ISSN 2616-5767 Vol.5, Issue 9: 8-12, DOI: 10.25236/AJETS.2022.050902

The parameter acquisition system of oil drill's bit in working process

Pan Wu[1,a,*], Wei Lin[1,b], Jun Tian[1,c], Guochao Li[1,d], Chunping Liang[1,e], Jianhua Zhao[1,f], Yanyun Chen[1,g], Linyan Chen[1,h], Guang Chen[1,i]

[1]College of Engineering, Southwest Petroleum University, Chengdu, China
[a]960496380@qq.com, [b]641906807@qq.com, [c]444593164@qq.com, [d]374397252@qq.com, [e]252451353@qq.com, [f]191086593@qq.com, [g]190258814@qq.com, [h]764590259@qq.com, [i]15510938@qq.com
**Corresponding author*

Abstract: *In the process of oil drilling, it is often required to improve the drilling efficiency and to be able to analyze the faults in the drilling process, so it is of great significance to study the parameter acquisition system of the oil drill bit working process[1]. Aiming at this situation, this paper designs a device for downhole data acquisition, vibration detection, temperature detection and rotational speed detection of deep well drill bits. In this paper, an overall scheme is designed, and the acceleration[2], on-board temperature [3]and rotational speed[4] of the three axes of X, Y, and Z are selected as the main measurement objects. The working parameters of the drill bit can not only reflect the entire working condition of the drill bit, but also can be used for failure analysis during the drilling process. Provide strong evidence. First of all, components need to have high temperature resistance characteristics. At the same time, the selected components can meet the detailed parameters of technical requirements, including measurement range, measurement accuracy, resolution, etc. Secondly, design the hardware circuit, including acceleration acquisition circuit, temperature measurement circuit, rotational speed measurement circuit and data storage circuit. Finally, the software is designed, including the data acquisition, the A/D conversion and the Flash stored program design.*

Keywords: *Drilling Engineering; Deep Well Drill Pipe; Measuring Device; Data Acquisition*

1. Introduction

In petroleum drilling engineering projects, through the real-time acquisition of drilling process parameters such as vibration, temperature, and rotational speed of the device[5], technicians can monitor and analyze the downhole conditions and observe the changes of relevant parameters in the downhole, which can increase the future drilling process. reliability and improve drilling efficiency[6].

The measurement technology of petroleum engineering is to fit the obtained data into a curve for analysis through a variety of testing equipment and instruments[7], so as to obtain the process data of the drill bit, and provide the basis for the analysis of the failure of petroleum engineering.

At present, there are few equipments for testing parameters of deep well drill bit working process in China, and even the equipments in some fields are blank[8]. The purpose of this topic is to solve the equipment for collecting parameters in the working process of the drill bit in deep wells.

2. Overall design of deep well drill pipe measuring device

The main parameters collected by the deep well drill pipe measuring device are acceleration, temperature and rotational speed. When the data needs to be analyzed, the historical data of these main parameters is required. Therefore, the entire measurement device also needs Flash to store the data to the collected data[9]. The specific design block diagram is as follows:

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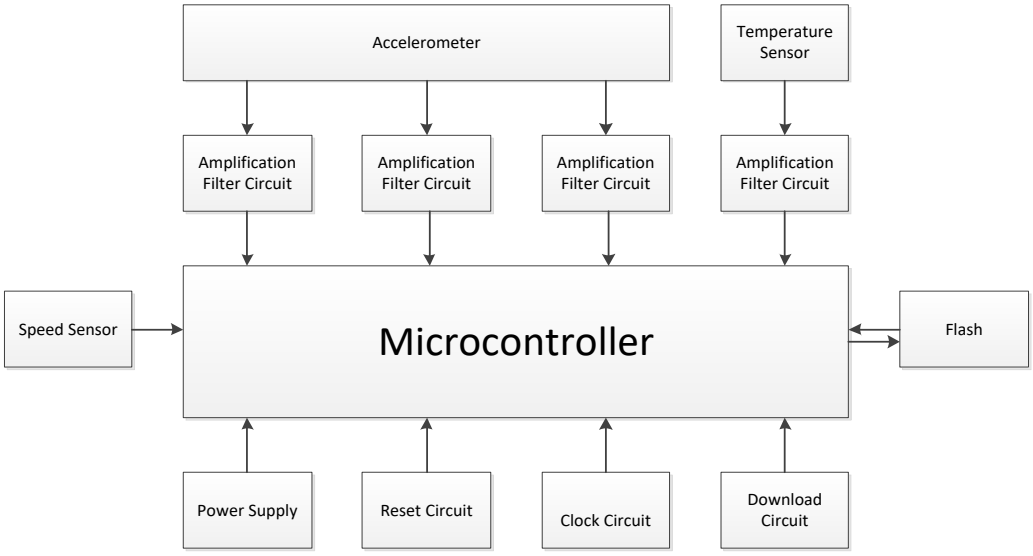

