

# Intelligent Community Scheme Based on Vehicle Design

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**Abstract.** With the help of cutting-edge technologies, we propose a feasible intelligent community scheme concept by designing vehicles with different functions. Firstly, we send a questionnaire to the public and use the AHP method to analyze. We find that residents have a greater demand for leisure travel, medical security and safety protection. Secondly, we design three different means of transportation, namely intelligent drones, intelligent medical vehicles and intelligent leisure vehicles to solve the problem. In each design, its importance and its innovation points are detailed. Then, in order to meet the intelligent needs of residents, we design the intelligent community APP, which is divided into the elder version and the younger version, to provide residents with more convenient and comprehensive services. The scheme we proposed improved the automation and intelligence of the community, thus providing a more comfortable environment.

**Keywords:** Intelligent vehicle, Drone, Security, Medical protection, AHP method.

## 1. Introduction

With the development of social economy and science and technology, people's requirements for living environment and quality of life are getting higher and higher. The lag of old-fashioned community management can obviously no longer meet the needs of residents and community management. As a consequence, community management needs to undertake the task of assisting government departments to do a good job in grassroots social governance. These all pose new challenges to community management services [1].

Young and middle-aged people are the mainstay of society and the backbone of the country's rapid development [2]. We provide a convenient and diversified intelligent community environment from the perspective of the elderly and children. Meanwhile we help young and middle-aged people to relax in the limited time of community life, so as to reduce the pressure of young and middle-aged people in various aspects.

He Chao [3] proposed a closed-loop intelligent community policing system integrating "collection, management and early warning" to provide more convenient and efficient policing services for community residents. Zhu Haijuan et al. [4] achieved an advanced and secure information management platform. Her methods include standardizing the process of collecting information, avoiding use risks, improving processing capabilities, and jointly building and sharing with all parties. Chen Zongwu[5] strengthened the construction of information infrastructure and build an intelligent community to provide a technology platform. Ren Mengyao[6] improved the participation of target groups to ensure residents a correct understanding of intelligent community construction. So, she can enhance the enthusiasm of target groups to participate in intelligent community governance. Liu Wei [7] proposed a new intelligent community algorithm based on weighted short job priority. He used the weighted algorithm to realize the classification and grading of alarm information and segmentation processing. Xie Su et al. [8] proposed a new model of cooperation between medical institutions, pension institutions and insurance institutions. They make full use of human resources, and comprehensively build a volunteer service system. Li Hao et al. [9] proposed the construction of a traffic management system with artificial intelligence as the core to facilitate residents' going out.

We distributed 200 questionnaires to representative communities. After receiving the feedback from residents, we ranked the needs of residents for intelligent communities through the TOPSIS method modified by entropy weight method.

## 2. Intelligent Community Scheme Determination

### 2.1. Analytic Hierarchy Process

Analytic Hierarchy Process (AHP) is a multi-level and systematic decision-making method proposed by Professor THOMAS L SAATY in the 1980s. This method can regularize cumbersome problems and be used to solve multi-level decision-making problem [10,11].

When using AHP, the following steps are often needed to go through:

(1) Analyze the relationship between factors in the system and establish the hierarchy of the system. Based on the research of a large number of literature and field investigations, we constructed the target layer, decision-making level and program level of the intelligent community index evaluation system.

(2) A judgment matrix is constructed by comparing the importance of elements of the same level with respect to a criterion at the previous level. According to the expert scoring and the analysis of the questionnaire, the importance of the intelligent community program indicators at each level is compared, in order to quantify the comparison results. We adopt the 1-9 scale method, and the meaning of each scale is shown in Table 1.

**Table 1** The meaning of each scale in the scale method of levels 1-9

Level	A description of the criticality
1	Equally important
3	Slightly more important
5	Obviously more important
7	Strongly more important
9	Extremely more important
2,4,6,8	Corresponds to the compromise scale between the above two standards

According to the above hierarchical structure model, the importance of each element of the same level on a criterion of the previous level is compared in pairs. The judgment matrix is obtained according to the scale method of 1-9:

$$A = (a_{ij})_{n \times n} = \begin{bmatrix} a_{1,1} & a_{1,2} & \dots & a_{1,n} \\ a_{2,1} & a_{2,2} & \dots & a_{2,n} \\ \dots & \dots & \dots & \dots \\ a_{n,1} & a_{n,2} & \dots & a_{n,n} \end{bmatrix} \quad (1)$$

Here,  $a_{ij}$  is the criticality ratio of the indicator  $i$  to that of  $j$  for the construction of intelligent communities, which meets  $a_{ij} > 0, a_{ii} = 1, a_{ij} = \frac{1}{a_{ji}}$ .

