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GSM Based Wireless Technology for Oilfield Security Management System

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Abstract

Security Management at the industries mainly during the night times at the oil field is the difficult task for security people. Checking for power failure, oil theft, temperature range, tilt of the tank leakage of oil due to rotation of pump done by the thieves is a critical task for security people. By implementing the wireless embedded technology this problem can be solved. The manpower at the site location is reduced and security level with the help of GSM based wireless technology is improved which consists of transmitter (GSM modem) at the site location and receiver in the GSM mobile. Information which is transmitted by the GSM modem at the plant location will be sent to respective person's mobile as a text message. The security people will take appropriate action according to the problem. For this purpose we use LPC2148 (ARM7) microcontroller, which is the present dominant microcontroller in mobile based products and software development tools like Keil, flash magic for loading hex file into the microcontroller.

Keywords : LDR; LPC2148 (ARM7); Temperature sensor potentiometer; Embedded 'C'; Wireless communication; Keil; Flash magic; SIM 300 GSM Mode

Introduction

With a great development of national and international economic construction there is a large demand on oil products e.g. petroleum in various industries. The international price of petroleum and oil has been increasing in recent years so production efficiency has been improved and wastage due to tilt, overflow occur in valves, so improvement is required to protect oil from theft on domestic oilfield. To protect and save the oil products since working for 24 hours continuously, huge manpower is needed even though the implementation of safe management for oilfield is difficult. We can overcome these difficulties by implementing a perfect scheme using GSM technology. This system improves the level of oilfield security.

Regional of Perambulation for the site of oil-well is very vast, meanwhile, as for the problem of petroleum, transmission line and transformer being stolen, which has been one of the important management works. Not only the cost is high, if the fiber cable would lay between the working stationing several tens of square kilometers, but also we need to consider a lot of manpower and material resources with line maintenance and guard against theft. It is a perfect scheme that wireless monitoring with remote control system is established. This method could solve the problems with high efficiency, could also reduce the effective loss of country, so it has the very important social and economic benefits economic benefits for the controllability and dependability of remote communication. By developing the desktop application, it is easier to monitor all the activities of the oilfield. This includes accessing the sensed data from the different types of sensors like motion sensors, gas sensor, chemical sensor and managing the databases of the same. All the data is managed by administrator, and if any problem occurs then he can control the entire things remotely. The communication between the application software and the electronics devices takes place wirelessly.

System Structure

The security management system for oil field based on GSM Technology design is divided in to two sub systems,

(1) Transmitting section
(2) Receiving section

The transmitting system consists of

(1) Sensor Unit
(2) LPC2148(ARM7)Microcontroller
(3) SIM300 GSM Modem

Further the sensor unit is divided into five categories

(a) TSOP1738 – IR transmitter and receiver as a tank over flow sensor
(b) L7805 as a power failure indication unit
(c) Limit switch as a valve rotation unit
(d) Mercury tilt switch as a Tilt sensor
(e) LM-35 Temperature sensor

The receiving section consists of GSM based Mobiles. Fig.1 shows the Block diagram of the security

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management system for oil field based on GSM Technology.

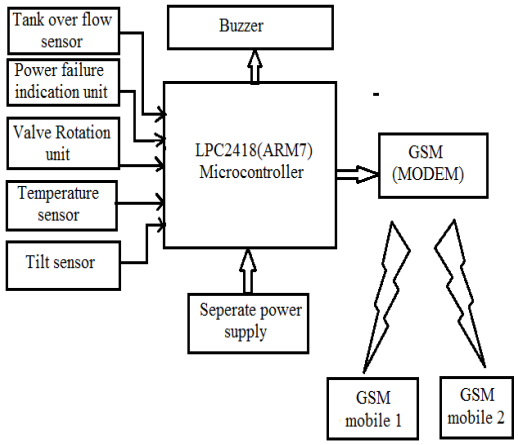

Figure.1 Block diagram of security management system for oil field based on GSM Technology

The TSOP1738 -IR transmitter and receiver, L7805, Limit switch, Mercury tilt switch, LM-35 modules are interfaced to I/O ports of the LPC2148 (ARM7) Microcontroller. The tank levels, tilt of the valve, angle of the valve rotation are continuously monitored by LPC 2148 controller. If any change of parameters occurs at the corresponding modules the controller will turn ON the buzzer, then message will be displayed on the LCD display and at the same time the controller activates the GSM Modem and this GSM Modem sends the message to the two authorized persons by using GSM based wireless technology.

