 4: Working of Receiving Site

3) Software Designed: In This Section the data which is received, decoded and processed by receiving unit will be displayed in the form of levels in computer system on the software. This software is created with the help of Visual Basic. This software has 3 progress bars one for each oil tank and all progress bars have 3- levels (low, half and full) on which software firstly gets data about tank and level from processor placed outside via serial port (RS-232 interface) and displays progress bars with level and percentage of filling tank. Also it contains a space to save a data on file maintained on hard disk.

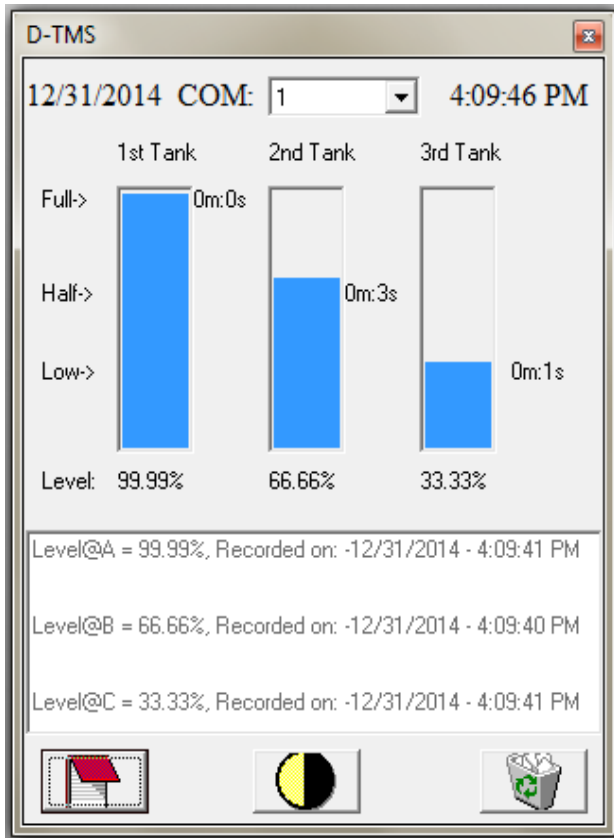


Figure 5: Software Designed For System in Visual Basic

In this the red icon shows the last recorded measurements history with date and time, on the right side there is delete logs button which require username and password to delete the logs and this is mainly for security purpose and only admin of the system will have right to delete logs, port will be selected from the scroll bar at the top, date and time are automatically taken by the software of the system at the time of measurements taken from the system.

### 3. SYSTEM ENVIRONMENT

System Environment is the work area in which system exist. It is of two types:

1. Hardware requirements
2. Software requirements

#### 1) Hardware Requirements

1. MAX-232 chip.
2. RS-232 interface.
3. AT89S52 processing chip.
4. 434 MHZ Radio sending module.
5. 434 MHZ Radio receiving module
6. HT12E Encoder Chip
7. HT12D Decoder Chip
8. Alcoholic Thermometer
9. Pentium 4 processor
10. 1 GB RAM
11. 40 GB HDD

### 2) Software Requirements

Software is designed by using visual basic 6 for automatic control & display with other features. In this system, a host software is working at a computer system which is equipped with hi-tech autonomous and intelligent features like auto-time capture, auto-saving date and time, status of a particular level of particular tank in a file maintained on hard disk to hold this all data which it updates timely whenever it receives data.

Software is also equipped with the authentication process. If any one wants to delete the saved data, then he/she has to face the authentication process by entering the username and password. Artificial neural networks and fuzzy logic is also used for recognising codes.

### 4. MEASUREMENTS OF OIL

In Analysis Part of the system the measurements of the oil in the oil tanks are analysed during different temperature conditions i.e. how much the level of the oil in each particular oil tank varies or not.

