

# "Zero Contact" Intelligent Guidance Solution Based on Community Light Belt System

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**Abstract:** With the acceleration of urbanization and population growth, the road conditions of the community are becoming more and more complex, how to provide the optimal route for residents, rescue workers, intelligent vehicles and so on has become an urgent problem to be solved. This paper puts forward a solution based on community intelligent light belt system, which aims to realize "zero contact", "intelligent delivery" and "intelligent guide" of intelligent community. The system consists of three parts: the community light belt control system, the delivery car based on photosensitive sensor identification technology, and the database management system of local or cloud platform. This paper successfully achieves the goal of building an intelligent community by means of Arduino code, sensor technology, Internet of things technology and so on.

**Keywords:** Zero contact, Intelligent guidance solution, Community Light Belt system

## 1. Introduction

According to the current domestic situation, no community uses or builds LED light belts as guide signs in the community, but with the exponential growth of urban migration population, the increasingly complex residential road conditions have led to the inability to choose the optimal route has become a problem of public concern, and the market demand for this is increasing day by day [1-3].

The main target market of this study is the developers of the residential area, because this research system can not only provide a strong layer of security for the whole community, but also facilitate the residents of the community in their daily life[4].

Recently, according to the Ministry of Civil Affairs, the Central political and Law Commission, the Central Internet Information Office, the Development and Reform Commission, the Ministry of Industry and Information Technology, the Ministry of Public Security, the Ministry of Finance, the Ministry of Housing, Urban and Rural Construction, and the Ministry of Agriculture and Village, the opinions on further promoting the Construction of Intelligent Communities (hereinafter referred to as "opinions") have been issued, which clearly states that by 2025[5,6].

Basically build a smart community service platform with grid management, fine service, information support, open and sharing, and initially build a new digital community of wisdom sharing and harmonious co-governance.

At present, the epidemic situation in China has been brought under control, but under the influence of all kinds of isolation policies in closed areas at that time, not only the contemporary residents have put forward higher requirements for intelligent facilities and convenient equipment and security systems in the community, but also the national policy is also vigorously promoting the construction of intelligent communities.

At present, a number of domestic large logistics companies have also launched all kinds of unmanned intelligent express delivery services in recent years, making a great contribution to the solution of this problem.

In the contemporary increasingly large and complex residential buildings within the emergency due to the lack of familiarity with the roads within the community, the problem of wasting valuable rescue time is also gradually emerging.

This directly leads to the urgent demand of the market for a system module which can not only achieve security, but also serve distribution and information management.

As an important driving force of the change of the times and urban change, intelligence is opening up an unprecedented development space for the vigorous development of the intelligent community. Based on this research, this paper designs a smart community system based on community intelligent light belt, which integrates three functions: security, logistics and transportation, and information management.

## **2. Research methods**

In order to solve the problem that rescue workers can not reach the rescue site quickly and accurately due to the complexity of the community, this product aims to provide route signals for residents, rescue workers, smart cars and so on.

This study is based on arduino single-chip microcomputer and uses time delay, flicker and other functions to design the community guide light belt system. Secondly, based on sensor gray recognition technology and arduino UNOR3 motherboard, with the help of photosensitive sensor, infrared sensor and motor drive board, an intelligent delivery car for tracking light belt is designed and manufactured. Finally, the cloud platform database management system is built by using Python language, Apache and Dreamweaver development platform.

This product can statistics the distribution information according to the needs of residents and send the items to the designated unit door, so as to realize the usable physical model of "zero contact", "intelligent delivery" and "intelligent guide" of the intelligent community.

In the actual test, when residents encounter an emergency, the LED light belt on the ground will lead rescuers to the designated position with the quickest route of action, providing valuable time for rescue.

When in a non-emergency situation, the guidance system can guide the intelligent tracking delivery car to carry out accurate and intelligent delivery in the community according to the user messages collected by the database, so as to achieve "one system and two functions".