Wireless Data Transmition

The embedded kit has an RF-Transceiver for both data sending and receiving purpose. The system designed in this article employ wireless system in the front-end of data acquisition, which consists of oil well shutdown alarm, oil well running alarm, power failure alarm, oil stealing alarm, night patrol alarm.

A. Wireless acquisition function:

According to actual situation of oilfield, the security management should complete a lot of wireless acquisition functions in this system.

1) Function of oil well shutdown alarm :

Wireless transmitter is installed on starter of the power distribution box. When the oil well is shutdown and the belt of pumping is fractured, it sends wireless information and then passing through wireless receiver. The information is sent to duty room and is received and taken by the operator on duty in real-time, so as to reduce the time of oil well shutdown.

2) Function of oil well running alarm :

After solving problems of fault, we need to run the oil well, then the message will be sent by transmitter when oil well is restarted. The green lamp will be lighted, the buzzer will send out monotone alarm sound when the receiver receives a message with running alarm, which will suggest that the oil well will go normal.

3) Function of power failure alarm :

Wireless transmitter is installed on the power. The wireless transmitter is automatically converted into working state of DC battery of the internal when the power stops, meanwhile the message with power failure alarm is sent by wireless transmitter, which is received by the receiver and the warning signal is suggested to the on duty operator.

4) Function of guard against theft oil alarm :

The criminals must rotate the handle on the well location when they steal oil. Because the remote control as protection is installed on the handle, it will send a wireless signal to the launcher when the emergency of theft is happened, then through secondary emission of the launcher, the message will be received by the receiver in the control center of several kilometers away, the message to sound and to light will notice the duty human. This will lead to the failure of criminals' attaining their purpose.

5) **Function of the night patrol alarm :**

In order to ensure safe operation of the oil production, the oil workers must go everywhere and check the equipment on time every day, it is because the well location is not only widely distributed in oil, but also the oil production adopt working state without watch. After the arrival of oil production workers at the oil well around several meters of the distribution box, to click the button on the remote controller, and the remote controller sends the message to launcher, and then sent it to the host receiver in the control center to record the number of workers, number of well locations and the time immediately.

B. Hardware Structure:

The transmitter and receiver are the intelligent wireless equipment based on embedded. It consists of data acquisition module, storage module, wireless communication module, device controlling module, user setting module, display module and power supply module. The block diagram of main circuit is showed as figure2. The control platform of the security management uses the AT Mega 8 microcontroller, it also have many serial ports and parallel ports to send and collect the information. In the launcher, we uses D ports as wireless

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data receiver port through PT2272, Tout port as the end of wireless emission with binary frequency shift keying(2FSK) in software radio using arithmetic method. Meanwhile, Receiver, which is located in the control center with several kilometers away, receives the signal and then uses Frequency-shift Signal Demodulation. Figure 2 showing Hardware Structure of system.

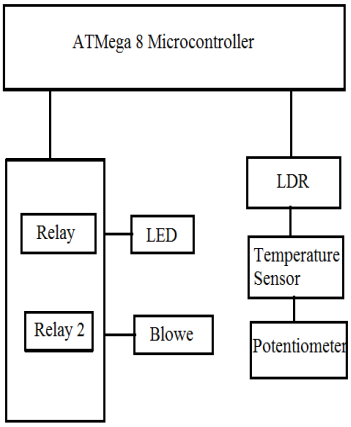


Figure 2. Hardware structure of system

1)Data acquisition and Data emission:
TXD(Transmit Data) Output serial data at 9600 bps of 3V or 5V logic level, usually connected to RXD(Receive data) pin of microcontrollers working at 5V or 3V. TE(Transmit Enable) This pin goes HIGH during transmit mode. It can be used to enable PA if any on RF module. Pin can be left unconnected if there is no PA pin in RF module.

