

# Research on Application of forklift dispatching intelligence in Industrial intelligence

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**Abstract:** In the modern information technology industry rapid development, forklift truck as an important content in the field of industrial production and transportation, research scholars in view of the traditional forklift control application problems are analyzed in the experiment, on the basis of consideration of work safety and comfort manipulation, forklift scheduling intelligent control system was put forward, both could regulate the working state of the vehicles and personnel, It can also use sensing technology to sense and analyze, effectively control data cost, and truly achieve the development goal of industrial intelligence. On the basis of understanding the development status of intelligent forklift dispatching, this paper analyzes the intelligent control system of forklift trucks combined with state-aware technology, and makes clear the research direction of intelligent forklift trucks in the future from the perspective of industrial intelligence development, which is also an effective measure to improve the level of social and economic growth in the new era.

**Key words:** Industrial intelligence; Forklift dispatching; Intelligent; State aware techniques.

## 1. Introduction

As the world's largest forklift production country and consumer market, China sold a total of 456,885 motor industrial vehicles in 2019, an increase of 5.95% compared with 2018, according to the data provided by the World Industrial Vehicle Statistics Association. In the first half of 2020, a total of 261,283 motor industrial vehicles were sold, a year-on-year increase of 11.17%. It can be seen that in the development of social and economic construction, the sales volume of forklift truck market shows a gradual upward trend. [1.2.3]At the same time, forklift downstream application industry is also very wide, the most representative of which is the logistics industry and manufacturing. According to China's industrial vehicle statistics show that in 2019 forklift demand the biggest industry include automobile, electrical machinery, postal service, logistics, warehousing, transportation, and the fastest growing industries such as automobile, food and beverage, paper making, the fastest decline in industry computer electronic equipment, communications equipment, agricultural, tobacco manufacturing, etc. With the continuous improvement of the intelligence level of China's manufacturing industry, the innovation speed of the automation level of production service is getting faster and faster. Intelligent equipment gradually enters the current market, further releasing the application space of intelligent forklift. Although the development of forklift automation and intelligence has become the consensus of the industry, but the number of new manufacturers in the market is increasing, the lack of industry technical standards, whether product quality or market price will be affected. From the overall point of view, smart forklift is in the primary development stage, whether it is technology research, scene, application and so on, there is a long way to go.

On the one hand, electrification. After the state put forward the preferential policy of electric forklift truck, the 13th Five-Year development plan of industrial machinery industry clearly proposes that the development of lithium battery and combustion battery driven forklift truck is regarded as the key development and design of new products in the new period, and mainly solves the technical problems of lithium electricity. In the traditional sense, the trolley forklift basically chooses lead-acid battery, and there are limitations in both working time and working quantity. However, after the application of lithium battery forklift technology, the product design cost gradually decreases, and the market share of lithium electric forklift is increasing. Combined with the data analysis, it is found that the domestic market began to use electric porters to replace manual

porters, which can effectively reduce the demand for human resources. Among them, the technical structure of electrification is shown in Figure 1 below:[6.7.8]

