Real-time bus information service system based on Internet of things

Kai Li[a], Yunlong Li, Xingbo Yang, and Junhao Zhang

School of Mechanical Engineering College Zhengzhou University of Light Industry, Zhengzhou 450000, China

[a]472916147@qq.com

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Abstract: At present, there is no bus real-time information prompt system with relatively mature technology in the transportation service system. According to the features of less information prompt and single function at the bus station, this paper proposes a new bus information service system based on the insufficiency of research on bus crowding degree technology and the Internet of things technology. Using infrared ray detection technology to collect data on the bus, the bus signal logic analysis of the real number, then each stop the car can also take the number seats, in the end analysis platform to upload information records and statistics, analysis the bus situation information, such as using the GPRS wireless transmission technology in bus station waiting passengers display shows the information for reference. When the bus is about to enter the station, the RFID identification technology is used to read the vehicle information, and the congestion situation and ride advice are broadcast to the passenger voice, so that people can choose more comfortable and convenient ways to travel.

1. Introduction

The concept of the Internet of Things is the inevitable development of information technology, and it also injects new impetus into the development of various industries and improves people's quality of life and production activities [1]. At present, the Internet of Things technology is still in a period of rapid development. The future Internet of Things will eventually realize the integration of physical network and social network, which is of great significance for improving social production level, intelligence level and people's quality of life [2].

With the improvement of science and technology and the rapid development of information technology, people are increasingly demanding the level of living services, especially in terms of transportation. For fast-paced urban life, buses have become the main means of transportation for people. Therefore, studying bus service systems has important practical significance for improving social benefits and travel efficiency. At present, Internet of Things technology has been applied in intelligent public transport service systems, such as: application analysis of Internet of Things in intelligent public transport system [3]; research on data acquisition system of Lanzhou bus condition based on Internet of Things technology [4]. According to the survey, some modern cities have adopted intelligent bus stop signs to facilitate people to obtain real-time information on buses. However, the current electronic stop signs only show the expected bus times and times on the route, with less information and functional limitations. Big [5], cannot provide real-time car information on the bus in real time, cannot really meet the purpose of people's comfortable.

After comprehensively considering the shortcomings of today's transportation service information technology, this paper proposes a new real-time vehicle information service system based on the Internet of Things architecture, using the Internet of Things technology to collect and analyze the actual number of buses per station. And crowded conditions, display vehicle information on the bus station to facilitate passengers to choose the best mode of travel and traffic routes, can greatly improve the level of public transport services.

2. System design principle

The system is based on the Internet of Things architecture, combined with Internet of Things technology, embeds RFID tags into bus and bus stops. When the bus enters the station, it can extract site information, and the site can also identify information such as bus shifts and vehicle congestion. From the perspective of technical architecture, the real-time vehicle information service system based on the Internet of Things can be divided into the sensing layer, the network layer and the application layer. (1) The sensing layer is the basis of the Internet of Things application, including infrared light sensors, wireless sensor aggregation nodes, etc., and RFID is the main technology.(2) The network layer is composed of a GPRS wireless transmission communication network, the Internet, etc., and the network layer is equivalent to transmitting and processing information acquired by the sensing layer for communication between the sensing layer and the application layer.(3) The application layer is the interface of the bus in-vehicle information service system and the user, which realizes the intelligent service application of the Internet of Things. The system uses the bus station display platform LED information prompt screen and voice broadcast to realize the user application of the bus in-vehicle information service system [6]. The overall structure of the system is shown in Figure 1:

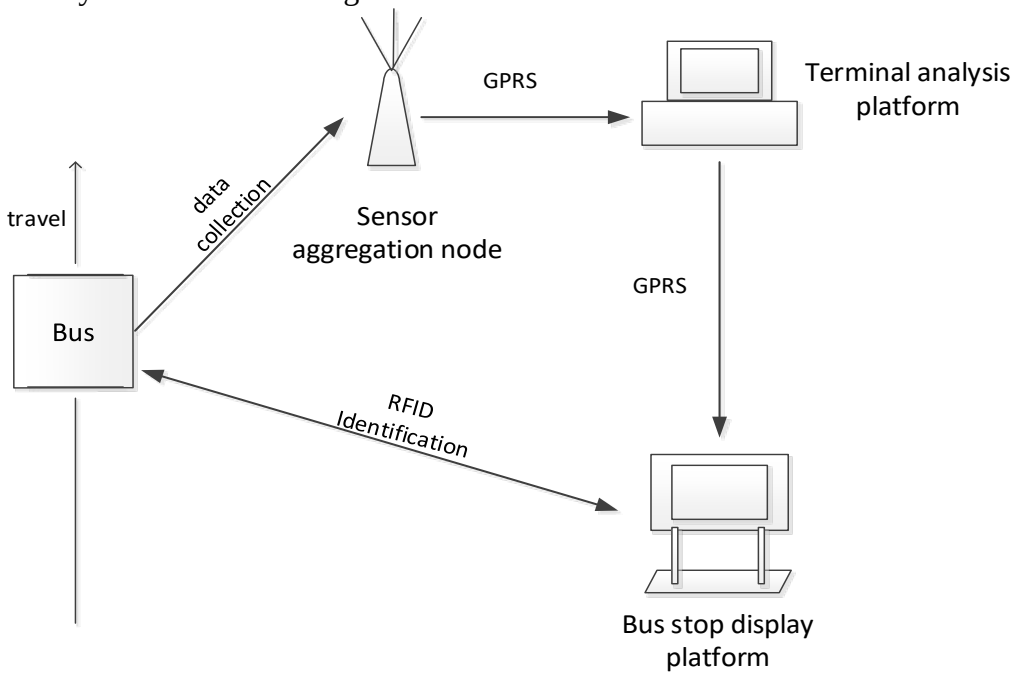

Figure 1. Bus real-time vehicle information service system structure diagram

3. System design implementation

3.1 car number data collection

3.1.1 Principle of infrared light detection technology

Infrared light detection technology belongs to one of the Internet of Things sensor technologies, and the main electronic components used are infrared light-emitting diodes and phototransistors. As shown in Fig. 2, the principle of infrared light detection technology is: constructing a detection line with an infrared light-emitting diode and an infrared photo-transistor, so that one end of the infrared diode emits light, at this time, the infrared light is fan-shaped outwardly; the other end is installed. The phototransistor receives infrared light, and a line is formed between the diode and the triode. The connection is the constructed detection line. If someone passes the middle of the two sections to block the detection line, the other end of the triode will not be able to receive infrared light, it will be in the off state, and vice versa, it can be judged whether someone has passed the door [7].

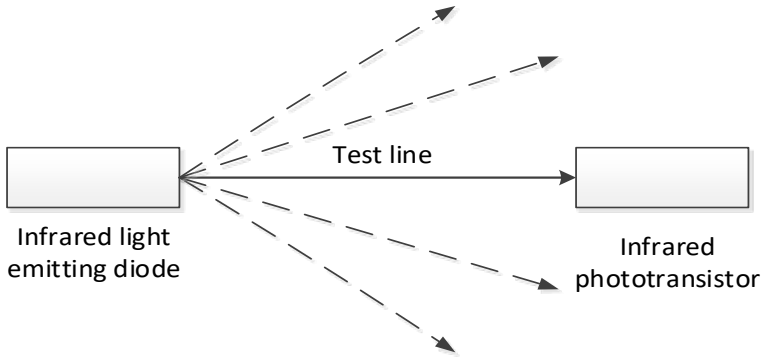

Figure 2. Schematic diagram of infrared light sensor.

3.1.2 Using infrared light sensor to collect data

The system proposes an infrared light detecting technology, in which two reverse infrared light sensors are installed respectively on the inside of the bus door and the lower door at a distance of about 1 meter from the bottom, one near the door and the other near the door. In addition, the distance between the two detection lines is smaller than the thickness of the human body.

Three infrared light sensors are also installed at the midpoint of the top of the door and on the sides of the door near the side of the door. In order to prevent the occurrence of crosstalk of infrared rays.

As can be seen from the above method for detecting the number of people by the infrared light detecting technique, as shown in FIG. 3, if one person passes through the door, the detection line near the door half of the first waist is blocked, and then the detection line near the door is Blocked, at this time, the two infrared light sensors at the half of the door are in the cut-off state. As the person walks in the car, he will first leave the detection line near the door, and the infrared light sensor that constitutes the detection line will be turned on. The two are blocked from the detection line and are in an off state, thereby forming a complete process of passing a single person through the door. The number of people passing through the door and through the door can be inferred and recorded based on the sequence and number of five sensors.

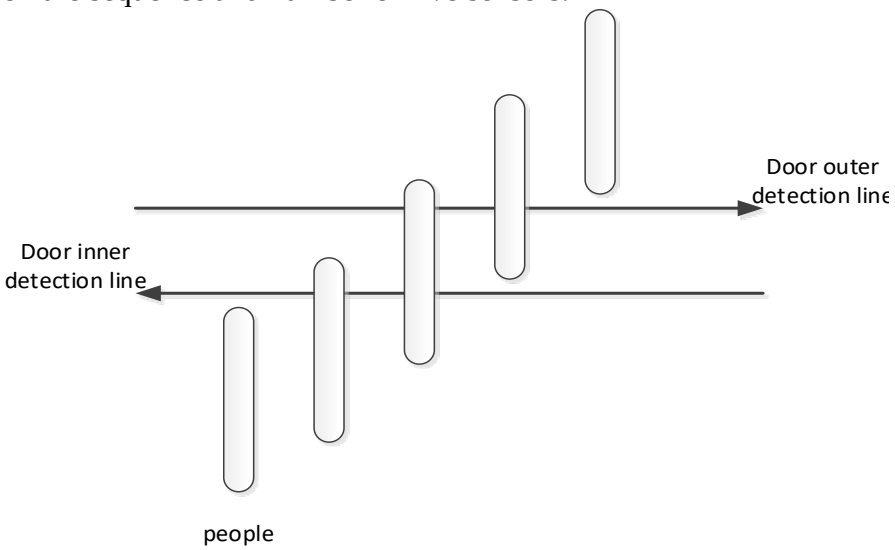

Figure 3. Two-way detection line process diagram.

