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INNOVATION DESIGNING INTELLIGENT TREKKING POLES BASED ON BIG DATA GIS

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ABSTRACT

With the expansion of the hiking leisure and tourism market, the demand for intelligent outdoor equipment has increased accordingly, and the application prospect of Trekking Poles is infinitely broad. This study focuses on the design of intelligent Trekking Poles, besides, based on optimizing the structure and functions of the existing Trekking Poles on the market, it also combines the reasoning advantages of Big Data Geographic Information System (BD-GIS) and AI to assist climbers who can easily obtain spatial geographic information. Which are used for travel planning, safety factor analysis, problem decision-making by mastering intelligent management of Big Data, and convey it to users for a safer and more convenient outdoor experience. It has significant practical prospects for users' safety, comfort, and outdoor activity experience, and it will become one of the most important infrastructures for smart tourism.

KEYWORDS: *Big Data, Geographic Information System (GIS), Artificial Intelligence (AI), Trekking Poles, Smart Tourism*

INTRODUCTION

Due to its abundant natural resources, China has many famous mountain sceneries and plentiful tourism resources of various typical geological landforms, which attract many tourists to visit famous mountains and forms the feeling of traveling through thousands of rivers and mountains. With the improvement of current economic conditions, in particular, and the increasing environmental awareness of ecotourism, thus mountaineering, hiking, or Nordic walking has gradually become a popular option for outdoor activities or leisure tourism, and Trekking Poles have also become indispensable supplies for mountaineering, hiking, or Nordic walking (Hawke and Jensen, 2020).Meanwhile, through the intelligent development trends of technology and mobile devices (e.g. information and communication technologies, ICT and Internet of Things, IoT), Trekking Poles will inevitably tend to intelligent design such as how to make smart planning for outdoor hiking activities, providing relevant information of terrain condition, predicting risk factors, and forming a type of smart tourism (Kaur and Maheshwari, 2016; Kontogianni et al., 2018).Consumers demand Trekking Poles, in addition to the design, material selection, material use, and production, they pay more attention to portable, sturdy, and efficient, and even hope to achieve the guidance of intelligence and convenience, so that one equipment can be used for multiple purposes.

According to the document "Development Plan for Mountain Outdoor Sports Industry" issued by the government in 2016 (General Administration of Sport, 2016), it can be seen that China is committed to supporting the diversified development of the industry and products on mountain outdoor sports. With the continuous improvement of the national economy, the people's demand for sports consumption has continued to increase, and the industry of mountain outdoor sports

has also achieved rapid growth. Data show that the number of outdoor sports enthusiasts has reached 130 million, and the market scale of outdoor products has reached 18 billion RMB. In general, the overall strength, industry coverage, social participation, and market recognition of China's mountain outdoor sports industry have increased significantly. From 2011 to 2018, the market scale of the outdoor products industry grew rapidly, 2011 reaching 14.52 billion RMB and with a growth rate of 50.91% (CICC international consulting, 2020). Although the growth rate gradually slowed down and declined in the latter, it also has found a turning point. In the high-end market, there is still demand for intelligent equipment.

With the continuous development of society, the people's consumption structure will inevitably change, which will cause the consumption of outdoor sports, fitness, and tourism to continue growing (Kontogianni and Alepis, 2020). Outdoor supplies prime refer to the equipment required for participating in outdoor activities, including basic professional clothing, shoes, tents, sleeping bags, Trekking Poles, and so on. Outdoor sports have gradually become a fashion in China, and it also breeds unlimited business opportunities. The number of tourists in China is increasing at an annual rate of 26%, of which the fastest-growing is among travelers in the 20-40 age group. The market demand for tourist products is increasing by 17% every year. Compared with the annual transaction volume of the global outdoor sports industry by more than US $15 billion, China's related industries are still in the initial stage, and the market development space has deep prospects (CICC international consulting, 2020).

The diversified development of "outdoor +" is closer to the living needs of the public. As a type of family expenditure, entertainment consumption is an indispensable part of the country after economic development. Nowadays, family travel tends to be a travel mode of "outdoor + tourism" (Perićet al., 2019; Buckley and Westaway, 2020). For the public, it not only meets the needs of family tourism, but also meets the needs of participating in sports, the new two-in-one type of tourism is bringing a new trend. Therefore, the outdoor industry chain has gradually formed. The industrial spaces of supporting occupations including outdoor personnel knowledge and skills, camp management, outdoor curriculum design, which directly or indirectly give rise to the driving force of the outdoor products market.

