Journal of Engineering Sciences
Vol 12, Issue 7, July/202J
ISSN NO:0377-9254

COGNATE POSITION AND STATIC DETECTION OF HYDRAULIC ENDORSE BASED ON PARTICLE SWARM EXAGGERATION

Sardarhussain Hanumadgundam[1], Vamsi Krishna Boya Kommasani[2], Mohan Dunnapothula[3],P.Jhansi[4], Dr.G.Lakshminarayana[5]
Assistant Professor[4], Professor[5],UG Student[123]
DEPT OF ECE
SVR ENGINEERING COLLEGE, NANDYAL

ABSTRACT

The position and posture of the hydraulic support seriously affect the efficiency of coal mining and the safety of coal production. However, most of the current detection technologies have poor reliability, and the detection methods are difficult to adapt to the complex environment of coal mines. To effectively monitor the hydraulic support, and thereby improve the efficiency of coal mining, we propose a new method to detect the relative position and posture of the hydraulic support. The method is based on the mathematical idea that three points can determine a plane. Firstly, we use angle sensors and displacement sensors to build the detection device, use STM32 microprocessor to collect data, and realize real-time display of the data on the PC. Then, we conduct a single point detection experiment and a plane moving experiment, and combined the particle swarm optimization (PSO) algorithm to optimize the data. Experiment results show that the relative error of the single-point detection can reach 0.53%. Thirdly, we carry out a detection experiment of three points on the plane. Experiment results show that the detection accuracy of the two planes can reach 0.2◦ . Finally, to test the monitoring effect of the detection device on the hydraulic support, we carry out the relative position and posture detection experiment of the canopy. The experiment results show that the device can effectively detect the posture change of the canopy when the hydraulic support are moving. The method we use is contact measurement, which has high reliability and strong stability. The research on the relative position and posture detection of hydraulic support provides a reliable method to monitor the support working status. It lays the foundation for the intelligent control of the mining working face straightness and the perception of the support posture.

I. INTRODUCTION

The intelligentization of coal equipment and the digitization of mines are inevitable trends in the development of coal mining technology [1]. With the development of unmanned technology in the fully mechanized coal mining face, the research and development of intelligent mining equipment and the comprehensive advancement of intelligent mining are important directions for achieving the goal of reducing coal miners and improving efficiency. The relative position and posture detection technology of hydraulic support is one of the important technologies of intelligent mining. Hydraulic support is the key supporting equipment for fully mechanized coal mining face. The straightness of the hydraulic support group and the posture of hydraulic support are important parameters for mining working face. The coal mining efficiency is determined by the working performance of the hydraulic support and the automation level of mining working face straightening. Besides, the geological conditions of large inclination, thick and extra-thick coal seams are complex, supporting is difficult, and the support stability of hydraulic supports is critical [2]. The real-time posture of each hydraulic support can not only reflect the straightness of the hydraulic support group, but also reflect the status of the roof and floor of mining working face. The relative position and posture detection of hydraulic support is of great significance to the roof control [3] and load capacity analysis [4]. During coal mining, hydraulic supports are arranged side by side to support a working space for the shearer and scraper conveyor. The scraper conveyor is arranged at the front of the hydraulic support. The three-machine matching model for fully mechanized mining face is shown in Fig. 1. The middle chute of the scraper conveyor is hinged with the pushing cylinder at the bottom of the hydraulic support. The shearer is located above the scraper, and the scraper is used as the track to complete coal cutting. At present, the length of the fully mechanized coal mining

face in China is generally 120m-300m. During coal mining, to achieve the overall advancement of mining working face, the pushing cylinder at the bottom of the hydraulic support pushes the scraper conveyor forward, then the pushing cylinder pulls the support itself to follow forward. Ideally, all hydraulic supports should be distributed in a straight line on mining working face after the hydraulic support moving, the position and posture of each hydraulic support are close to the same to ensure the normal operation of the scraper conveyor and the shearer. Due to the complex working environment underground, the influence of the low precision of the lifting control of the column and the large movement error during the support work, the relative tilt, torsion, and pitch would occur between the hydraulic supports. The relationship between position and posture of hydraulic support is called the relative position and posture. When the position and posture of the hydraulic support deviate from the desired state, the hydraulic support group will no longer maintain vertical distribution, which may cause the arrangement of the hydraulic support and the scraper to deviate from the ideal position. When the mining working face no longer maintains straightness, it will affect the normal operation of the shearer [5]. The hydraulic support is mainly composed of a canopy, balance jack, shield beam, connecting rod, base, pushing cylinder, and column. Because there are multiple motion actuators in hydraulic support, its position and posture will change when supporting [6]. Therefore, it is necessary to detect the relative position and posture of canopy and base separately, or use only the parameters of the hydraulic support column and balance cylinder to calculate the position and posture, then detect the relative position and posture of hydraulic support. The detection system provides a more accurate and reliable method to detect the straightness of hydraulic support. Our research provides a basis for the prevention of hydraulic support instability and collapse under complex geological conditions of large dip angle and large mining, for promoting the development of unmanned and automated mining of complex coal seams, and for the intelligent sensing of hydraulic support and integrated mining working face. The relative position and posture detection system can provide detection data to analyze the straightness of mining working face and the instability of hydraulic support. It provides a platform for the intelligent control of hydraulic support.

