

Intelligent Switch Based on Passenger Flow Detection of Urban Rail Transit

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Abstract: According to the demand of intelligent station construction in urban rail transit, the intelligent control of station hall, platform and other equipment places is improved, and the electrical equipment in the station is adjusted by intelligent passenger flow detection switch, so as to achieve the power consumption principle of "needed and supplied", which can ensure the use of equipment when the passenger flow in the station increases and realize energy saving and emission reduction when the passenger flow decreases. The application of intelligent switch device based on passenger flow detection in subway stations helps urban rail to grasp the passenger flow in time, reduces energy consumption, and effectively realizes energy saving and emission reduction while improving the efficiency and safety of intelligent management of station operation.

Keywords: Intelligent switch; Urban rail transit; Energy-saving; Passenger flow.

1. Introduction

With the comprehensive promotion of smart cities, the increasing passenger flow and increasingly complex routes have brought new challenges to rail transit as the pulse of urban growth, accelerating the construction of smart urban rail as a strategic breakthrough in the construction of a powerful transportation country. Stations are not only the basic management unit and external service window for urban rail operations, but also the pilot test field for smart urban rail. In the future, it will definitely become a trend of vigorous development. The construction and operation of smart stations will directly affect whether the goals of energy conservation, personnel reduction, efficiency enhancement, and improvement of management and service levels can be achieved, so as to achieve simultaneous management of economy and ecology, actively play a leading role in demonstration, and drive the construction of smart cities. The application of intelligent switches in smart stations can, on the one hand, accurately detect passenger flow to improve the monitoring and operation capabilities of the station, thereby ensuring passenger safety and reducing the labor intensity of staff; On the other hand, it is possible to predict passenger flow to brake corresponding equipment switches in real time, achieving "what you need is what you supply", to reduce unnecessary energy consumption and waste.

Currently, some existing stations in rail transit still have the following problems:

The labor intensity of on-site operations in various disciplines is large, and the workload of station inspection and other operations is large, which occupies a large amount of staff time and increases their work intensity. Take passenger flow statistics as an example: AGM can calculate daily OD passenger flow, and data acquisition has a lag. At present, the judgment of the passenger transport organization level of large passenger flows is mostly based on the experience of staff, who use the naked eye to detect it. During peak hours of operation, there will also be a certain lag. In the future, with the continuous improvement and popularization of smart urban rail construction, rail transit, as the "brain of urban communication", will definitely become the main tool for people to travel, and the passenger flow at stations is bound

to increase. Effective and timely control of passenger flow at stations has important safety value and significance.

The integration efficiency of station equipment is not high, the equipment is complex, and the buttons are jumbled. Some existing line staff have encountered situations of "oversupply" or even "oversupply" in equipment control and execution, breaking the principle of "what is supplied is what is needed", resulting in low energy utilization efficiency and increasing the waste of unnecessary energy. Based on the above reasons, in addition to vigorously promoting the construction of smart stations for new railway lines, some existing stations are also being targeted for smart station reconstruction. Through the transformation and upgrading of existing equipment, it is possible to achieve intelligent ride safety, efficient and automated management, and green and energy-saving operation.

This article analyzes the shortcomings of the traditional station switching process execution process for operational scenarios such as morning departure and evening outage, and proposes optimization suggestions. Based on the background of intelligent transformation and upgrading of existing stations, the upgrading and upgrading of the original switch has added passenger flow prediction and analysis and automatic switch control functions, combined with infrared wide-angle cameras, raspberry pie, mobile power supplies, and other devices, to achieve intelligent one-button switching stations, making the station efficient, automated, and energy-saving in the process of starting in the morning and stopping in the evening.

2. Intelligent switch operation scenario

The morning departure and evening shutdown of the station mark the beginning and end of daily subway operations, and are important operational scenarios that station managers focus on and implement. As a preparation for operation, it is necessary to ensure that the environmental control equipment and corresponding modes operate normally, the station lighting is turned on normally according to the specified mode, the passenger information system display screen correctly publishes information, and the automatic fare collection gate operates normally. At the same time, the escalator should operate correctly according to the defined upward and

downward directions, and the entrance and exit rolling shutter doors should be opened normally. Accordingly, nighttime outages also need to be implemented correctly based on scenario requirements.

2.1. Operation of traditional station switches

Traditional station equipment switches need to be manually triggered and executed according to a specific time. Enable a device to operate in a corresponding scenario at a corresponding time. Such functions are only limited to regularly starting (or closing) the environmental control mode in the morning and evening, and regularly releasing voice announcements and passenger information during operation.

The switch for automatic control of morning and evening operation in traditional stations is limited to the control equipment of the electromechanical equipment monitoring system and the voice broadcasting system of the platform station hall; For safety reasons, equipment such as escalators and roller shutter doors will not be automatically controlled, but will be manually operated. This means that all large and small equipment in the station need to be confirmed and enabled (or closed) by the station staff one by one. The entire process will be very cumbersome and inefficient, not only posing certain safety hazards, but also causing unnecessary energy waste.