(3) The relative weights of the compared elements to the criterion are calculated by the judgment matrix, and the consistency test is performed. Calculate the maximum feature value of the judgment matrix, and then apply the formula:

$$C_R = \frac{C_I}{R_I}, C_I = \frac{\lambda_{\max} - n}{n - 1} \quad (2)$$

Derive the consistency ratio value. Among them, the average random consistency indicator can be obtained from Table 2. Typically, when, the matrix was considered to meet the consistency requirement.

**Table 2** Average random consistency indicator  $R_I$

$n$	1	2	3	4	5	6	7	8	9	10	11	12	13	14
$R_I$	0	0	0.52	0.89	1.12	1.26	1.36	1.41	1.46	1.49	1.52	1.54	1.56	1.58

(4) Scores are calculated and sorted based on a weight matrix. To calculate the weight of each indicator in order to improve the quality of intelligent community, we present three weight calculation methods.

Arithmetic averaging to find weights:

$$\omega_i = \frac{1}{n} \frac{\sum_{j=1}^n a_{ij}}{\sum_{k=1}^n a_{kj}} \quad (3)$$

Geometric averaging to find weights:

$$\omega_i = \frac{\left( \prod_{j=1}^n a_{ij} \right)^{\frac{1}{n}}}{\sum_{k=1}^n \left( \prod_{j=1}^n a_{kj} \right)^{\frac{1}{n}}} \quad (4)$$

Eigenvalue method to find weights:

(5) It is easy to prove that the consensus matrix has a eigenvalue of n and the rest of the eigenvalues are 0. Its corresponding feature vectors are:

$$k \left[ \frac{1}{a_{11}}, \frac{1}{a_{12}}, \dots, \frac{1}{a_{1n}} \right]^T \quad (k \neq 0) \quad (5)$$

Normalize them to get the weights for each metric.

In the past, when using AHP to solve practical problems, people mostly used one of these methods to find weights. However, different calculation methods may lead to biased results. In order to ensure the robustness of the results, we adopt three methods to calculate the average after calculating the weights. Then we calculate the scores of each scheme according to the obtained weight matrix. Afterwards, we perform sorting and comprehensive analysis, so as to avoid the bias caused by the use of a single method. Consequently, the conclusions will be more comprehensive and effective.

## 2.2. Scheme Determination

A total of 200 questionnaires were distributed and 187 valid questionnaires were recovered. According to the AHP, the weights of the five schemes were obtained as shown in Table 3.

**Table 3** Intelligent Community Solution Weight

Scheme	Leisure travel	Medical coverage	Education	Security	Facility construction
Weight	0.392	0.266	0.054	0.215	0.073
Score	38.6	27.1	6.0	21.1	7.2

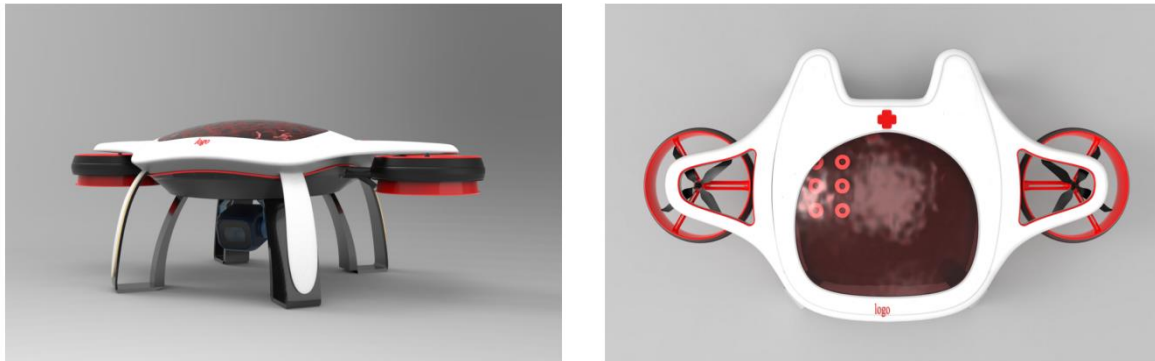
From Table 3, it can be seen that among the five schemes, leisure travel, medical coverage and security schemes contribute more to intelligent community construction. So we will put forward some ideas and optimizations for the intelligent community construction from these three aspects.