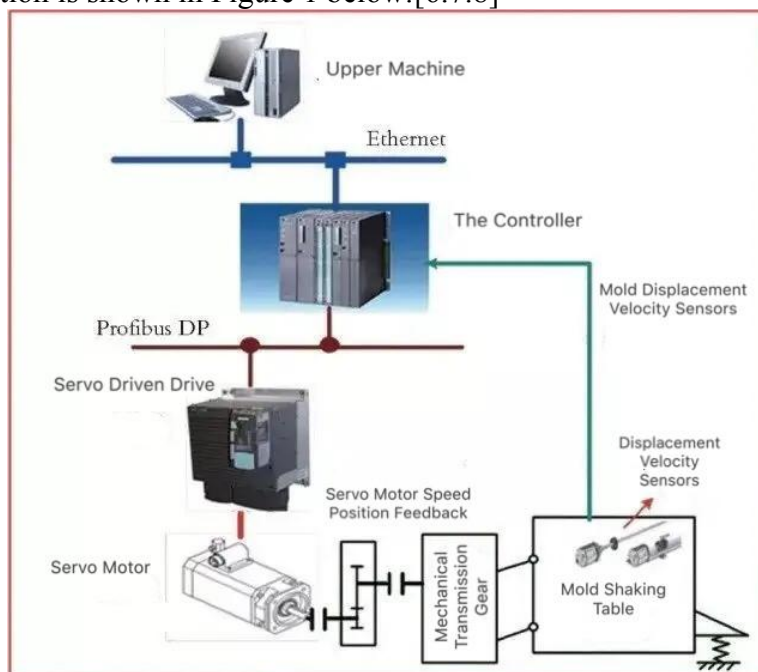


Figure 1. Technical structure diagram of electrification

On the other hand, intelligence. With the rapid development of artificial intelligence and other new information technologies, the technical theories of unmanned driving, digitalization and Internet applied in the forklift industry have become more mature, which effectively realize many functions such as software and hardware supervision, equipment diagnosis and remote monitoring, and fully meet the multi-directional needs of different users. According to the practical investigation and research, the sales volume of forklift AGV in China in 2019 was 2,700 units, up 80% compared with 2018, and the market scale reached 1.3 billion yuan. Although the conversion rate of forklift truck AGV has not reached 0.3% compared with traditional forklift trucks, with the continuous innovation of science and technology, the AGV forklift truck market will have a broader space in the future.

In the development of modern industrial technology in China, forklift truck enterprises only rely on technology innovation function is difficult to obtain market advantage, in order to better cope with the pressure of market competition, forklift truck enterprises should not only from the visual level to the customer with purchase suggested that optimize forklift base even function properties, deeply research the problem such as driving or operating noise habit, To upgrade the forklift structure and basic functions, to provide quality service for customers. Therefore, on the basis of understanding the development status of industrial intelligent technology, this paper studies the intelligent management system of forklift dispatching based on state-aware technology, so as to guide the transformation and upgrading of traditional manufacturing industry.[9.10]

## 2. Method

### 2.1 Control System

According to the structure analysis of the hardware control system shown in Figure 2 below, the hardware part of forklift truck should be controlled by three modules, which firstly refers to signal acquisition, secondly refers to data communication, and finally refers to vehicle output drive.

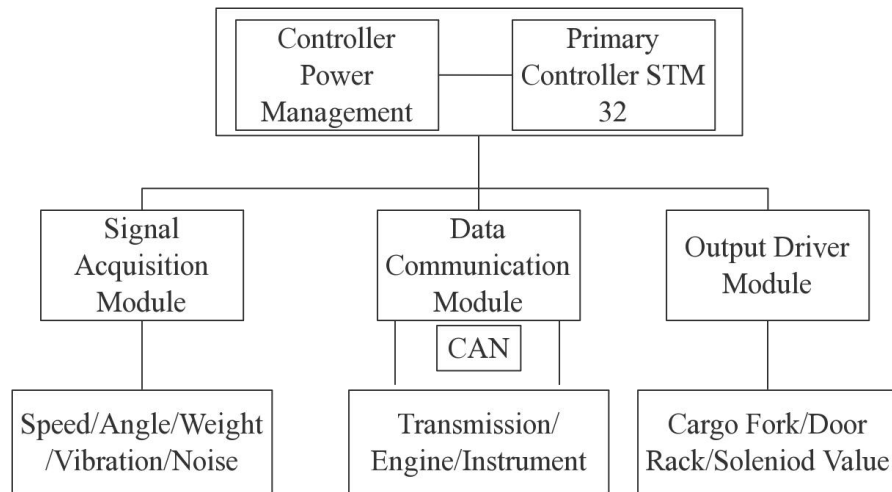


FIG. 2 Structure diagram of hardware control system

Based on the analysis of the controller power design structure diagram shown in Figure 3 below, it can be seen that the actual design must meet the requirements of different types of forklifts, have wide voltage input capability, and effectively suppress the vehicle operation, power interference from human operation or engine. In the system studied in this paper, after field test and analysis, the controller power supply is selected to meet the requirements of 9 to 36V power input switching stable power supply, the input peak can reach 60V, can fully meet the power demand under different working states.