In addition to the trend of modern high-end intelligence, safety factors are also one of the important considerations for outdoor climbers. Thus, based on the environmental safety of outdoor mountaineering, hiking or Nordic walking, this study considers how to combine the theory and method of Big Data Geographic Information System (BD-GIS) to intelligently design the Trekking Poles. It can not only have the basic function of the intelligent crutch, but also identify the dangerous elements in the geographical environment and provide risk avoidance schemes for users in combination with the information processor of GIS and mobile devices, which can greatly reduce outdoor risk (Czioska et al., 2017).At present, most of the Trekking Poles products on the market are designed traditionally, mainly focusing on the style auxiliary functions of materials and hardware, but it has not been found that there are software functions that combine them with smart forms as design products to solve user safety.

Apart from the transformation of hardware design, the aim of our work is also to propose innovative design thinking in software design by using the concept of BD-GIS and artificial intelligence (AI) for exploiting the Trekking Poles. This provides stable and reliable relevant information for mountaineers or tourists using the technical advantages of BD-GIS so that users can establish planned itineraries according to local conditions, master dynamic information during activities to meet the actual needs of smart tourism (Gretzel et al., 2015). In case of unexpected conditions, users can change their itinerary, route, or recreational form to better adapt to their environment, optimize the experience of mountaineering, hiking, or Nordic

walking, make climbers feel a convenient and pleasant hiking process, improve the safety of hiking, and it is also an important foundation of smart tourism.

LITERATURE REVIEW AND METHODS

This study primarily focuses on the thinking of the incorporation of software and hardware design to Trekking Poles for providing smart function. At present, however, manipulating hardware design is almost the unique idea and main trend in the market, so the thinking and combination of software are rarely mentioned. Moreover, with the development of technological trends by integrating with intelligent equipment, mobile devices, IoT, Big Data, and AI, combining the functions of software and hardware for implementing the exploiting suitable Trekking Poles has become a highly feasible solution.

In the era of vigorously on outdoor activities, how improving user satisfaction, suitability and the safety of good tools ineffectively, and based on people-oriented thinking, is the highlight issue of smart tourism. Thus, the basic technological principles that support the above properties for creating smart tourism are introduced in this study based on two parts: hardware design and software design. The hardware part continues the previous patented design concept by our teams, mainly emphasizing on the extension concept of appearance and functions (Li, 2018). The software part is considering how to import the concepts of DB-GIS, AI, and smart tourism. The key architectural components are hardware design and software design. Such hardware functions include GPS locator, music player and speaker, information processing and display and auxiliary tools, etc. that are different to the existing functions of Trekking Poles on the market. Then, software functions are an innovative combination of methods and concepts that includes GIS platform and function, big data, AI, and smart tourism tools, etc. (as Fig. 1)Basis on the above design, the following sections willprovide an overview of the framework and highlight the benefit of the design content, also further to illustrate the combination elements, theoretical roots of this study, and how to meet the needs of users by integrating above elements into practical products.

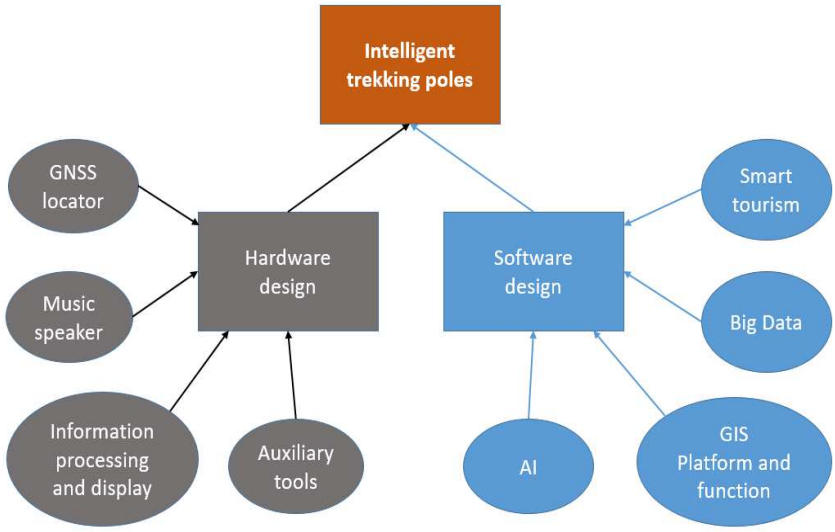


Figure 1: Intelligent Trekking Poles Designing Concepts and a Combination.

Smart Tourism

First of all, here we must understand what means is “smart tourism”? What are their conditions? What kinds of functions can be provided? Where is the feasibility and prospect of its development?