Figure 1: Block diagram of parameter acquisition system

The whole design block diagram is composed of the minimum system of the controller, acceleration sensor, temperature sensor, rotational speed sensor, and Flash, so that the measurement device realizes the acquisition and storage function of the main working parameters of the deep well drill pipe.

3. Implementation of accelerometer data acquisition

The oil drill pipe will continuously vibrate during the working process. When the vibration exceeds a certain value, it will cause excessive bending, excessive wear and even fatigue damage of the drill pipe[10]. Therefore, the acceleration of the oil drill pipe in all directions during the working process is detected. of great significance. The accelerometer is mainly used to measure the vibration of the acquisition system in the three directions of X, Y, and Z. The single-axis accelerometer can only collect acceleration motion data in a single direction. This article not only needs the axial acceleration data, but also needs to collect the acceleration in two radial directions. Therefore, we choose the three-axis accelerometer 830M, which can Collect vibration data in X, Y, Z directions. Specific power supply parameters Vdd=3.3V.

The acquisition process is: initialization -> X/Y/Z channel selection -> read X/Y/Z acceleration -> store X/Y/Z value -> end.

According to the sensor parameters and circuit design, the acceleration in each direction can be calculated as follows:

$$G = |V/2 - 2.5| / 0.0125\text{mv}/g \tag{1}$$

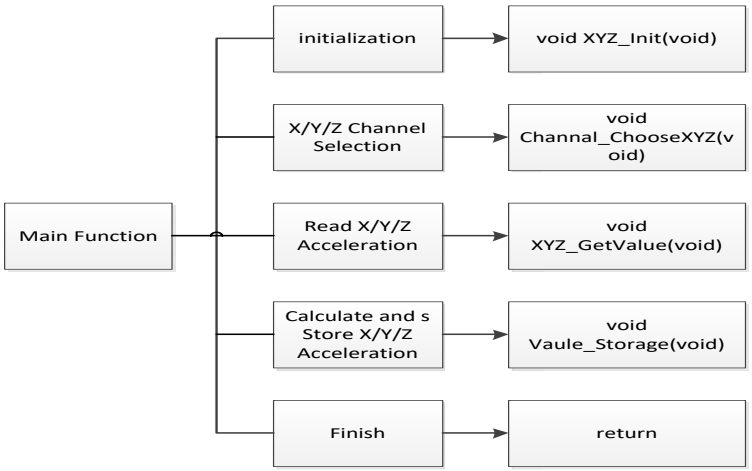

Figure 2: The related process function of accelerometer data acquisition

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In the acquisition system, the data in the sensor needs to be read out and stored. Since the output acceleration is an analog quantity, the analog quantity collected by the controller needs to be converted by the ADC to obtain a digital quantity before it can be read by the controller[11]. The implementation according to the software process is in Figure 2.

As can be seen from Figure 2, in the process of realizing acceleration data acquisition in the main function, the I/O port of the controller needs to be initialized first, including the port multiplexing into an ADC port; secondly, the X/O port is read by polling the channel. Y/Z acceleration value; then, convert the read channel value into the corresponding X/Y/Z acceleration value; finally, store the corresponding cache value in Flash, thus realizing the acquisition of the acceleration of the three axes and store the entire process.