II. POWER SUPPLY

Block Diagram

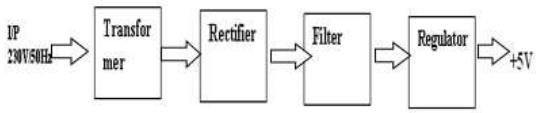
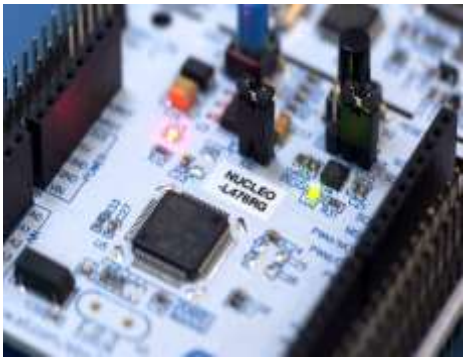


Figure Power Supply

III. HARDWARE

3.1 STM32 - Introduction to STM32



32-bit microcontrollers are gaining more popularity as they become more affordable in comparison to traditional 8- and 16-bit microcontrollers. ARM is one of the most popular 32-bit architectures available, and STMicroelectronics offers a suite of controllers that meet almost every need in the 32-bit range. The following video gives you an overview of ST's offerings along with the steps to use STM32CubeIDE:

3.2 Liquid Cristal Display

A liquid crystal display (LCD) is a thin, flat display device made up of any number of color or monochrome pixels arrayed in front of a light source or reflector. Each pixel consists of a column of liquid crystal molecules suspended between two transparent electrodes, and two polarizing filters, the axes of polarity of which are perpendicular to each other. Without the liquid crystals between them, light passing through one would be blocked by the other. The liquid crystal twists the polarization of

light entering one filter to allow it to pass through the other.

A program must interact with the outside world using input and output devices that communicate directly with a human being. One of the most common devices attached to an controller is an LCD display. Some of the most common LCDs connected to the contollers are 16X1, 16x2 and 20x2 displays. This means 16 characters per line by 1 line 16 characters per line by 2 lines and 20 characters per line by 2 lines, respectively.

Many microcontroller devices use 'smart LCD' displays to output visual information. LCD displays designed around LCD NT-C1611 module, are inexpensive, easy to use, and it is even possible to produce a readout using the 5X7 dots plus cursor of the display. They have a standard ASCII set of characters and mathematical symbols. For an 8-bit data bus, the display requires a +5V supply plus 10 I/O lines (RS RW D7 D6 D5 D4 D3 D2 D1 D0). For a 4-bit data bus it only requires the supply lines plus 6 extra lines(RS RW D7 D6 D5 D4). When the LCD display is not enabled, data lines are tri-state and they do not interfere with the operation of the microcontroller.

3.3 PIN DESCRIPTION:

Most LCDs with 1 controller has 14 Pins and LCDs with 2 controller has 16 Pins (two pins are extra in both for back-light LED connections).