Smart tourism is a new emerging concept both theoretically and practically (Buhalis and Amaranggana, 2013; Wang et al., 2016). So far, there is no complete and concrete definition. Different technical fields and viewpoints have been put forward different perspectives (Saraniemi and Kylänen, 2011). In general, however, smart tourism has involved various entities like the data centers of tourism resource, IoT and Cloud Computing, next-generation communication networks, high-performance information processing, intelligent data mining, and other technologies in tourism experience, which provides tourists with favorable information and convenience through intelligent computing (Zhang et al., 2012; Smirnov et al., 2013; Wang et al., 2016; Tavitiyaman et al., 2021)

The Smart tourism perspective focuses on the tourists' needs by integrating with ICT, digital innovation, and tourism behavior (Wang et al., 2016; Ajantha et al., 2017). It's also centered on the interactive experience of tourists, guaranteed by integrated industry information management, and characterized by encouraging industrial innovation and promoting the upgrading of industrial structure. Smart tourism is actively perceived as tourism-related information and timely arranges and adjusts tourism plans by using new technologies such as mobile cloud computing and the Internet and portable terminal Internet access devices (Smirnov et al., 2013; Kauand Maheshwari, 2016). In short, it is the real-time interaction between tourists and the network, so that the travel arrangement enters the touch era.

The aim of the developed smart tourism for applying, thus, is to manage the platform and destination for the effective allocation of tourism resources, enhancing the tourism benefits of tourists, and providing a smart tourism experience. It is also applying computing knowledge, especially in the era of Big Data, to adapt services for the tourists to enhance user experience, quality, and reliability by the information provided (Hamid et al., 2021). The application of smart tourism plays a significant role in planning the perfect tour and allowing users to extract relevant details such as weather, position, travel itinerary, and events. Meanwhile, it will make the tourists aware of the destinations as a point of interest in advance and give them insight into the places they are planning to visit during the trip and create suggestions for tourists depending on their preferences and equipment to facilitate them arranging a leisure and tourism plan, to meet the requirements in terms of efficiency, visualization, and security.

In the design of this study, we propose a hybrid approach to implement travel and smart tourism based on the practices, the 'key concepts' of smart tourism can be identified as the basis of some extensive functions. These concepts are basic information of the destination, road and traffic conditions(Zhao and Hu, 2019), regional disaster assessment information (Zhang et al., 2021), weather forecast (Hawchar et al., 2020), safety assessment (Chang, 2021), emergency disposal and consultation(Zhou et al., 2020), tourism itinerary planning (Rathnayake, 2018), etc. as presented in Fig. 2.

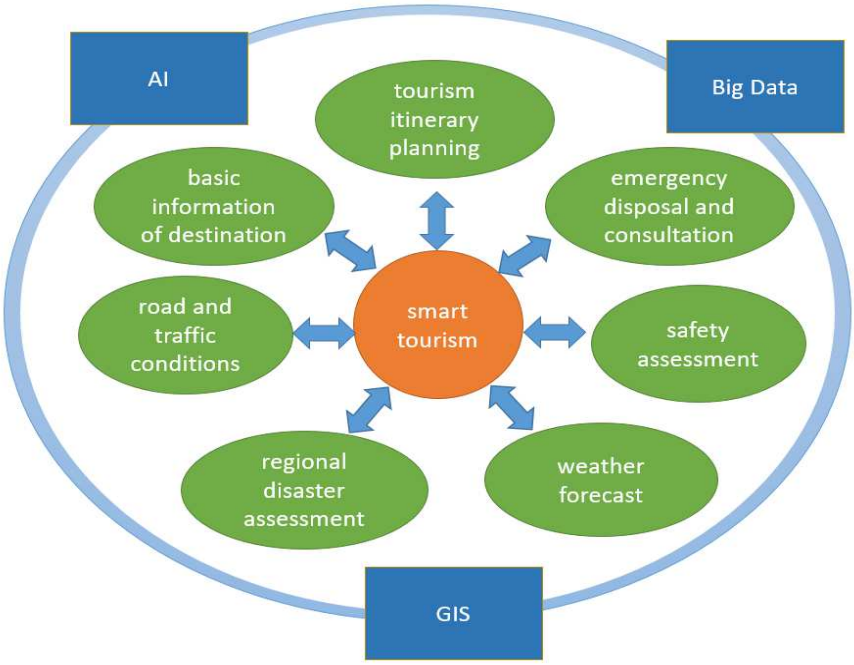


Figure 2: Smart Tourism Key Concepts Schema.