4. Implementation of onboard temperature acquisition

The onboard temperature sensor detects the real-time temperature of the entire acquisition system. As the drilling depth continues to increase, so does the operating temperature of the drill bit[12]. The working temperature of the drill bit will not affect the working life and sealing performance of the drill bit, but also have an irreversible impact on the underground frozen soil layer. Therefore, it is of great significance to collect and analyze the temperature change during the working process of the drill bit. The temperature sensor used in the acquisition process in this paper measures the temperature of the acquisition control board. When the control board is installed close to the drill bit, the temperature of the acquisition control board will increase with the temperature of the drill bit, so that the working temperature of the drill bit can be indirectly obtained. temperature curve.

The detection range of the temperature sensor in this paper is -55℃~150℃, and the nonlinearity can reach ±0.3℃, which can meet the temperature measurement range of 3000 underground. According to the value sampled by AD, the value of temperature can be obtained, and its calculation formula is:

$$T=(Tem\_Value*500)/1024-273.15 \quad (2)$$

Among them, T represents the calculated temperature, Tem_Value is the value of the ADC read in the control system, and the software workflow during the temperature acquisition process of the data is:

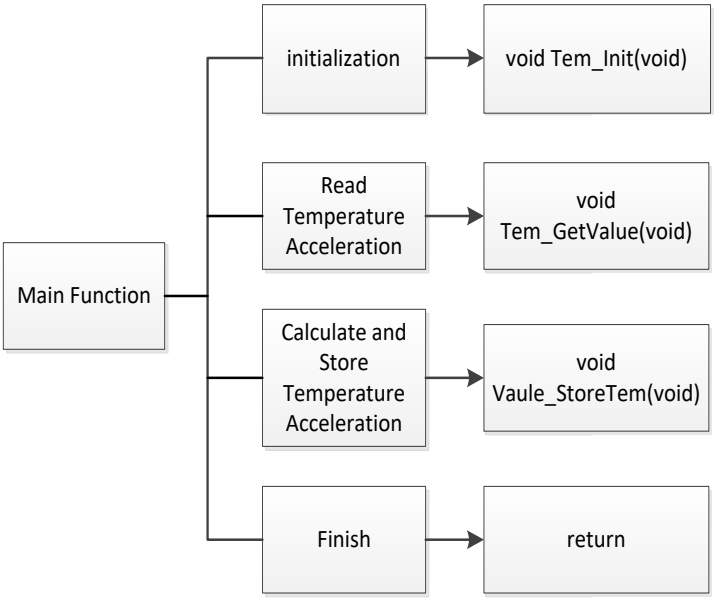

Figure 3: Process function related to temperature data acquisition

As shown in Figure 3, the temperature acquisition is also realized by the controller ADC to realize the analog signal transmitted from the temperature sensor, and the acquired data is stored in the Flash after calculation to realize the acquisition and storage of the temperature.

5. The realization of speed data acquisition

The different rotational speed of the drill pipe during the drilling process will affect the vibration of

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the drill pipe, which will affect the bending, wear, fatigue and damage of the drill pipe[13]. The detection range of the speed sensor used in this article is 1~5000RPM, and the maximum withstand temperature is greater than 175℃. The principle block diagram is as follows:

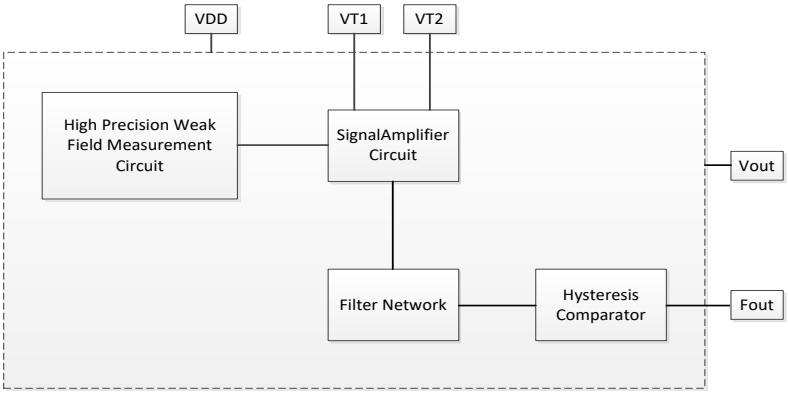

Figure 4: The principle block diagram of the speed sensor

It can be known from the principle block diagram of the rotational speed sensor that the detected rotational speed output signals include analog output and digital output, and the array output signal is used in this paper. For the acquisition of digital quantities, the pulse period is calculated according to the time between the rising edges of the external interrupt acquisition pulse of the chip, and the frequency of the pulse is obtained according to the period, so as to calculate the final speed parameter.