- Temperature Effects

The most important factor in finding out the accuracy of oil is temperature i.e. to find out the accurate level in different temperature effects for e.g.:

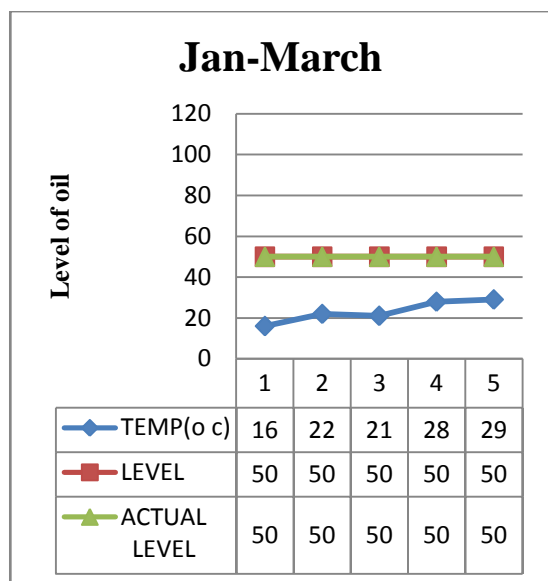
1. When the temperature is too hot the consistency of the oil at that time becomes thin, at that time we will find the accuracy of each particular tank and also record the time taken by each tank to be filled.
2. When the temperature is too cold the consistency of the oil at that time becomes little harder as compare to the hot environment time, and then we will check the accuracy of the system with time taken by each particular tank.
3. Similarly, when the temperature effect is normal (not so hot or not so cold) then we will also check the accuracy of the oil with time taken by each particular tank to be filled.

### 5. EXPERIMENTAL RESULTS

In this phase, System is tested with different temperature conditions. We place the system in a cabin and by heating the room with heater we can provide the hot temperature (according to the quarterly average temperature values of a year which are considered from website [www.accuweather.com](http://www.accuweather.com)) to the system. Similarly, by placing the system in A.C room we can provide cold temperature to the system and take the values of oil level. We measure the temperature with alcoholic thermometer.

The accuracy of oil in different temperature conditions over a year is explained as below:

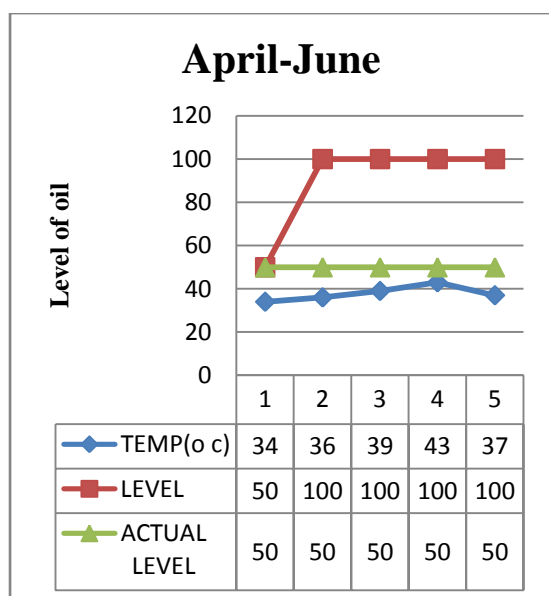
We take the quarterly average temperature values from the website [www.accuweather.com](http://www.accuweather.com) which is the American website and provides the accurate temperature values and we test the system. Here, TEMPERATURE, LEVEL and ACTUAL LEVEL are the three basic Parameters of the system. In which LEVEL shows the Level of oil displayed by the progress bars on the computer screen. ACTUAL LEVEL shows the actual level of oil in the oil tank. TEMPERATURE is the environment condition (hot, cold, normal) which change during the year.



Graph 1: Shows no variations in level of oil

In graph 1 we consider the average temperature values of three months Jan, Feb and March. The Temperature is less than 30°C and there is no change in the Actual level of oil it is same as the Level shown by progress bars on the computer screen.

Similarly, In graph 2 as the month changes April, June, July the temperature will also increase from 30°C, When the temperature raises after 30°C the level shown by progress bars on the computer screen will not same as the Actual level of tank. At that time Error has been detected there, i.e. the tank is having some empty space in it. This is because when the temperature increases after 30°C the environment becomes hot and the consistency of the oil increases and, oil touches the sensing probes by expanding itself. The tanks have more space to add more oil in them.