Geographic Information System (GIS)

The technical strength of GIS lies in data collection, storage, analysis, and display (Mahmood and Salam, 2013). It is an emerging frontier discipline that integrates computer science, geography, surveying and mapping, remote sensing, environmental science, urban science, space science, governance science, and related disciplines (Stępniak and Turek 2020). It has sprung up rapidly in recent 30 years. Based on the geospatial database and supported by computing hardware and software conditions, it manages and operates spatially related data, and uses geographic model analysis approaches to timely provide a variety of spatial and dynamic geographic information. Which is a series of computer application systems for geographic research, comprehensive evaluation, management, quantitative analysis, and decision-making services (Rathnayake, 2018; Andersen et al., 2019; Hawchar et al., 2020).

In the 1960s, GIS originated in North America, especially in Canada and the United States. With the rapid development of computer technology, in the late 1980s, processing, analysis, and overall technology became increasingly mature. Now it has been successfully applied to academic and technical fields such as resources, environment, land, transportation, education, military, disaster research, automatic mapping, and so on. Meanwhile, by integrating with spatial information technology, including the theories and technologies of the satellite positioning system, GIS, and remote sensing, and combined with computer and communication technology, spatial data collection, measurement, analysis, storage, management, display, dissemination, and application are carried out (Chen et al., 2019).Spatial information technology is called "geospatial information science" in a broad sense, and it is also called Geo informatics (Xiao et al., 2018; Hardy et al., 2020).

From a comprehensive definition of applicability, GIS has successfully entered the field of human daily life, such as Google Map, Baidu Map, etc., which are indispensable tools for people in geospatial processing, query, and application (Rathnayake, 2018). There are often used to query destination information, environmental exploration, street view guidance,

route planning, time estimation, and location sharing. It is also an essential platform of various e-commerce, such as taxi calling, shared car rental, logistics navigation, express delivery, car navigation, etc. Therefore, it is one of the most significant basic elements in the new emerging smart cities and smart tourism in the future.

What is GIS technology? It is a kind of technique that is based on natural geospatial and using the methods of geographic model analysis which can improve spatial and dynamic geographic information in real-time for users(Andersen et al., 2019). In recent years, with the development trend of AI, Internet big data analysis, IoT and other technologies, the data information analysis of GIS has become increasingly simple, and the application is more socialized.

In terms of technology, the spatial analysis of GIS refers to a method of spatial data analysis based on the location and shape of geographical objects, which aims to extract and transmit spatial information. Spatial analysis is the critical feature and core skill of GIS which is divided into vector spatial analysis and raster spatial analysis. The spatial analysis of vector data is mainly manifested as follows: generally, there is no using model analysis and processing methods, owing to which is diverse and complex. Spatial analysis methods of vector data include extraction analysis, superposition analysis, neighborhood analysis, statistical analysis, and network analysis. Furthermore, the spatial analysis of raster data mainly includes extraction analysis, superposition analysis, distance analysis, density analysis, neighborhood analysis, difference analysis, statistical analysis, surface analysis, etc.

In addition, the application and development of temporal GIS are the core issues in the future. Through spatial-temporal databases which let time and space are inextricably linked. In many application fields, such as environmental monitoring, earthquake rescue, weather forecasting, etc., their spatial objects change over time, and these kinds of change patterns play a very significant role in the solution process (Hawchar et al., 2020; Andersen et al., 2019).. Therefore, solving the temporal problem of GIS has also become a critical direction in the realms of GIS. Generally speaking, the basic elements of GIS technology include spatial data, calculating or analyzing information, and knowledge service (Nimmagaddaet al., 2019). Further, the extensible technology includes the organization and management methods of spatial data, the solution and analysis of spatial data, and the visualization and application of global data on physical geography.

Using geospatial technology in tourism planning will provide infrastructure and capability for the application of smart tourism. Meanwhile, the accurate positioning ability of geographic information can also provide high-quality decision support for the application of smart tourism. In the future, smart tourism will achieve better interaction and integration between tourists and the surrounding environment and ensure better security and tourism experience. The prime feature of the new generations' GIS, from the perspective of spatial data, is dynamic heterogeneous, spatiotemporal intensive, and unstructured "Big Data". In terms of information computing, it is a spatial processing and analysis tool for computing (e.g. Cloud Computing) and is supported by high-performance equipment. From the service point of view, it is the personalized service mode and the application by a huge service network of geographic information.

Based on the above mention, GIS may have exciting prospects in these aspects in the future as follows. First of all, data acquisition: data is the fundamental of GIS, and data acquisition skills are the source of GIS technology. Based on the basic techniques, the incremental data sources of GIS generally include satellite remote sensing, positioning information, photo grammetry, various sensors of smart city, etc. This trend has developed into the increment of large data sources, and it is so-called Big Data (Gao, 2021; Wang et al., 2021).