The objectives of this study are as follows:

- (1) Taking the intelligent community as the goal, this study first uses the system based on the design of community guide light belt.
- (2) Secondly, an intelligent distribution system based on sensor technology is designed and made, and (3) the database management system of cloud platform is built.
- (4) The general integration becomes an applicable physical model which can calculate the distribution information according to the needs of residents and send items under the designated unit door to realize "zero contact", "intelligent delivery" and "intelligent guide" of intelligent community.
- (5) Docking developers to complete outdoor field installation and commissioning.
- (6) Strengthen marketing promotion and improve exposure and user stickiness with the help of social media, search engines and other platforms.
- (7) Constantly optimize the profit model and obtain revenue through the implantation of advertising revenue in its own car space.
- (8) Strengthen customer service, collect customer needs and improve customer satisfaction and loyalty to promote sustainable development.

## **3. Products and services**

### **3.1 Product introduction**

The product model system consists of three parts: community light belt control system, delivery car based on photosensitive sensor recognition technology, local or cloud platform database management user collection system.

Its original design is based on the light belt buried on the ground of the community under the control of arduino single-chip microcomputer, which can provide route signals for residents, rescue workers,

intelligent vehicles and so on.

The light belt control system uses time delay, flicker and other functions to design and drive, and the intelligent distribution system of tracking light belt is based on sensor gray recognition technology, photosensitive sensor, infrared sensor, motor drive board and arduino UNOR3 motherboard. Finally, the community database management system uses Apache, Dreamweaver and Python language design to build the platform and build web web page port.

### 3.2 Detailed product introduction and technology

#### 3.2.1 LED lamp guidance system

The basic function of the main module controls the arduino NUO R3 single-chip microcomputer by writing arduino code to set the time delay change between each lamp distance, which makes the single-chip microcomputer output the time difference between high and low level to achieve the effect similar to that of a current lamp, so that the light bulbs inside the lamp belt are lit one by one, thus leading the way for the freight system.

In the face of an emergency, when the rescue workers or vehicles arrive at the starting point (community gate), the master control room uses the single-chip microcomputer to design the simplest route according to the model / actual community ground in advance, automatically select the optimal path and control all the lights from the starting point (the entrance of the community) to the downstairs path of any unit.

The system provides obvious signal signposts for rescue without the influence of weather, day and night, environment and so on.

Its operation flow chart is shown in Figure 1. Figure 2 below is the physical diagram of the lamp tape system which can be controlled by arduino after the burning time delay function and the LED lamp with tone library.