### 3. Intelligent Vehicles Design

#### 3.1. Intelligent Security Scheme

In the current community, security measures are actually relatively in place, but residents still demand further requirement for security. In fact, safety incidents in the community are still common - 10.21 explosions [12], fire incidents [13], "double robbery" robbery [14] and so on.

It is difficult to invest a lot of manpower to patrol the community to achieve community safety at all times. We propose an intelligent security scheme. The main body of the scheme is the intelligent drone, and its design concept diagram is shown in Figure 1.



**Figure 1.** Intelligent drone conceptual blueprint

The innovative features of this intelligent security scheme are as follows:

(1) In the poorly illuminated road section, residents can apply for intelligent drone following protection and provide lighting with one click on the intelligent community APP (described later). When they notice suspicious persons, the drone transmit it to relevant departments immediately. Meanwhile it will monitor suspicious persons in real time and take protective measures.

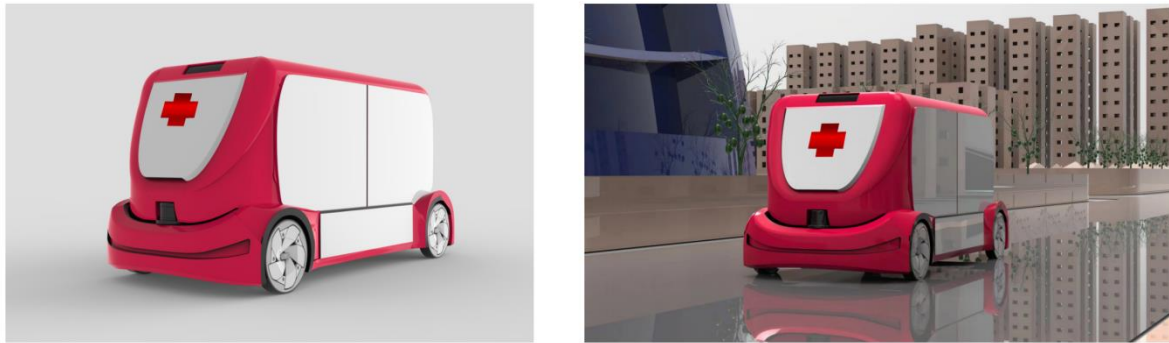
(2) The data of the intelligent drone is directly connected to the property or relevant departments. The all-round accurate situation transmission is implemented where the fixed monitoring can't detect, so as to realize more accurate help for the property to residents.

(3) Residents can order items with intelligent drones through the intelligent community APP. Items are delivered outside the community by the delivery staff, and the drones are responsible for delivering them directly to the window of residential buildings. In this way, it is faster and more convenient, while avoiding non-community residents from entering, to facilitate management and improve safety.

#### 3.2. Intelligent Medical Scheme

Ambulances or community hospitals have certain limitations in the treatment of patients, and these limitations create challenges for timely patient visits. The main limitations are narrow roads and complex terrain in the community, which is not suitable for ambulance traffic. When no one is around, residents cannot carry out rescue or assistance in time. Lack of guidance or support with professional rescue knowledge in the event of an emergency.

We propose a intelligent medical scheme based on the actual development of intelligent communities and comprehensive consideration of various factors. The main body of the scheme is the intelligent medical vehicle, and its design concept diagram is shown in Figure 2.



**Figure 2.** Intelligent medical vehicle conceptual blueprint

The innovative features of this intelligent medical scheme are as follows:

(1) Equip residents in need with intelligent wearable devices, which can monitor residents' physical condition and real-time positioning. The devices are interconnected with the intelligent medical vehicle. When the physical condition of the residents is abnormal, if the situation is urgent, the intelligent medical vehicle directly dispatches to the rescue. At the same time it synchronizes the data with 120. When the hospital ambulance rushes to the community, it realizes rapid docking, which can greatly improve the efficiency of patient rescue. If the situation is mild, such as a slight fall, the intelligent medical vehicle will send a intelligent drone to implement medical assistance. It will also detect the patient's general condition, and give reasonable video or voice help suggestions according to the patient's condition.

