

Intelligent Queuing System Based on Laser Sensors

Caiyu Wan, Zhenlong Hu*, Jianhua Hu

School of Engineering and Technology, Jiyang College of Zhejiang A&F University, Zhuji,
311800, Zhejiang, China

Abstract

With the arrival of the era of big data, theme parks are growing rapidly under the increase of tourism industry and entertainment consumption ratio, while the corresponding dispatch system and FAST PASS currently used by major theme parks have low usage rate by visitors and digital services need to be improved. This system is suitable for multiple queuing service windows and is designed for queuing users and businesses using the Intelligent Internet of Things as a framework. The system uses a collection module and a control module together to build the predictive communication component; its microcontroller is connected to the ESP8266 WIFI module as the network layer of the whole system; the application layer chooses the mobile phone terminal for the convenience of the user to achieve an effective visual presentation of the data. Through this system, users can know the waiting time of each queue item in real time through the mobile Internet terminal, so that the queue waiting of users is no longer limited to the queue waiting situation learned within the line of sight, but also makes the quality of queuing service more efficient.

Keywords

Digital services; Queuing system; Time use; Internet of things.

1. Introduction

The rapid development of the information society continues to change the queuing patterns of people. In order to put the "information Internet of Things (CPS)" "Internet of Things (IOT)" as the main body of the strategic deployment of the Internet of Things in-depth thinking. Since the concept of intelligent queuing system was proposed, its development in China has been closely around the queuing system of each enterprise, through the integration of queuing system represented by big data, cloud computing, Internet of Things, mobile Internet, etc., in different service areas, eventually forming an efficient and intelligent queuing service model. The current intelligent queuing system as an emerging high technology product, in entertainment amusement projects in a specific form and application landing, for enterprises and users to improve the utilization of resources.

2. An Overview

2.1. Project Background

Along with the rapid development of digital economy, people demand higher and higher quality of service for leisure and entertainment, and pursue high quality service experience. As the current popular domestic tourism card mecca – theme park, is also with more than each queue waiting entertainment service projects. For the theme park, service quality, service concept and management level reflects the public image of the enterprise, service quality standards have become a common concern of both enterprises and users, and the queuing service window is an important place representing the service quality of the enterprise. Therefore, theme parks

should not only have novel amusement projects, but also meet the service experience of huge crowds.

During the validity of a day, facing a large items number of people and not knowing each play item, maximizing the use of resources and reasonable time arrangement become the concern of every visitor and business.

2.2. Purpose and Significance of the Study

Its intelligent queuing system aims to use the Internet of Things to reduce the pressure of the queuing service of enterprises and minimize the waiting time. Similarly like users in banks, taxation bureau, hospital and other business halls of existing multi-project service windows, there is also a user station is more than an hour, greatly affecting the quality of service, in order to establish a good image of enterprise, the team designed based on machine vision recognition caused by queuing can not be arranged independently, to solve the phenomenon of laborious queuing, to create Humanized service environment.

3. Overview of the Key Technologies

3.1. Introduction of the VL530X Structure

The VL53L0X consist of an integrated 940nm optical communication based on a SPAD (Single Photo Avalanche Diode) sensor display and a human safety compliant VCSEL (Vertical Cavity Surface Emitting Laser) that meets human safety standard”(World Electronic Components, 2018).To do this, the VCSEL(Vertical Cavity Surface Emitting Laser) is used to emit a laser that is reflected back by the VL53L0X after hitting an obstacle and is received by the VL530X to measure the propagation of the laser in the air time and thus the distance is obtained. There are two holes on the VL530LOX, one for the SPAD laser detection array and for the VCSEL laser emission.

VL53L0X combine the advantage of SPAD and VCSEL to meet safely, high accuracy, reliability and low power consumption in playground crowd surveying in different climatic environments and complex terrain.

3.2. Introduction to the Analog Block Diagram

The Arduino board is a hardware facility that implement the control output device using the programmed raw code Java. Arduino Nano board its convenient and flexible features in the playground is a very easy to start open source hardware products, for different modes of playground entertainment projects are suitable, and only a simple function code to control its operation, practicality.

3.3. ESP8266WIFI

The ESP8266 is divided into ESP-WROOM-02U and ESP-WROOM-02D, which are functionally the same, except that the former has an on-board antenna and the latter requires an external WIFI antenna. The ESP8266 has a large operating temperature range and can maintain stable performance, which is suitable for amusement parks with large areas and complex weather environments. It can be used in different entertainment facilities in the amusement park.

4. System Analysis and Design

4.1. System Objective Design

The main goal of this system is an intelligent queuing system base on laser sensors, in today's big data era, more and more queuing systems choose to combine online and offline, to provide users with online queuing and calling services, to provide users with real-time queuing and waiting time for each item in the queuing service of participating in multi-project queuing

windows, to help users can refer to the system according to their actual situation each queuing item need to wait. It help users to choose the best queuing item according to their actual situation and realize the digital queuing system service.