Secondly, data analysis: Driven by Big Data sources, the development of GIS data analysis is closely related to Big Data, AI, cloud computing, and other information technologies(Zhao and Hu, 2019). Thus, efficient data management has also become the infrastructure of GIS. That's why the spatial database has always been a foundational theory of GIS. These data has different shapes (e.g. lakes, roads, houses, and rivers), different properties (e.g. line map, satellite map, and street view map), different trajectories (e.g. driving cars, aircraft in the air, running floods, and hidden ocean currents), which are difficult to describe by a unified model. Spatial data analysis and mining are also the foundations of sustainable development for GIS. Nowadays, with the development of Big Data and cloud computing, Big Data GIS has become the technical capability of various state-of-the-art applications and promoting the development prospect of smart city and smart tourism (Yona et al., 2021).

Thirdly, data presentation: In a broad sense that includes but is not limited to maps, charts, mobile apps, web applications, etc. It not only refers to visualization but also refers to various functions that touch the end-user. Data presentation is closely related to the Internet, computer vision, and other fields. From the perspective of the basic platform, the development of cloud computing technology of Mobility/Mapping as a service (MaaS) has become a new opportunity and brought a new business model(Lopez-Carreiro et al., 2021; Zhao et al., 2021). For now, professionals will mention several terms when discussing cloud computing: Iaas, PaaS, and SaaS, that is, infrastructure as a service, platform as a service, and software as a service (Tsai, 2021). Based on this technical background, a new business model for the geospatial information industry will be MaaS in the near future.

Big Data and AI

The era of digital has emerged as an essential part of today's life, due to the data acquisition and storage that has led to the generation of massive volumes of data using sensor devices everywhere that so-called Big Data, which can be used in many specific realms (Balbin et al., 2020; Chang, 2021; Wang et al., 2021). Thus, Big Data has become a key element factor in smart tourism that can be used to develop such an intelligent system to enhance the performance of decision systems in smart tourism. Safety information of outdoor leisure and tourism such as weather conditions, topographic and geomorphic conditions, road maintenance status, timely disaster information, refuge place, safe place, best path assessment, etc. (Guo et al., 2020; Sarker et al., 2020; Huang et al., 2021). Which generated from data analysis is considered as a successful technology with immense potential for improving smart tourism services.

GIS and Big Data have been integrated with each other, nowadays, due to the rapid change of information technologies. Big Data has 5V characteristics, namely, large volume (Volume), multiple types (Variety), fast update (Velocity), high value (Value) and authenticity (veracity) (Laney, 2001). Discovering regular patterns through Big Data, however, providing smart thinking for generating knowledge and solving the problem is the core of its application (Oksanen et al., 2015; Balbin et al., 2020; Wang et al., 2021). In particular, the geographic data involved in the tourism field is a kind of Big Data that can solve various spatial issues or problems by analyzing and integrating with other data. With the development of Information Technology (IT) rapidly, the theory and technology of Big Data offer new blooming opportunities for outdoor leisure and tourism. Nowadays, people generally use diversified technologies such as IoT for data collection and AI for big data analysis (Zhang et al., 2021) to strengthen data integration and sharing and optimize the infrastructure of smart tourism.

In the utilizing of smart tourism, the effective processing and using knowledge from processed Big Data is the most important factor in the development of more efficient decision models (Balbin et al., 2020). In order to provide information

and knowledge for smart tourism services (Nimmagaddaet al., 2019), Big Data applications must effectively collect, securely store, analyses and develop smart tourism information. Big Data also aids decision-makers or users in developing to extend smart tourism infrastructure and resources. As for developing smart tourism, destructive technologies that we need refer to the technologies that can make use of high technology and change the ways we work which are smart and effective. These days, which include IoT, Big Data, artificial intelligence (AI), etc. Big Data and AI analytics are increasingly important and have become the subject of focus for disruptive technologies (Liu et al., 2020). Turning this Big Data into an understanding of real-world information can help us make decisions and improve performance in the realms of smart tourism. Especially, the revolution in internet information and communication technologies has had a profound effect on the tourism industry. In 'interactive tourism,' tourists have an increasing tendency to use smartphones as an aid in routing and discovering places (Isinkaye et al., 2015; Kontogianniet al., 2018).

Location-Based Service (LBS) applications represented by Google maps and Baidu maps, in recent years, have entered into every user's mobile phone and have had a profound impact on Internet life (Oksanen et al., 2015). The application of LBS requires the high freshness of data, especially the high response ability to update the data of roads and place names, which has a great impact on the users' experience. Intelligent data matching is to filtering the massive network information obtained by the search engines, obtaining the information associated with geographical location, and matching it with map data, to quickly find changes and update automatically (Mahmood and Salam, 2013; Rathnayake, 2018).