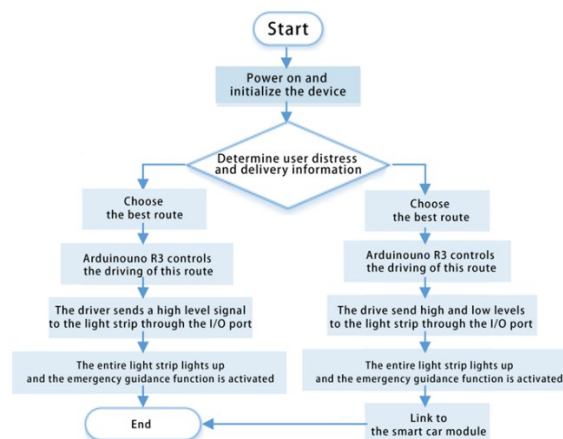


Figure 1: Flow chart of LED light guidance system

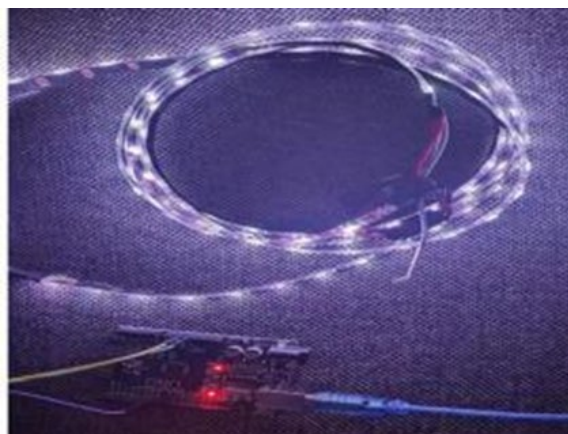


Figure 2: Picture of light tape system

### 3.2.2 Unmanned intelligent distribution system

The system is composed of arduinomag single-chip microcomputer, grayscale sensor, photosensitive sensor, infrared sensor, Bluetooth module, ultrasonic module, steering gear module, car model, etc., using sensor technology, Internet of things technology, single-chip microcomputer technology, ultrasonic and infrared radar technology to achieve tracking, light tracking, obstacle avoidance, Bluetooth remote control effect.

The functions of the unmanned intelligent distribution system are as follows:

First of all, the arduinoUNOR3 of the burned program emits the high level command photosensitive sensor module to determine whether there is a light source that reaches the set sensitivity degree. When the light source reaches the sensor threshold, it will feedback the telecommunication number to the arduino single chip microcomputer, and then immediately order the infrared sensor and ultrasonic module to work. If the ultrasonic module receives the return wave value after transmitting the ultrasonic wave, at the same time, the infrared sensor receives the infrared light wave in front.

Under the feedback value of the dual system, the single-chip microcomputer determines that there is an obstacle ahead and commands the L298N drive board to stop and make the vehicle stand still.

After judging that there is no obstacle ahead, the arduino single-chip microcomputer will order the L298N drive board to drive the operation of the motor and steering gear according to the light source of the light belt system received by the left and right photosensitive sensors, so as to achieve unmanned distribution of power.

It is equipped with a Bluetooth module, which can artificially transmit signals through Bluetooth remote control under special circumstances to control the single-chip microcomputer to forcibly launch low-level control drive board commands to send the car to rest.

Figure 3 below is the flow chart of the unmanned intelligent distribution system:

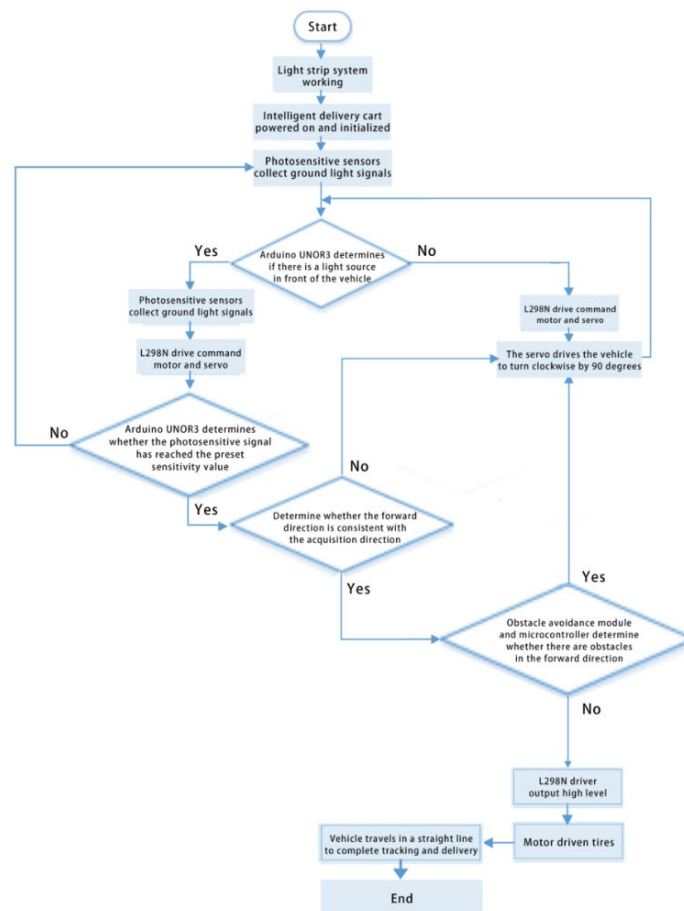


Figure 3: Flow chart of logic analysis introduction

Physical display and introduction of parts and components of distribution system:

(1) Introduction of core motherboard arduino:

Arduino can sense the environment through a variety of sensors and feedback and influence the environment by controlling lights, motors and other devices.