2.2. Operation of Intelligent Station Switches

Traditional station equipment switches still have certain shortcomings and need to be continuously optimized and improved. For example, during holidays, it is necessary to manually adjust and set the device switches accordingly, and even devices that could have been automatically implemented need to re edit the operation (or shutdown) time.

Using intelligent switching devices can effectively solve the imbalance between time and equipment. Firstly, infrared cameras and wide-angle lenses are used to acquire and preprocess image information, detect and track pedestrians in the station hall and platform, and then raspberry pie is used to process and analyze background data, so as to achieve on-off braking control of corresponding equipment based on actual passenger flow conditions. Through the application of intelligent switching devices, precise control of station equipment switches can be achieved, meeting passenger flow needs and improving service levels based on the full use of energy.

3. Application of Intelligent Switch in Urban Rail Station

The intelligent switch is a modification and upgrade of the original switch, mainly composed of infrared cameras, wide-angle lenses, sensors, mobile power supplies, and raspberry pie, which are combined to form a smart switch device that can achieve "one touch" for the station. The intelligent switching device mainly includes the following functions: accurately detecting passenger flow; Automatically switch on and off the braking equipment based on passenger flow conditions, monitor the predicted number of passengers, and adjust the departure interval and driving speed.

(1) Accurate detection of passenger flow -

Using HOG+SVM algorithm to achieve pedestrian detection under top view, automatically acquire real-time images to count real-time passenger flow within the station. According to the actual situation, implement corresponding

traffic plan.

(2) Active braking device switch -

calculates the traffic volume through image processing code, and adjusts the lighting system in the area based on real-time traffic volume. When the traffic in the area is greater than 0, send a Bluetooth signal to turn on the lighting system in the area; When the traffic in the area is less than 0, a Bluetooth signal is sent again, and the lighting system in the area is turned off. Control electricity reasonably according to the flow of people to achieve the effect of energy conservation.

(3) Monitoring, prediction, and adjustment of operations -

Based on the detected traffic data, Raspberry pie conducts data analysis in the background, calculates the stops of regional traffic during different periods, and outlines the flow curve. Intelligent detection and prediction of passenger flow to assist efficient operation and management of urban rail transit.

4. Future Prospects for Intelligent Switches

Based on the response to the policy of transforming from a "transportation power" to a "transportation power", smart urban rail is bound to become a major trend of future development, and smart stations are a breakthrough that cannot be underestimated. Intelligent station refers to a new generation of technologies such as artificial intelligence, big data, and cloud computing, based on the original station, to achieve digital intelligent transformation of traditional stations and accelerate the deep integration of the Internet and transportation. Smart stations are characterized by "intelligence", but focus on "operation and service". In order to further create safe operation and convenient service, the innovative functions of smart stations mainly focus on five categories: holographic perception, automatic operation, intelligent diagnosis, autonomous service, and active evolution.

This product takes intelligent diagnosis as the starting point, and will optimize and upgrade the original functions. At this stage, this product can control the brightness of the lighting system through Bluetooth reception signals based on the actual passenger flow situation. When the area's traffic volume is greater than 100, send a Bluetooth signal, turn on the area's lighting system, and adjust the light to level 2; When the traffic in the area decreases to 0, the device sends a Bluetooth signal again, and the lighting system in the area adjusts the light to position 1. In the future, this product will expand to four levels of lighting control based on the original basic lighting. According to different actual operating conditions received, it will introduce three levels of lighting control corresponding to low, normal, and peak hours. During low operating hours, it will implement one level of lighting control, and gradually increase brightness. For large passenger flows of Level 1, Level 2, and Level 3, the lighting system will continue to maintain the minimum basic lighting brightness and issue pop-up reminders at different levels based on the actual situation. While ensuring that the basic lighting needs are met, the staff will be notified in a timely manner to take corresponding emergency measures to ensure the safety of train operation with intelligent diagnosis and accuracy, thereby improving passenger comfort.

5. Conclusion

The construction of smart stations for urban rail transit will

greatly improve the modern management level of urban rail transit, as well as improve quality service and operation management capabilities. The Intelligent One Button Switching Station utilizes intelligent switching devices to accurately detect and predict passenger traffic through infrared wide-angle cameras and raspberries, thereby braking the equipment in real time, greatly reducing the labor intensity of staff, improving the level of operational management, and achieving intelligent ride safety, efficient and automated management, and green and energy-saving operation during the morning departure and evening shutdown operations based on the principle of "what is needed is provided". With the continuous progress of artificial intelligence technology, smart stations will be given a new definition, transforming towards intelligent intelligence, and truly realizing intelligent services and green operations.

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