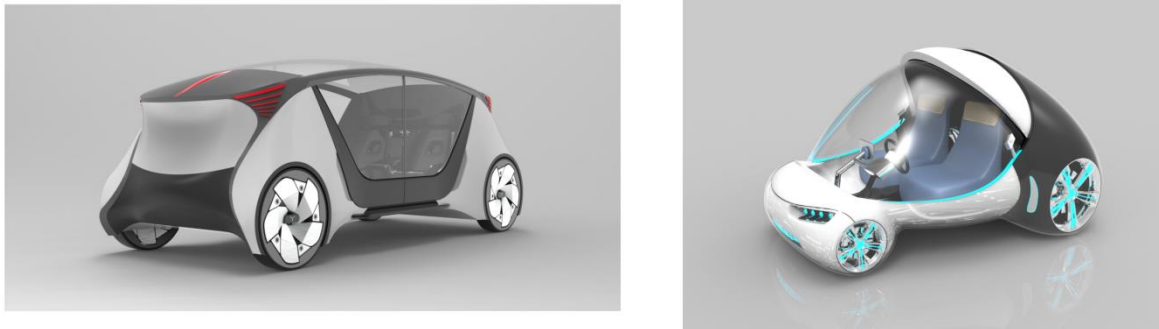
(2) The internal space of the intelligent medical vehicle is equipped with humanized and intelligent mobile beds. When it is necessary to dock with the hospital ambulance, the mobile ambulance bed can be transferred directly to the hospital ambulance. It can greatly compress the transfer time and reduce the possible risks during the transfer. It is also equipped with an intelligent display screen with AI "LiBao" to communicate remotely with professional medical teams. It is also equipped with an intelligent robotic dog "Zhenbao", which can comfort patients physically and mentally and help them obtain drugs or needs when they have limited mobility.

(3) The internal environment and lighting of the intelligent medical vehicle can be adjusted according to the psychological state or personal preferences. This will meet the personalized needs of residents for the medical environment to the greatest extent.

### **3.3. Intelligent Travel Scheme**

For short and medium-distance travel, if chosen to walk, it is difficult for the elderly or children. On the one hand, if chosen to travel by car, most of the elderly are not familiar with the function of the vehicle, which causes a lot of risks. On the other hand, the values of thrift produced by time reason of the elderly make them unwilling to waste money on driving to a not so far place.

We propose an intelligent leisure travel scheme to maximize the use of travel time and relax the body and mind of residents. The main body of the scheme is the leisure vehicle, and the design concept diagram is shown in Figure 3.



**Figure 3.** Intelligent leisure vehicle conceptual blueprint

The innovative features of this intelligent travel scheme are as follows:

(1) Whenever the elderly or children need to travel short and medium distances, they can call the intelligent leisure vehicle with one click on the intelligent community APP. The intelligent leisure vehicle uses an autonomous driving system that can accurately locate any location within short and medium distances.

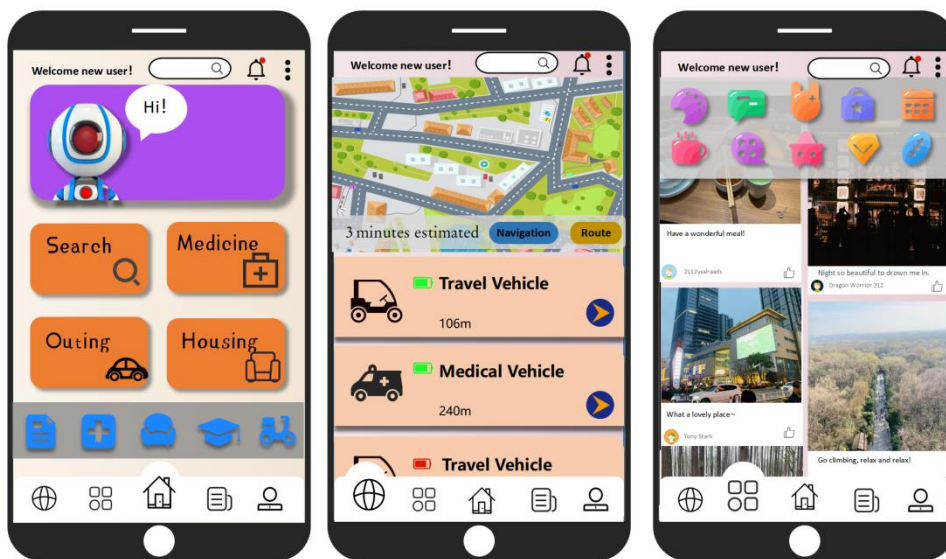
(2) The body of the intelligent leisure vehicle uses electronically controlled dimming glass, so that passengers in the vehicle have two options. One is to enjoy the scenery outside the window while riding. The other one is to turn off the external environment image, and be in the virtual environment of the vehicle. When multiple people need to travel, they can choose a four-person intelligent leisure vehicle. It can not only become a place for families to enhance parent-child relationships, but also become an entertainment place between neighbors.