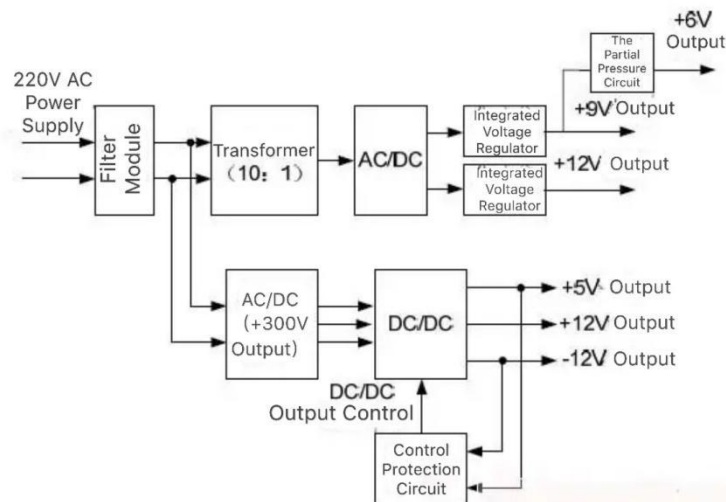


FIG. 3 Structure diagram of controller power supply design

At the same time, the main controller uses STM32V air, which has a strong application performance, can effectively control the development cost and development time.[11.12.13]

From the perspective of system operation, the signal acquisition module contains a large number of sensing nodes and nodes to form the perception layer. The sensor node will transfer the forklift's data collection to the collection node, and the collection points will compress and process the data to improve the accuracy of the data information. Without affecting the structure and electrical performance of the forklift truck, the evaluation model based on the performance of the forklift truck can facilitate the staff to quickly grasp the working state of the equipment and avoid safety hazards during the work. The data communication module can not only provide an effective basis for information exchange between controllers, engines, instruments and other equipment, but also build an information sharing platform between electrical control units. Through the experimental test and analysis, it is found that the data communication protocol can accurately detect the various functions of the intelligent forklift dispatching, and ensure that it achieves the expected set

operation performance. Combined with the structural diagram of the drive output module shown in Figure 4 below, it can be seen that it fully meets the basic requirements of high-current drive of forklift trucks and can effectively improve the reliability of system functional operation.

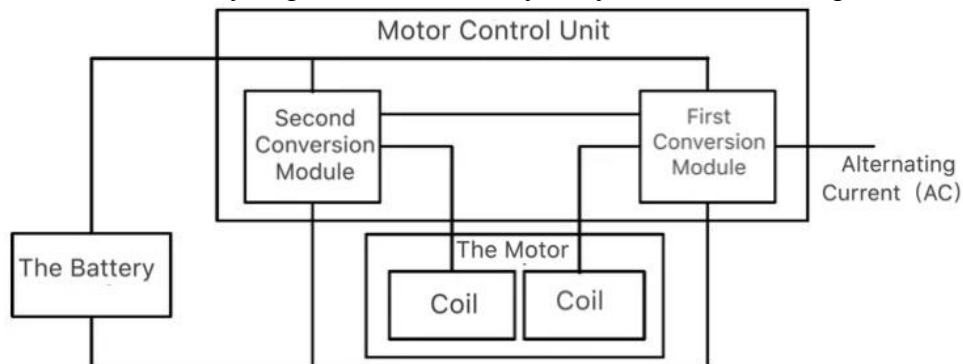


FIG. 4 Structure diagram of the driver output module

## 2.2 Visual control

In the remote intelligent control system, in order to ensure that the function of forklift operating system can be effectively applied, we should pay attention to the design of forklift visual control system, the specific content involves the following points:

On the one hand, automatic addressing. This operation can ensure that the path of the forklift will not deviate when it is carried out. Cameras are installed on the front and back of the forklift to quickly obtain the moving track of the forklift and ensure that the moving track does not deviate. At the same time, to install infrared sensor and SCM system, scientific processing of relevant data information and output signals, to facilitate the staff to control the operation of forklift. The specific structure is shown in Figure 5 below:[14]