As for the perspective of technology, there are two popular approaches to support the development of Big Data, respectively in the fields of data analysis and AI. Data analytics can provide a method to demonstrate processed outputs of Big Data with visualization and graphical formats. Moreover, data analytics can collect data from real-world equipment to digital and analyze the processes and environments (Huang et al., 2021; Montoya-Torres et al., 2021). Thus, data analytics can facilitate users to Interpreted data from the scenes into meaningful information and support decision processes. Data analytics as an auxiliary tool can lead to process optimization and increased efficiency in multiple realms (Zhao and Hu, 2019; Balbin et al., 2020).

In another techniques field, it refers to AI that can be used for interpreting Big Data, further, that can also imitate the patterns of thinking and can be used for modeling human behavior utilizing machine learning progresses (Chen et al., 2019).Generating Knowledge from Big Data using AI and data analytics techniques are expanding the real values of such outcomes. Studiess how that among AI techniques which deep learning techniques can provide better results compared to data mining methods, a deep learning-based method can be used for predicting various conditions (Isinkaye et al., 2015; Chen et al., 2019).Such digital principles are related to AI that permit collecting data to be gathered virtually in real-time, providing deeper insight into the dynamics, trends, and situations of smart tourism in different conditions. It is, therefore conducive to predict conditions in smart tourism before an adverse situation occurs.

HARDWARE DESIGN

Current Status of Market Product

Hiking is a popular leisurely activity that provides a variety of health benefits, such as reducing the risk of heart disease, reducing blood pressure, and improving cardiopulmonary health. The use of specially designed trekking poles has become popular among participants seeking to relieve knee pain and increase balance and stability while walking. Trekking poles can decrease the loading and strength of lower limbs, but it will increase cardiovascular demand. When carrying a large external

load, trekking poles can provide benefits by reducing lower limb muscle activity and increasing balance and stability (Hawke and Jensen, 2020). However. Hiking may increase injury risk, due to the physically demanding nature of the activity, with the most common being overuse and traumatic injuries. These injuries account for 75% of injuries to the lower extremities (Hawke and Jensen, 2020).Thus, nowadays, the use of Trekking Poles has become an indispensable tool. Among the athletes participating in hiking competitions, according to research, 248 samples were collected, 104 athletes were injured, and 95 injured did not use hiking sticks, accounting for 91% of all injured. Further, the injury rate of 199 players who did not use Trekking Poles was 47.7%, while only 9 of the 49 players who used Trekking Poles were injured, and the injury rate decreased to 18.4% (Chen and Qing, 2016).

The above research shows that the importance of using Trekking Poles, but what are the benefits of using Trekking Poles? Here are summarizing a few advantages that Trekking Poles commonly would provide as follow:

- Increase balance. When we walk along winding and narrow paths, rocky slopes full of stones, and ice-covered lands, and snowfields, it will be more stable with the help of Trekking Poles.
- Relief legs. If you only use your legs when climbing the mountain, you will soon get tired. When using the Trekking Poles to help, we can give full play to the strength of the upper limbs, reduce the fatigue of the legs, and make us walk easier and farther.
- Shock absorption. If you only rely on your legs, when going down the mountain, your knees will bear a lot of force. Using Trekking Poles can significantly reduce impact and protect the knee.
- Protection. If you encounter insects, snakes, and wild animals, or need to cross the grass, you can make good use of the Trekking Poles to achieve self-defense.
- Build a shelter structure. When tents need to be set up in the field, the Trekking Poles can be used as the support column of the tents.
- Explore the way. When we cross a river, snow, or mud, it is difficult to predict the depth. At that time, we can measure itby the Trekking Poles. Besides, when walking, if you encounter wood or stones in the way, you can use the Trekking Poles to preliminarily judge whether it is stable, then select the route.
- Drying clothes. Tie two Trekking Poles into the soil, and then pull up the rope that can to obtain a convenient clothes hanger.
- Selfie stick. By adding additional gadgets, the Trekking Poles can also be transformed into selfie sticks.

The structure of Trekking Poles currently on the market is shown in Fig. 3, which is divided into grip, shaft, locking mechanism, basket, and tip. The grip is divided into straight grips and T grips by judging the shape. Based on the materials, it can be divided into cork, sponge, rubber, plastic and Ethylene-Vinyl Acetate copolymer (EVA) foamed materials. The commonly used materials for supporting shafts are aluminum alloys, carbon fiber, and titanium alloys.