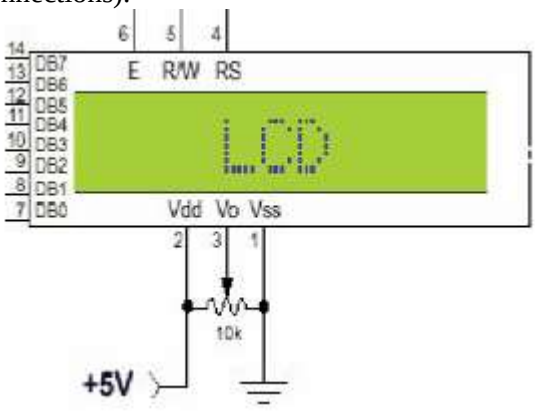


Figure Pin diagram of 1x16 lines LCD

3.4 L293D

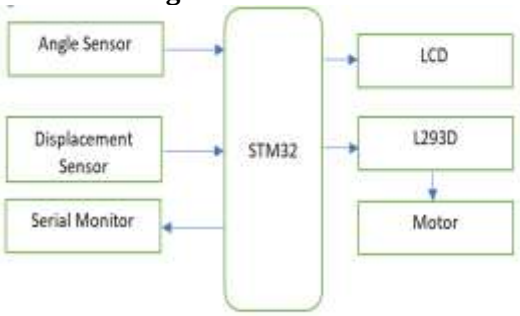
L293D is basically a high current dual motor driver/controller Integrated Circuit (IC). It is able to drive load having current up to 1A at the voltage ranging from 4.5V to 36V. Motor driver usually act as current amplifier because they receive a low current signal as an input and provides high current signal at the output.

Motors usually operates on this higher current. L-293D has to builtin H-Bridge driver circuits and is able to control two DC motors at a time in both clockwise and counter clockwise direction. It has two enable pins and they should be kept high in order to control the motor. By changing the polarity of applied signal motor can be rotated in either clockwise or counter clockwise direction. If L 293D enable pin is high, its corresponding driver will provide the desired out. If the enable pin is low, there will be no output. L-293D has different features including internal ESD protection, large voltage supply range, large output current per channel, high noise immunity input etc. L 293D plays a vital role in electronics era and has several different applications e.g relay drivers, DC motor drivers, stepping motor drivers etc. The further detail about L 293D motor driver/controller will be given later in this tutorial.

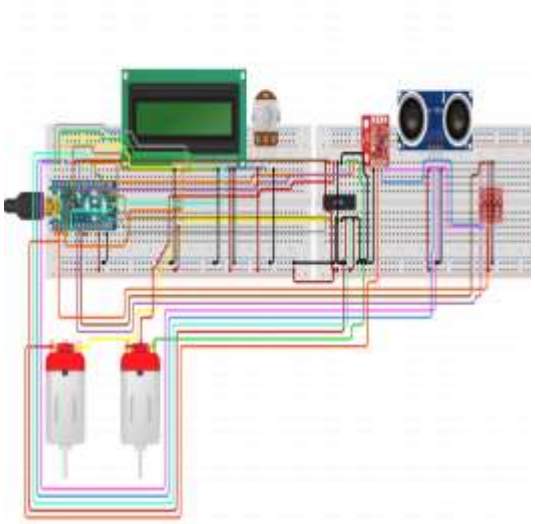
L293D Motor Driver

IV. RESULT

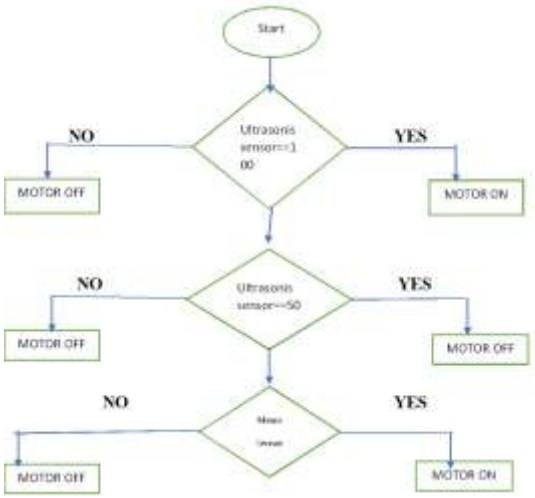
4.1 Block Diagram:



4.2 Schematic Diagram:



4.3 Flow Chart:



Working:

- An ultrasonic sensor is an electronic device that measures the distance of a target object by emitting ultrasonic sound waves, and converts the reflected sound into an electrical signal.
- The Motor Driver is a module for motors that allows you to control the working speed and direction of two motors simultaneously.
- Lcd is to display the data.
- These devices (or systems) have the ability to sense, control and actuate on the micro scale, and generate effects on the macro scale.