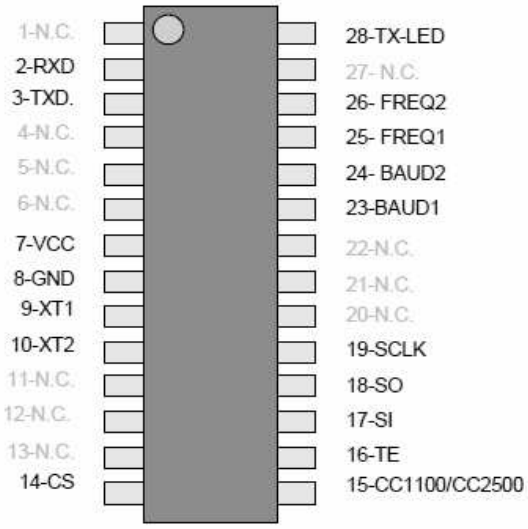


Figure 3. The diagram of RF Transceiver pin configuration

2) Data receiver:

RXD, Input serial data at 9600 bps of 3 or 5V logic level, usually connected to TXD pin of microcontrollers working at 5V or 3V. If your MCU is working at 5V and ST1197 is working at 3V then insert a 1K resistor in series. X1-X2-Connect an 8 MHz crystal with 33pF load capacitors.

Algorithm

Step1: The user has to initialize the microcontroller and GSM modem.

Step2: Microcontrollers continuously check the conditions one after the other.

Step3: First check for the power failure condition. If yes send message to mobile as" power failure".

Step4: Same message will display on LCD and buzzer sound will also occur.

Step5: If the condition is no, go for the next condition

Step6: Check for the overflow, if the condition is 'yes', then send message to mobile as "overflow " repeat the step4, if condition is ' no' then repeat step5.

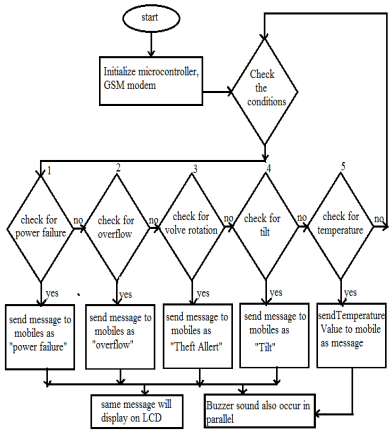
Step7: Check for the Volve rotation if the condition is 'yes' then send message to mobile as "theft alert". Repeat the step4, if condition is 'no' then repeat step5.

Step8: Check for tilt. If the condition is 'yes' then send message to mobile as "tilt". Repeat the step4, if condition is 'no' then repeat step5.

Step9: Check for temperature, if the condition is 'yes' then send temperature value to the mobile and buzzer sound will also occur.

Step10: This process repeats continuously.

System Flow Chart



Result

Figure 4, shows the various temperature data taken from the oil well and controlling structure of the application. This application is also able to show the

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graphical representation of the power failure and the different level of oil in the oil well.

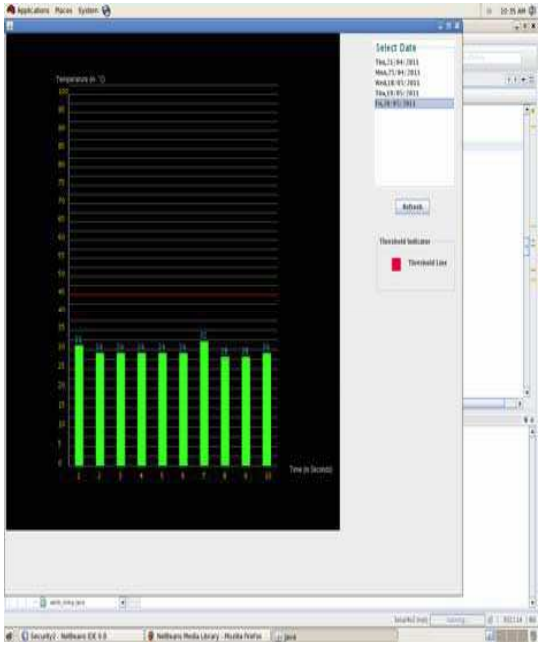

Figure 4. Graph of various temperature values

Conclusion

The security management system for oilfield adopted GSM technology and Embedded System. It provides better security compared with human and free cost of maintenance. There is possibility of receiving all the oil well parameters like the current oil level, temperature of oil well, power supply status. This system enables central controlling and manages the entire database and hence requires low man power. This system has its wide use in the real life too, such as it can be used in military application to recognize the position of soldiers with the help of motion sensors. This application can further extended to have a neural network technology to recognize the theft.

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