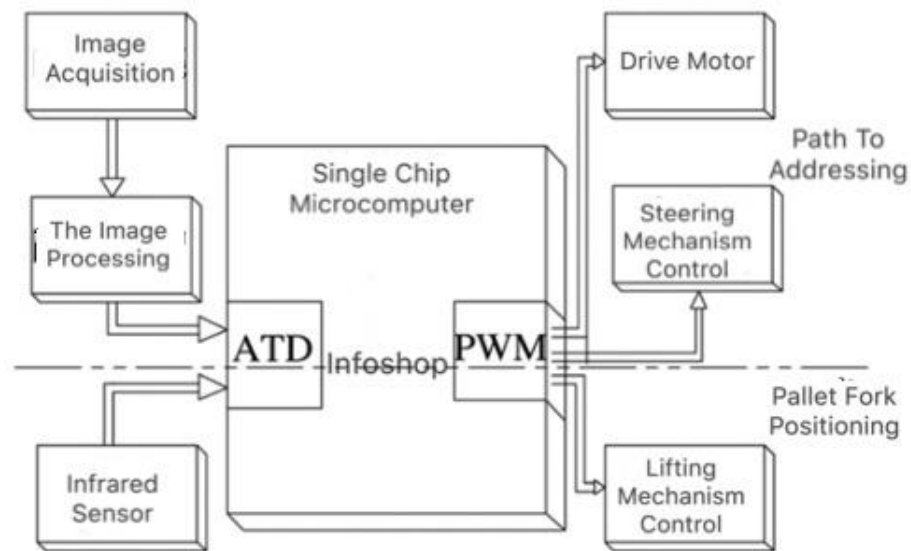


Figure 5. Structure diagram of automatic addressing

On the other hand, image acquisition. This part needs to collect information with the help of cameras, mainly capturing the specific path of forklift operation. The path image obtained by this operation is usually a sequence of continuous grayscale images. By combining the basic information of forklift operation speed, control accuracy and so on, the gray image sequence of forklift can be quickly captured to ensure that the image information will not be distorted. The type of single chip microcomputer installed must be considered. In the system studied in this paper, the method of dividing the image into two can reduce the working pressure of the microcontroller in a

certain sense and truly meet the basic needs of path capture. The specific process is shown in Figure 6 below:

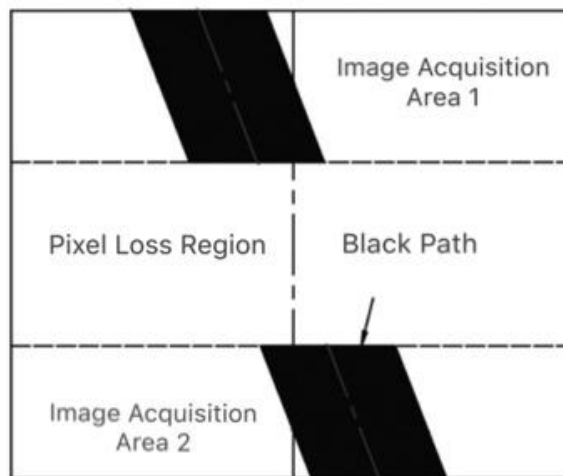


FIG. 6 Flow chart of image acquisition

### 2.3 Path Planning

On the one hand, positioning. Normally, the forklift should be positioned in accordance with the height direction of the shelf. In the process of remote intelligent operation, the staff should fully consider the safety and scientific nature of the transportation of goods, to avoid damage due to human factors and external factors and other problems. Therefore, when considering forklift positioning work, it is necessary to ensure that the forklift can reach the preset height, and can complete the subtraction and unloading work autonomously; On the other hand, planning. In the intelligent control of forklift dispatching, the path planning should be analyzed according to the running track of the equipment. After determining the starting point and the end point, the driving track of the forklift should be designed scientifically. Generally speaking, the design expectation point can be referenced by geometric parameters. In the working state, if the forklift can work according to the preset trajectory, it can not only reduce the impact caused by human factors, but also reach the destination quickly and accurately.

## 3. Result analysis

In the development of economic construction and social civilization put forward sustainable development target, the auto industry as an extension of one's own ability, with the improving of the technology level of science and technology, human life quality requirements continue to increase, comply with the demand of times development, industrial automotive industry began to green, intelligent and digital direction, One of the most representative is intelligent forklift dispatching. Combined with the intelligent dispatching system analysis as shown in Figure 7 below, it can be seen that the future forklift technology research should develop in the following directions: First, intelligent management. In the future, the technical function of forklift application will be completely changed, and the practical operation will be transformed from human management to intelligent management mode. Industrial enterprises should also optimize the allocation of resources, scientifically divide the rights and responsibilities, and comprehensively monitor the quality through intelligent management mode, so as to improve the intelligent level of industry development. Secondly, intelligent products. The purpose of studying intelligent products of forklift dispatching is to meet the needs of freight transportation in various fields and improve the economic and social benefits of enterprise development. Therefore, the efficiency of product function directly affects the future development direction of enterprises and whether it can meet the high quality requirements of consumers. Industrial intelligence has a very broad development prospect in the