4.2. System Performance Analysis

The system is mainly designed for the existence of multiple queuing service windows of enterprises and the core of users involved in the queue, convenient for users to know in real time the time required to wait in line for each item, according to the individual situation to participate in the queue, the system has the volume down, easy to install, and easy to maintain and operate.

4.3. System Function Module Design

Analyzed on the IoT framework, the functional modules of the laser ranging based intelligent queuing system are divided into acquisition module, control module, Network module and application module. Acquisition module: for the perception layer of IoT, this system uses laser sensors to range the length of the queue in real time and collect the required data in each queue waiting area. Control module: connects the acquisition module and the application module, which will collect the data for preprocessing, algorithm calculation, real-time update and control transmission to get the waiting time data. Network module: it is the network layer of IoT, which can make the collection module and control module work in real time within the coverage of the network. Application module: the waiting time data will be visualized and presented to the user, in order to facilitate the presentation, the system chooses the central large screen to present to the user.

5. Overall Design and Implementation

5.1. Smart IoT Building

The intelligent IoT in laser ranging based smart queuing system includes three layers of structure: perception layer, network layer, and application layer. Among them, the perception layer, which is the base part of the whole IoT, needs to be completed by this layer to collect the data of queuing people in each project and process them in place. The system uses a laser sensor as the acquisition module and a control module as the communication module, which is connect to its acquisition module, to pre-process, analyze algorithm and calculate the estimated waiting time of the collected crowd data in all aspects.

The whole framework is mainly base on the hardware terminal, and the data obtained from the communication module is presented to the users in a visualization under the coordinated transmission of the communication base station, providing a complete service platform for the user.

5.2. Design and Implementation of Major Modules

5.2.1 Acquisition module

The acquisition module, ad one part of the perception layer, is placed its designated queue service location for real-time measurement of the number of people, laying the foundation for its data processing, time prediction, and visualization techniques in the follow-up, whose accuracy, efficiency, and practicality are crucial. The control of the control circuit Arduino Nano board, control pulses are sent to the integrated safety light point of the VCSEL in the VL53L0X, which is quickly returned to the SPAD laser detector after the character to receive the laser.

5.2.2 Control module

Carrying on from the above, the control module, as the most central part of the sensing layer, is to pre-process, algorithmically analyze, real-time update and control the data transmitted from

the acquisition module. There are many dirty data and default values in laser measurements, and the data is reasonably and properly pre-processed before the algorithm calculation is built. The main purpose is to remove the missing values, then to remove the values that are not in their normal range, and to process the anomalous data.

5.2.3 Network module

The network module is the network layer of the whole system, the ESP 8266 module is chosen to support three modes of STA, AP and SAP+AP, in this system SAP (soft router mode) is chosen, in this mode, the ESP8266 itself is equivalent to a router the application devices used in this system can link the signals sent by the module in this mode.

5.2.4 Application modules

The application module, as the application layer of the whole system, visualizes the valid data obtained by processing to the user and realizes the value of the application layer service. The user clicks send to find out how much time is required to wait in line for the current entertainment item measured by the system.

Users can choose their most suitable amusement program according to the current estimated time required for each item in the display, which greatly reduces the time consumption on waiting in line.

6. Development and Testing

Test this system using 3D scenario reduction method, in order to better show the multi-project queuing service, this system choose to simulate the queuing service in the theme park play scenario, using 3D printed object blocks to simulate the demonstration of the flow of people, place the laser sensor in front of the queuing area, as the theme park set up a single pass in the queuing area, we also set up the same in the queuing area corresponding to the similarity of the queuing terrain. In this area for adding or subtracting 3D object blocks to simulate the real-time Dongtai changes in the flow of people, by checking whether the waiting time displayed on the mobile phone terminal and the expected waiting time match, so as to determine whether the corresponding function of the laser sensor-based intelligent queuing system is achieved.

7. Conclude

This paper deals with the design and implementation of a laser sensor based intelligent queuing system. The importance of applying the smart IoT framework in building smart queuing systems is first discussed in the context of the current digital economy and queuing services. By sorting out the intelligent IoT framework and analyzing the data transmission process in it, the data transmission is divided into four categories according to the application scenarios: acquisition, control, network connection and visual presentation. After sorting and testing, the acquisition and control are the underlying network framework in IoT, which can achieve effective data are transmission within the coverage of the network layer, and finally the valuable data can be transmitted to the application layer to provide users with reliable data for reference.

In the whole system building process, I deeply realize that an efficient and intelligent IoT system is difficult to be completed by only one person, although the system can achieve real-time measurement of the flow of people, but in the waiting area affected by the topography of the queue. And the system as a whole is relatively simple to build, the layout is not too beautiful, etc. In the future, I will work hard to learn and improve my personal strength, so that this system can be better improved.

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