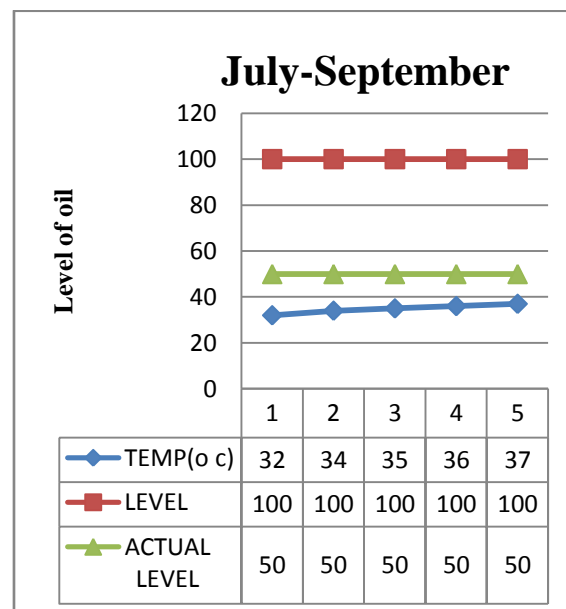


Graph 2: Shows variations in level of oil

In graph 3 July, August, September months are considered and temperature is greater than 30°C, When the temperature raises after 30°C the level shown by progress bars on the computer screen will not same as the Actual level of tank. At

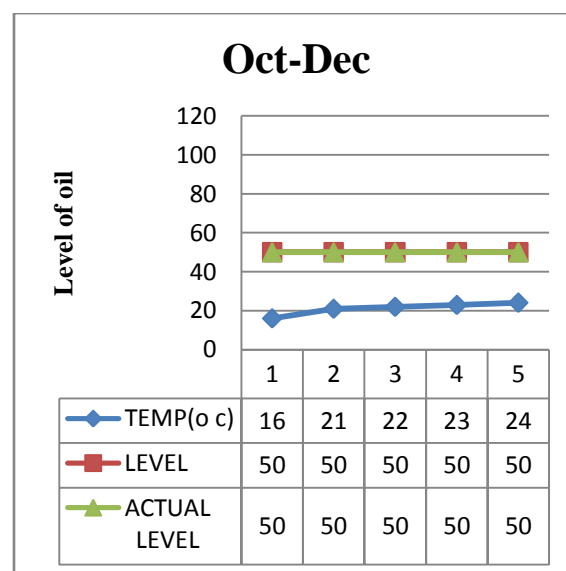
that time Error has been detected there, i.e. the tank is having some empty space in it.

This is because when the temperature increases after 30°C the environment becomes hot and the consistency of the oil increases and, oil touches the sensing probes by expanding itself. The tanks have more space to add more oil in them.



Graph 3: Shows variations in the level of oil

In graph 4 October, November and December months are considered and the Temperature is less than 30°C and there is no change in the Actual level of oil it is same as the Level shown by progress bars on the computer screen.



Graph 4: Shows no variations in level of oil

## 6. CONCLUSION AND FUTURE WORKS

In this Paper, Sensor Network Based Oil Monitoring System is presented by using demo design of the system for measuring the accurate measurements of oil in the given three oil tanks during different temperature conditions. In this system level of oil in each tank is displayed on the computer screen in the form of progress bars.

In 1<sup>st</sup> and 4<sup>th</sup> quarter of the year the temperature is less than 30°C and there will be no effects on the measurements of oil in each tank. The progress bars show the ACTUAL LEVEL of oil in each particular tank.

In 2<sup>nd</sup> and 3<sup>rd</sup> quarter of the year as the temperature increases after 30°C the progress bars on the computer screen does not show the ACTUAL LEVEL of oil, at this point error detection has been done i.e. The LEVEL shown by Progress bars is not same as the ACTUAL LEVEL of oil because when the temperature increases after 30°C environment becomes hot and the consistency of the oil expands. Due to increase in consistency of oil, oil touches the sensing probes by expanding itself and progress bars shows that the tanks are full and there is no space to add more oil in tank but actually there will be space in tanks to add more oil in them.

For Further Enhancements in the current design the Error which has been detected in the 2<sup>nd</sup> and 3<sup>rd</sup> quarter will be removed by working on the sensors or it may be removed by adding more nodes in neural network of the system to sense the ACTUAL LEVEL of oil and display the LEVEL same as ACTUAL LEVEL when the temperature raises after 30°C by sensing the inner and outer temperature of the system.

## 7. ACKNOWLEDGEMENT

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