The bus running in the city has the characteristics of good compartment closure, and stipulates that each passenger can only pass through the door in one direction, and the distance between the bus stations is sufficient for data analysis and Uploading, can accurately collect the data of the number of people getting on and off, and then calculate the number of people in the car, and transmit the information to the terminal platform in time.

3.2 Data upload and analysis

If the sensor is in the on state, the output electrical signal is U=1, and the off state is set to U=0. When someone passes the door, it will form a complete logical relationship, using mathematical knowledge to arrange and combine to get all the conditions as shown:

The method of infrared light detection technology proposed in this paper to count the real-time number of buses is not only simple to operate, but also uses less instruments. It only needs to install five sensors in a suitable position, and can overcome the shortcomings of traditional infrared detection with low accuracy, three at the top of the door. In order to avoid deviations in the detection, the number of passing persons can be inferred by setting the logical relationship signal output generated by the two sensors inside and outside the door to improve the accuracy.

Table 1. Bus boarding test results

U1=0 U2=0	U1=1 U2=0	U1=1 U2=1	U1=0 U2=1	U1=0 U2=0	Single pass
U1=1 U2=0	U1=1 U2=0	U1=1 U2=1	U1=1 U2=1	U1=1 U2=0	Double pass
U1=1 U2=1	U1=1 U2=1	U1=1 U2=1	U1=1 U2=1	U1=1 U2=1	Double pass
U1=0 U2=1	U1=1 U2=1	U1=1 U2=1	U1=0 U2=1	U1=0 U2=1	Double pass
U1=0 U2=0	U1=1 U2=0	U1=1 U2=1	U1=0 U2=1	U1=0 U2=0	Single pass

The intelligent terminal analysis platform records and counts each uploaded data, analyzes the congestion of bus lanes in different time periods, which is of great significance to traffic management [8].

3.3 Bus stop information display

Since the number of passengers on each type of bus is stipulated, the number of seats is also certain. According to the number of actual passengers per time, the number of passengers remaining after the bus exits can be easily obtained. The number of seats, using GPRS wireless transmission technology to transmit information to the various stations on the bus route, on the display screen to prompt the bus real-time number of people.

RFID has the advantages of long-distance identification, storage and carrying more information, fast reading speed, wide application range, etc. It is very suitable for use in intelligent transportation and vehicle management. Therefore, RFID technology has great potential for development and application in the transportation field. [9]. RFID technology is used to identify each bus that will be pitted at the bus stop, accurately and quickly read the vehicle information, and broadcast the vehicle congestion and ride suggestions to the waiting passengers to ease the traffic pressure.

4. Case study

This study is intended to facilitate people to obtain real-time information of buses in time, taking into account factors such as traffic flow, bus lines and number of running stations in Zhengzhou City. This paper selects two representative bus routes in Zhengzhou City (28 roads, 64 roads). For the research object, the bus standard for the two routes is 80 for the nuclear load、Based on the site map information of the two bus lines, several research areas are established.

In order to make the test objective and representative, the data was collected separately during the peak hours of the day and the time of the people. The infrared detectors were installed on the buses on the two test routes, and the number of people getting on and off was detected at each site to collect data. After calculating the actual number of passengers on the bus every time the bus leaves the station, the GPRS wireless transmission technology is used to obtain the real-time information of the bus at the next station. The number of the actual bus numbe can be displayed on the display. Information on the number of passengers, the degree of crowding, etc. The results

obtained from the test are shown in the following table:

As can be seen from the above table, the information technology based on the Internet. Things proposed in this paper can provide passengers with more timely and intuitive driving information, helping people to choose suitable and comfortable travel modes and avoid crowded vehicles. The transportation department can also reasonably increase or decrease the capacity according to the data to analyze the real-time congestion conditions of different time periods improve the utilization of public resources, and realize the rational allocation of public resources [10].

Table 2. Vehicle information data collection of Zhengzhou 28 bus operation

Side name	Time point	The number of people on the bus	Number of empty seats	Number of people can get on the bus	Degree of crowdedness
WenHua road station	11:53	48	0	32	Medium
	16:08	18	4	62	Low
college road station	12:01	46	0	34	Medium
	16:14	17	5	63	Low
Zhengzhou University station	12:04	53	0	27	High
	16:16	24	0	56	Low
Henan hospital station	12:08	51	0	29	High
	16:20	21	1	59	Low
FengQing road station	12:13	54	0	26	High
	16:26	14	8	66	Low
TianMing road station	12:19	56	0	24	High
	16:30	17	5	63	Low

5. Conclusion

Based on the Internet of Things architecture, the system uses infrared light detection, RFID and other technologies to display the information on the number of people on the bus and the degree of congestion on the bus stop. This will not only enable the passengers to know more about the ride information, but also choose The convenient and comfortable travel mode further improves the intelligent transportation service system and enhances the performance of the urban public transportation information system. It is highly practical and has broad application prospects.

This system is based on the emerging research direction in the field of information science and technology. It further explores and applies the Internet of Things technology, and provides a basis for the application of the Internet of Things in other fields and solving practical problems.

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