6. Conclusion

The oil drill bit working process parameter acquisition system is mainly used to collect the main parameters such as temperature, acceleration, and rotational speed of the drill bit during the working process, and store these parameters in Flash, which is used to analyze the temperature change, vibration, and work of the drill bit during the entire process. parameters such as speed change. The oil drill bit working process parameter acquisition system is mainly used for the process analysis of the drill bit work and the failure analysis after the problem occurs.

Acknowledgement

Fund project: Nanchong - Southwest Petroleum University City School Science and Technology Strategic Cooperation ' Start Plan ' Project (SXQHJH056)

References

[1] Xingguo Hou, Zhengwen Guo. Current Situation and Development Trend of Petroleum Drilling Technology in China [J]. Chemical Engineering Design Communications, 2021, 47(11): 36-37.
[2] Zhengguo Yan, Wei Li. Inclination angle based on ADXL343 acceleration sensor Measurement System Design [J]. Today Electronics, 2015(01): 55-59.
[3] Xiaolu Wang, Shanshan Li, Maochao Lv. Research on the influence of different ambient temperatures on the measurement error of the circuit temperature measurement system[J]. Metrology and TestinTechnology, 2022,49(06):26-28.DOI:10.15988/j.cnki.1004-6941.2022.6.008.
[4] Jinwen Wu, Lei Li, Jihong Song. Design of frequency-based speed sensor based on the principle of electromagnetic induction[J]. Sensor World, 2021, 27(11): 6-9. DOI: 10.16204/j.cnki.sw.2021.11.015.
[5] Minsheng Wang, Xinjun Guang, Lidong Geng. The application status and development of artificial intelligence in drilling engineering Suggestion[J]. Petroleum Drilling and Production Technology, 2021,43(04):420-427.DOI:10.13639/j.odpt.2021.04.002.
[6] Guanjie Zhang. Application of Rotary Percussion Drilling Technology in Oil Drilling[J]. Chemical Design Communication, 2022,48(04):49-51.
[7] Guangming Han. Application of modern information technology in petroleum engineering construction[J].Oil and gas field surface engineering, 2014,33(01):15- 16.
[8] Fenglin Tang, Есауленко В.Н., Ning Fulong, Duan Longchen, Чихоткин В.Ф. Analysis and Research on Sensors for Bottom-hole Parameter Measurement System for Deep Well Drilling [J].

ISSN 2616-5767 Vol.5, Issue 9: 8-12, DOI: 10.25236/AJETS.2022.050902

Drilling Engineering, 2021, 48(05):38-46.

[9] Haige Wang, Yunhua Ge, Lin Shi. Status Quo, Challenges and Development Direction of "13th Five-Year Plan" of Deep Well and Ultra-Deep Well Drilling and Completion Technology [J]. Natural Gas Industry, 2017, 37(04): 1- 8.

[10] Qingyu Meng, Baichuan Wu. Analysis of drill pipe vibration characteristics and prediction of fatigue cycle [J]. China Manganese Industry, 2019, 37(06): 87-90+94. DOI: 10.14101/j.cnki.issn. 1002-4336.2019.06.018.

[11] Huajun Song, Guangbing Zhou, Wei Yu. Design of drill string vibration measuring instrument for laboratory drilling simulation platform [J]. Laboratory Research and Exploration, 2018, 37(06):60-62+75 .

[12] Rongzuo Guo, Jun Huang. Design of drilling platform data acquisition system based on IoT perception [J]. Computer Engineering and Design, 2020, 41(03): 887-895. DOI: 10.16208/j.issn 1000-7024.2020. 03.046.

[13] Dong Fu, Xiaowei Jin, Jibiao Xue, Ning Zhan, Pengxiang Zhang. The influence of drill pipe rotation speed on oil casing wear[J]. Mechanical Design and Research, 2021, 37(04): 115-119. DOI: 10.13952/j.cnki.jofmdr. 2021.0148.