(3) When young people are suffering from work pressure and life anxiety, they can choose to rest and relax in this intelligent leisure vehicle. The seats on this intelligent leisure vehicle use ergonomic zero-gravity seats to meet the passengers' needs for maximum comfort. When passengers experience anxiety and depression, appropriate music can be played to help passengers relax and fall asleep comfortably.

### **3.4. Intelligent Community APP**

The intelligent community APP mentioned above is powerful and can provide more convenient and faster services for community residents. We provide the elder version and the younger version of the intelligent community APP considering the different recognition of intelligent devices among the elderly and young people. The interface of the elder intelligent community APP is relatively simple, but the functions needed are all provided. The interface of the young intelligent community APP is relatively rich, containing almost all the functions required by young and middle-aged people. It is convenient to find the required functions. The voice function is provided, which provides great convenience for the life of young and middle-aged people.

The UI interface of the young intelligent community APP is shown in Figure 4.



**Figure 4.** Young intelligent community APP interface homepage

The young intelligent community APP has five function options directly below, and Figure 6 shows the main contents of the "Square", "Home" and "Map" interfaces.

Directly above the UI interface is the AI assistant "LiBao". It has the same function as in the elder version, but will take more into account the characteristics and needs of young people. Directly below "LiBao" are several important functions. Below it is the Intelligent Mini Program, which provides many interesting and commonly used programs for residents to relax or work.

At the top of the map interface is a real-time panoramic map of the entire intelligent community. Navigation and route means that "LiBao" will plan the route according to the current road conditions, and the voice prompts the most suitable route to the vehicle. Below it are the available vehicles, each showing the vehicle's appearance, battery, distance, and other details about the vehicle by clicking the right arrow.

The square is a place for residents to relax and discover interesting things around them. There are different options at the top of the interface that residents can choose according to their preferences. The main content of the interface is the daily life or interesting things shared by netizens. You can also put forward troubles in life, so that community partners can come up with suggestions to solve them together. The interface can enhance the friendship between community residents and form a good neighborhood relationship.

#### 4. Conclusion

Within the scope of the our investigation and research, no intelligent community scheme was found to meet the leisure travel, medical security and safety protection needs of residents at the same time through the diversified and functional vehicle design. We design the intelligent drones, intelligent medical vehicles and intelligent leisure vehicles and elaborate on their usages. Therefore, the proposal of this intelligent transportation solution is innovative. In addition, we also design innovative points to meet various needs on the basis of conceptual transportation, and provides a feasible scheme for the construction of intelligent community.

We adopt cutting-edge technologies such as the Internet of Things and AI, and partially realizes V2X. With the advent of the 5G era, the network delay has reached the single-digit millimeter level, making up for the shortcomings of long LTE-V delay and paving the way for wide-area vehicle networking.

Although we have made a more detailed description and thoughtful consideration of the intelligent community, there will still be some shortcomings. For instance, intelligent vehicles are currently only in the concept vehicle stage only, and there is still some distance from mass production. It needs to

be further improved to meet the requirements in intelligent communities. The application of 5G and AI in transportation is not yet mature, and in-depth research in the field of AI should be greatly strengthened to meet the requirements of intelligence. These are the further orientation of our research.

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