The microcontroller on the board can be programmed by Arduino programming language, compiled into binary files, and burned into the microcontroller.

It has three advantages: cross-platform, extreme simplification and openness.

It can run on three major operating systems: Windows, Macintosh OS (Mac OS) and Linux.

Arduino IDE is based on processing IDE development and is flexible enough, as shown in Figure 4 and Figure 5.

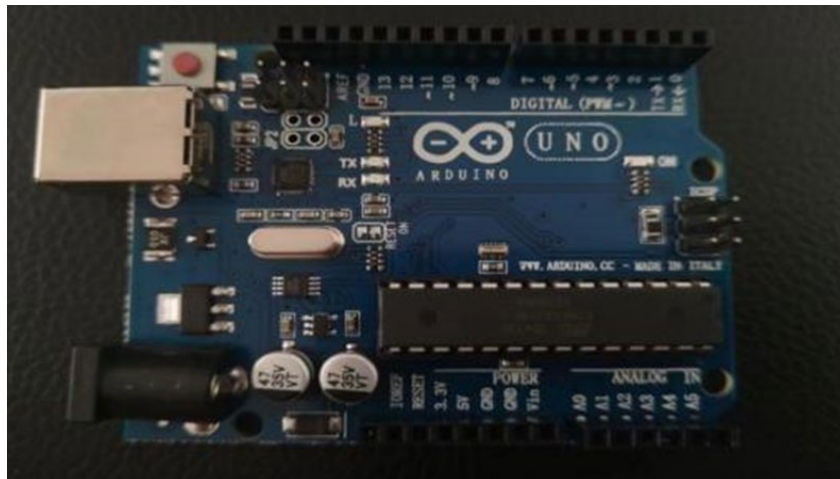


Figure 4: Photo of Arduino UNO R3 Board

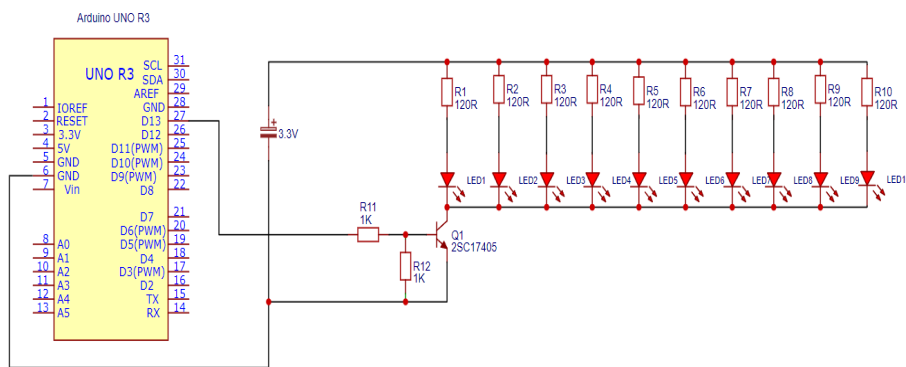


Figure 5: Arduino UNO R3 board in simulation software

Photosensitive module introduction: according to the characteristics of the decrease of the incident light intensity resistance and the increase of the incident light weak resistance, it is used to detect the light change in front of the car and feedback the data to the arduino UNO R3 microcontroller, so that the car can realize the light tracking function according to the ground LED light guide (Figure 6).

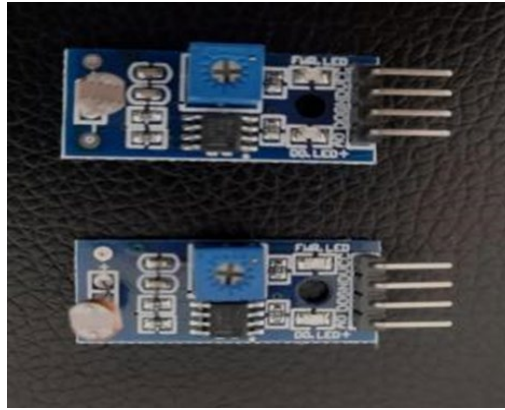


Figure 6: Photo of photosensitive module

The risk of unmanned intelligent dispatch is greatly reduced (Figure 7).