future industry, can change the traditional forklift operation mode and management scheme at the same time, fully show the application value of intelligent forklift dispatching technology; Finally, intelligent equipment. Because products are transported by forklift equipment, the quality of equipment directly determines the quality of products, and equipment is also an important resource for the construction and development of enterprises. If enterprises do not pay attention to the development of equipment in the construction and management, it will inevitably lead to more problems in the subsequent development. Therefore, in order to better cope with the increasingly competitive market environment, industrial enterprises should strengthen the research and development of intelligent equipment, and put forward effective solutions for the problems existing in the application of forklift trucks, so as to ensure the safe and stable operation of equipment technology.

#### 4. Conclusion

To sum up, forklift truck, as an indispensable carrying tool for automatic logistics system in the development of modern society in China, is mainly used in multi-field freight transportation, and the related technical management requirements are getting higher and higher. Therefore, scholars from various countries gradually strengthen the related technical research efforts and begin to pay attention to the application of intelligent forklift dispatching technology. Combined with the intelligent system proposed in this paper, the vision control and path planning and design scheme are determined, which can solve the problems existing in the practical work of forklift truck, further improve the working quality of forklift truck, and speed up the development of industrial intelligence in China.

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#### Reference

- [1] Xiaochang Liu, Hongjun Shi, Qi Zhou. Construction of intelligent test room for forklift drivers [J]. China Science and Technology Information, 2021(18):3.
- [2] Xigang Fang, Mengran Zhou, Feng Hu. Development of Clamping Force Tester for Portable Forklift Truck [J]. Digital Technology and Application, 2020, 38(3):2.
- [3] Quantian He. Application and requirements of laser forklift truck in warehouse industry scenario [J]. Science and Technology Innovation Review, 2020, 17(5):2.
- [4] Chuang Ma, Hui Ge, Zhongheng Wang, et al. Design of Welding Production Line for Forklift Truck [J]. Engineering Construction and Design, 2020(21):2.
- [5] Jiayun Zhao. Innovation Leads the High-quality Development of Forklift Industry -- Interview with Chen Saimin, General Manager Assistant and Secretary of the Board of Directors of Hangfork Group Co., LTD. [J]. Logistics Technology and Application, 2020(1):3.
- [6] Xiaohu Chen, Yu Fan, Yze Mei. Research on the Design of AGV forklift in Logistics and Warehousing Industry [J]. Science and Information Technology, 2022(17):3.
- [7] Xianqian Liu, Li Zhu. Discussion on Automatic Design and transformation of electric forklift [J]. Modern Manufacturing Technology and Equipment, 2020, 56(9):2.
- [8] Xinbao Wang, Jianwei Liang. Design of Intelligent Anti-collision System for Forklift Truck based on DWM1001 [J]. Science and Technology Innovation, 2020, 000(025):P.101-102.
- [9] Song Shi, Mengran Zhou, Feng Hu. Application of Clamping Force Wireless Detection System in Forklift Equipment [J]. China Equipment Engineering, 2022(8):2.

- [10] Hui Ge, Zhongheng Wang, Chuang Ma. Application of New Technology in Process Design of forklift Assembly Shop [J]. Engineering Construction and Design, 2020(21):4.
- [11] Fang Ren. Lidar: Accelerating the Intelligent Upgrade of Logistics Mobile Robots [J]. Logistics Technology and Application, 2021, 26(12):3.
- [12] Jinqiang Wang, Jun Yang, Jialu Tian, Jinghong Zhao. Development and application of task scheduling management system in Intelligent Foundry Factory [J]. China Foundry Equipment and Technology, 2020, 55(5):4.
- [13] Fa He. Jiang Zhe Li Zhong: Into the future of green, intelligent and digital Transportation [J]. Modern Manufacturing, 2020(26):1.
- [14] Liming Xu, Hua Deng, Liang Liu. Optimization of Parking space Allocation and Forklift Joint Scheduling Considering Time window Limitation [J]. Modern Information Technology, 2020, 4(8):4.
- [15] Shichen Shu, Hongjun Liu, Zhen Lu, et al. Forklift Potential Energy Utilization System Based on Accumulator Energy Storage and Comprehensive Dispatching [J]. Chinese Hydraulics & Pneumatics, 2021, 45(10):6.