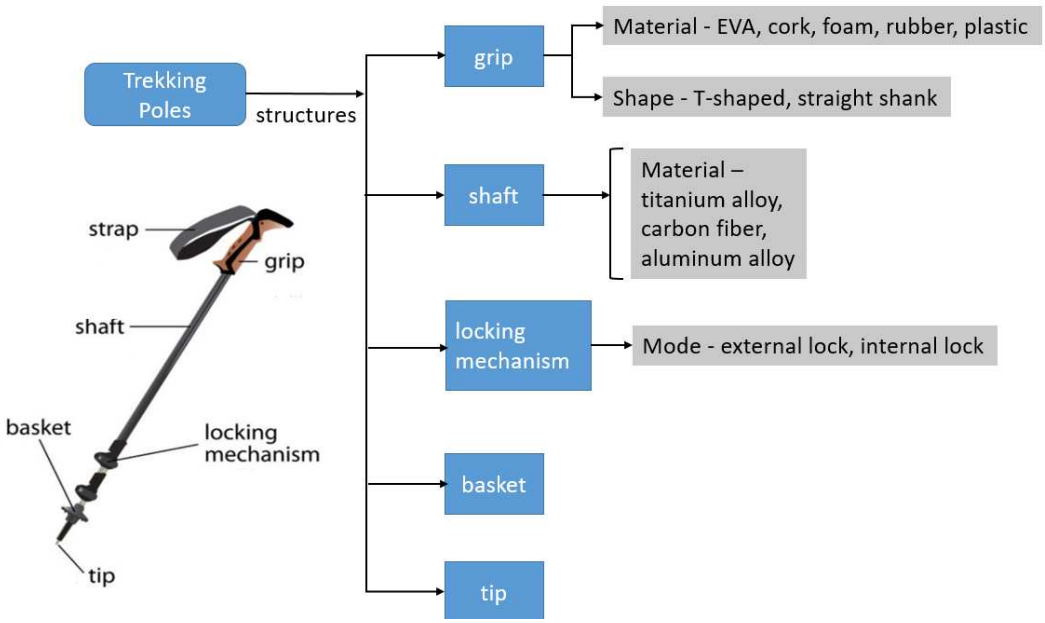


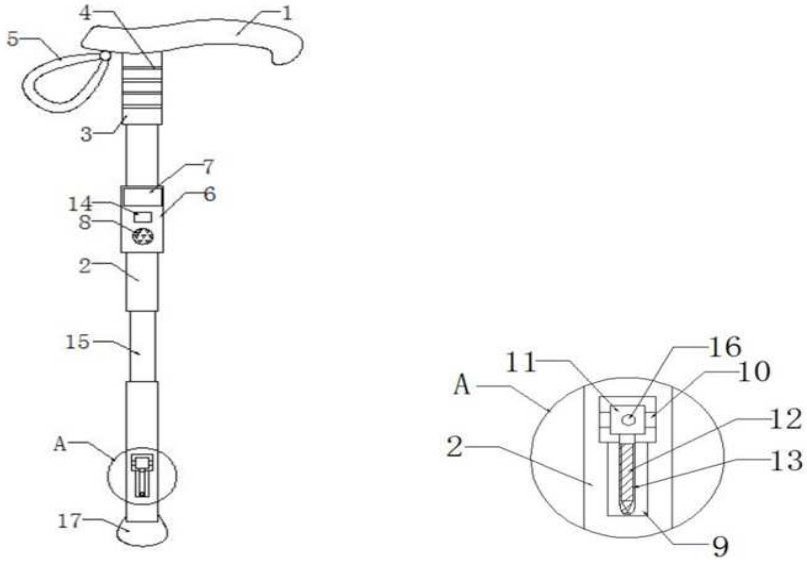
Figure 3: Structure Diagram of Trekking Poles in the Existing Market.

Designing Product of this Study

In this study, the existing Trekking Poles products in the market were considered before design, but no equipping spatial information function and intelligent guidance were found on trekking poles products. Thus, in the hardware design of the product that we are thinking of, besides the basic functions required by the Trekking Poles, the crucial design idea is enhancing and improving the application function of the Trekking Poles. The hardware is added with the terminal display equipment of the control box, embedding blade design, rod tip replacement module, and protective sleeve, voice and music playback module, etc.

