Research on the Key Implementation Technology of Removable Vending Machine

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Abstract. Vending machine as one kind of non-store business has been very popular in the developed countries for many years, and so has been China. Unfortunately, there are only very few related researches that have been done for studying consumers how they operate a vending machine by an efficient and convenient way. The main goal of this research is to explore how to apply the wireless location technology and route planning on designing the display panel of the removable vending machine.

Introduction

With the development of network technology, shopping has become the second largest shopping experience. And for the user, the vending machine possesses namely regards to choose the advantages of the traditional entity shop, and because of its convenient scattered distribution, wide, payment, etc can be comparable to online shopping, and is widely used in the worldwide [1].

With the popularity of vending machines, the level of experience is bound to increase. Especially with the popularity of the Internet, people are more and more inclined to reach for the shopping experience. Vending machines are usually placed in the foot traffic, however, on the one hand, due to the limited number of vending machine can set, on the other hand in the rain or the hot weather, even a few metres away enough convenient [2].

Wireless outdoor positioning system by means of Wireless Fidelity (WiFi) introduced by Microsoft for user tracking has sparked the research field. The system works by matching the unknown signal strength from the receiving client device to a WiFi signal strength database recorded beforehand. Such technique is known as fingerprinting. Since then, many variations and interests have been publish abundantly in various applications such as people tracking, mobile marketing, navigational aids, as well as for mobile robot, aiming for both positioning and navigation.

In this paper, the design of a vending machine have mobile function, people can check it on the smart phone APP distribution nearby mobile vending machine, and can browse the goods inside the machine information, needed to select good vending machines, and it can be under network navigation, automatic movement to the front of the person needs. Although the work of this article is preliminary and from vending machines mobile application is still a far distance, but from a technical reserves and the ability to relate to students exercise ways [3], has a certain value and significance.

Principle and Realization of Mobile Vending Machine

The mobile vending machine is mainly based on the existing vending machine technology to increase its mobile function. As shown in Figure 1, people use a special APP for vending machines in their smart phones to view the information of vending machines nearby on the map. After browsing the internal product information of the vending machine on the APP, it selects the vending
machine it needs and orders, then the current vending machine responds and runs to the person who needs it.

Figure 1. Mobile vending machine diagram.

The wireless communication system of vending machine consists of four parts: user end, vending machine, wireless router relay and remote monitoring management platform. The vending machine is made up of interactive parts, payment parts and shelf control. People can buy the goods they want at any time. Through wireless relay, a high speed and stable data transmission channel is established for vending machines, and all information such as commodity sales is transmitted to the background of enterprises for business analysis and operation. The remote monitoring management system will complete the billing, goods management and motion navigation control of the vending machine, as shown in Figure 2.

Figure 2. Mobile vending machine network structure diagram.

Research on Wireless Location and Path Planning of Mobile Vending Machines

In order to realize the wireless positioning of the vending machine, the antenna height and separation distance between the built-in transmitter and the wireless receiver of the vending machine are evaluated. WiFi USES the Alfa aip-w525h dual antenna with 5dBi gain, which has good wall-penetrating performance. The receiver used is a universal Broadcom BCM43142 wireless network adapter. By setting up WiFi AP, a default MAC network is established using Alfa Inc. ’s device [4]. The network channel is set to 1 and the communication frequency is set to 2.4 GHz. Because the data required is only the strength of the signal transmitted from a specific AP, there is no need to access the Internet, so the network is still disconnected from it. Finally, in the Homedale ® open source code to run Windows 8.1 wireless signal strength wireless monitoring, each interval of 2 seconds to record data at a time [5]. In order to accurately locate the position of the vending machine, the position of the vending machine and antenna should satisfy the relation shown in the Figure 3.
To solve the contradictory between the convergence speed and the local optimum in ant colony algorithm, an improved ant colony optimization algorithm is proposed for path planning. The local path information is integrated with the initialization of pheromone and the selected probabilities of the paths, resulting in improving the convergence speed. For overcoming the stagnation phenomenon, crossover operation is drawn into the proposed algorithm, which enhances the capability of escaping stagnation phenomenon. The proposed algorithm improves the search efficiency of optimum path for mobile vending machine [6-7].

And the vending machine can complete coordinate calculation through the following formula to achieve positioning.

\[
(X, Y) = \sum_{j=1}^{N} [\lambda_j \times (X_j, Y_j)]
\]

\[
\lambda_j = \frac{1/d_j}{\sum_{j=1}^{N} 1/d_j}
\]

\[
f(x) = 19.65e^{-(x+4.5)^2/4}
\]

Because neural network is highly parallel distributed computation have good nonlinear fitting ability, the characteristics of mobile vending machine using the neural network structure as a path specification algorithm can make the sales chance in under the condition of unknown environmental information have good applicability.

To solve the local minimum problem in the complex environment of local path planning for mobile vending machine, a multi-behaviors coordination approach is proposed. The proposed approach defines three kinds of basic behaviors. The mission of path planning is completed by switching among three kinds of basic behaviors.

![Figure 4: Mobile vending machine network structure diagram.](image)

The global path planning strategy and local path planning strategy of mobile robots are introduced in detail, and several corresponding planning algorithms are outlined for each planning strategy. And the search strategy based on state space of a global path planning strategy, namely the
establishment of environment model based on grid method, barrier free global path planning and then use the classical A* algorithm of mobile vending machine in known environment [8].

As shown in Figure 4, when the path planning, mobile vending machine sensor real-time detection of ontology to carry around the obstacle distribution, combining with the current position of the input values, the network in a timely manner to adjust the second hidden layer weights parameters, thus wj1, wj2 is dynamic change. Their values may not be the same after each iteration [9]. Through real-time adjustment of the connection weights, the next moment the path of the node location information through the network to calculate the output, a robot with just the output node information as your current location information, and then on to the next step of planning and so on, until reach the target.

Conclusions

(1) Puts forward the concept of mobile vending machine and the principle of structural design, on the basis of high cost does not increase, greatly improved the people's shopping experience, improve the market competitiveness of the vending machine;

(2) Based on the existing technology, the existing main problem is how to implement a wireless location and path planning. Monitoring signal calculation for positioning coordinates based on WiFi, vending machine run path planning is realized by using neural network algorithm, can be a preliminary solution to this problem.

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