Figure 7: Image of infrared receiving module

Sensor expansion board introduction: because the vehicle needs to achieve all kinds of functions, the front sensor development board is designed, which can be used to expand the connection of sensor components and realize all kinds of sensor functions at the same time. It can also pave the way for all kinds of subsequent development needs of customers, and has the sustainable development ability of "expandable", "updatable" and "modifiable".

Figure 8 below is a physical diagram of the delivery car that integrates all the electronic components and is burned and debugged:

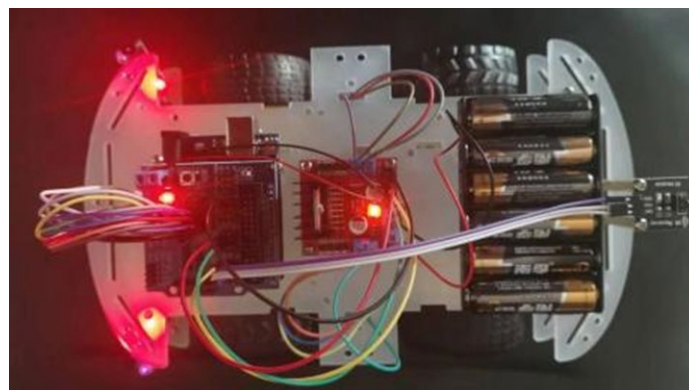


Figure 8: Picture of delivery trolley

### 3.2.3 Community Database Management system

This database is built by using Adobe Dreamweaver programming software and Apache Web server

software based on MySQL sentence and Python sentence, linking the local database platform and web page, and developing and designing the community data base management system, realizing the information management of the residents in the community, and providing the exact information foundation support for the intelligent delivery system and the urgent guidance system.

Figure 9 below is the flow schematic diagram and technical presentation diagram of the database management system:

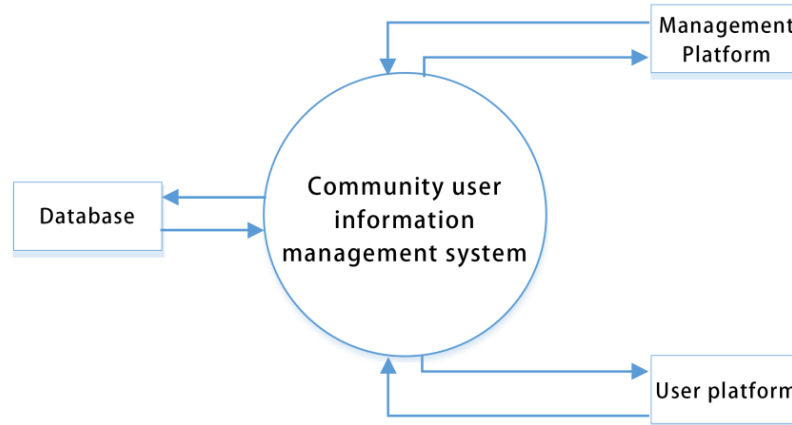


Figure 9: Data Flow Diagram

#### 4. Conclusion

The community intelligent light belt system proposed in this paper offers a cutting-edge solution to the challenge of providing optimal routes for residents, rescue workers, and intelligent vehicles. This innovative system has been verified through practical application and boasts advantages such as simple operation and a high degree of intelligence. It holds great significance in promoting the construction of intelligent communities. As we move forward in our research, we are committed to continuously optimizing system performance, expanding application scenarios, and providing even more effective solutions for the development of intelligent communities. By doing so, we aim to enhance the convenience and safety of people's lives, ultimately contributing to a more connected and efficient smart community.

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