V. CONCLUSION

To improve the current research on the position and posture detection of hydraulic supports, improve the mining efficiency of coal mines, and ensure the safe production of coal mines. This article presents a method for detecting the position and posture of hydraulic support. (1) Based on the idea that three points can determine a plane, this article establishes and derives the position and posture detection model, and uses MATLAB to perform simulation analysis. A detection device based on the combination of the angle sensor and displacement sensor is proposed, and the detection principle of the position and posture of the hydraulic support canopy is deduced. Simulink solves the forward and reverse simulation of the model, and the detection method is verified. (2) This article uses the optical platform and the prototype of the hydraulic support to detect the relative position and posture, and designs the single-point accuracy-test experiment and the moving plane accuracy-test experiment based on the PSO algorithm. The experiment results of the single-point accuracy test show that after the PSO algorithm is used to optimize the coordinates of the sampling points, the relative error of the detection device for single-point detection is 0.53%. The experiment results of the movingplane accuracy test show that the detection device has a high detection accuracy under the moving state, and the accuracy of the normal vector of the fitted plane is 0.2◦ . It can meet the needs of hydraulic supports, and can meet the needs of applications. (3) Based on the above theory and experiment tests, this article develops the hydraulic support relative position and posture data display system. On the three-machine supporting test bench of hydraulic support, shearer, and scraper conveyor, we used the detection device to detect the posture change of the canopy during the lifting movement of the column and the movement of the moving cylinder. The detection device realizes the data collection of the hydraulic support canopy posture, and the support posture calculated from the experiment data is relatively consistent with the support posture under theoretical analysis. The relative position and posture detection of the hydraulic support studied in this article provides theoretical support for the hydraulic

support online real-time monitoring, and lays the foundation for the hydraulic support automatic control. It is the basis for the development of hydraulic supports intelligent monitoring technology and the improvement of the existing detection and control methods. It is of great significance to realize the instability detection of hydraulic supports and the automatic prevention of falling during the mining of large inclination and high mining height coal seams.

VI. REFERENCES

[1] J. Ralston, D. Reid, C. Hargrave, and D. Hainsworth, ‘‘Sensing for advancing mining automation capability: A review of underground automation technology development,’’ Int. J. Mining Sci. Technol., vol. 24, no. 3, pp. 305–310, May 2014.
[2] H. Tu, S. Tu, Y. Yuan, F. Wang, and Q. Bai, ‘‘Present situation of fully mechanized mining technology for steeply inclined coal seams in China,’’ Arabian J. Geosci., vol. 8, no. 7, pp. 4485–4494, Jul. 2015.
[3] A. K. Verma and D. Deb, ‘‘Numerical analysis of an interaction between hydraulic-powered support and surrounding rock strata,’’ Int. J. Geomech., vol. 13, no. 2, pp. 181–192, Apr. 2013.
[4] A. Pytlik, ‘‘Process characteristics of hydraulic legs equipped with safety valves at dynamic load caused by a mining tremor,’’ Arch. Mining Sci., vol. 60, no. 2, pp. 595–612, Jun. 2015.
[5] J. M. Akande and M. A. Saliu, ‘‘Design of a powered support system in Enugu coal mine,’’ J. Emerg. Trends Eng. Appl. Sci., vol. 2, no. 6, pp. 1083–1089, 2011.
[6] C. González-Nicieza, A. Menéndez-Díaz, A. E. Álvarez-Vigil, and M. I. Álvarez-Fernández, ‘‘Analysis of support by hydraulic props in a longwall working,’’ Int. J. Coal Geol., vol. 74, no. 1, pp. 67–92, Mar. 2008.
[7] M. E. Yetkin, F. Simsir, M. K. Ozfirat, P. M. Ozfirat, and H. Yenice, ‘‘A fuzzy approach to selecting roof supports in longwall mining,’’ South Afr. J. Ind. Eng., vol. 27, no. 1, pp. 162–177, May 2016.
[8] C. Luo, X. Fan, J. Ni, H. Yang, X. Zhang, and W. Li, ‘‘Positioning accuracy evaluation for the collaborative automation of mining fleet with the support of memory cutting technology,’’IEEE Access, vol. 4, pp. 5764–5775, 2016.
[9] S. Hao, S. Wang, R. Malekian, B. Zhang, W. Liu, and Z. Li, ‘‘A geometry surveying model and instrument of a scraper conveyor in unmanned longwall mining faces,’’ IEEE Access, vol. 5, pp. 4095–4103, 2017.
[10] J. Wang, Z. Wang, J. Xu, C. Tan, and L. Si, ‘‘Moving distance measurement for hydraulic support based on fruit fly optimization algorithm,’’ Opt. Eng., vol. 56, no. 1, Jan. 2017, Art. no. 013111.