Among them, the terminal display equipment of the control box is equipped with an antenna module, GIS information processing module, and music playing module (Li, 2018). These designs are also the innovative design mode of this research, which is used to combine the prime modules of software designing functions. In the module, the chip of the Global Navigation Satellite System (GNSS) is embedding in the GIS information processor. Meanwhile, the dual navigation and positioning technology of Beidou Navigation Satellite System (BDS) and Global Positioning System (GPS) and IP67 protection are adopted, and the built-in battery is designed for charging. The standard of IP protection level is electrical equipment shell proposed by the European Committee for Electro technical Standardization (CENELEC), and numbers 6 and 7 represent the protection ability for dust and water.

The appearance structure of the intelligent design of Trekking Poles is mainly divided into 17 parts (Li, 2018) (as shown in Fig.4). Overall, the hardware designing features include: First, real-time positioning: it helps for viewing its position of geographic coordinate and three-dimensional coordinates in real-time by the terminal display of GNSS. Second, music playing module: which is equipped with a speaker and connected with Bluetooth. Third, terminal display device: which can provide the latest weather, terrain, geology, life, and other information in the target area to offers users the best path to the destination, danger notification, exploration strategy, etc. Forth, auxiliary toolset: that is providing relevant tools which users can apply outdoors or hiking, such as blade, rod tip, and protective sleeve.



1.Horizontal grip 2.Shaft 3.Vertical grip 4.Anti-slip pattern
5.Strap 6.Control box 7.Terminal display panel 8.Speaker
9.Groove 10.Rotating shaft 11.Slide block 12.Blade
13.Protective sheath 14.Battery compartment 15.Telescopic part
16.Set screw 17.Rod tip protective sleeve

Figure 4: The Design Structure of Trekking Poles.

This study compared with the existing in the market, in terms of structural design, the differences include as follows: First, adding the design of inlaid blade: the characterized of design is in that the blade can be fixed at any angle on the Trekking Poles, so when using the knife can be dexterous and practical under various circumstances and angles. Second, this design can replace different types of rod tip protective sleeves and can be applied to sand, rock, wetland, and snow, etc. Third, the GIS voice broadcasting module is used to broadcast road conditions, weather conditions, emergency notices, etc. Forth, the music playing module, that is, the Bluetooth link of the speaker, can meet the users' outdoor music enjoyment.

In addition, the specific functions of the product design are as follows:

First of all, geographic information processing: it is mainly providing the user with the function of map display and navigation, recognizing that the user can obtain the information of location and surrounding geographic, calculating and displaying the shortest path for the user to arrive at the destination, and guiding the user to process the obtained information of geographic environment and making reference decisions.

Secondly, replacing the rod tip of Trekking Poles: when climbing uphill, the user will adjust the grip to the position consistent with the height of the arm. At this moment, the stick tip needs to provide a function of the leading role. The advantage of this design is obtaining and analyzing the terrain, topography, landform, and other data from the user's mountain at that time through GIS, and then conveying the results to the user. According to the characteristics of various elements of the mountain, replacing the appropriate spare tip of Trekking Poles is conducive to improving the safety of climbing and obtaining a better climbing experience. Among them, the designed spare tips of Trekking Poles include "special stick tips for hard ground (rock ground)", "special stick tips for smooth ground (wet ground)", "special stick tips for ice and snow ground" and "special stick tips for soil ground".

Thirdly, music playing: the GIS Trekking Poles also innovatively adds the audio playing function to distinguish it from ordinary Trekking Poles. A music player is arranged at one end of the holding handle of the GIS Trekking Poles, a groove is arranged at the upper side of the support rod, and a loudspeaker is embedded therein. The music player is connected to the mobile phone via Bluetooth. Ordinary, it can play music and broadcast geographic information. In case of geological disasters, rugged terrain, and extreme weather, it can broadcast voice reminders. The design can not only locate, communicate and navigate but also entertain and relax.

Fourthly, cutting obstacles: when branches, thorns, or weeds need to be cut off during outdoor hiking, you can loosen the fixing screws on the Trekking Poles body, rotate the slider to form a certain angle between the blade and the Trekking Poles body, fix the slider, and then remove the blade protective sleeve and use for cutting with the blade.

SOFTWARE DESIGN

The Framework and Supporting Functions

Hardware design is the skeleton of this study, and software design is the soul. In response to the developing trajectory of the era and the prediction of usage demand, this study adds the framework of software design on the premise of optimizing hardware which represents the spiritual meaning of design. That is expecting to meet the experience and security requirements of outdoor hiking tourism in the future for achieving the goal of smart tourism. The conceptualized of this framework functionalities (as shown in Fig. 5) are based on the GIS platform by integrating with Big Data and AI reasoning ability. Through the integration of these technical theories, the functions of dynamic expression, data aggregation, and knowledge discovery can be achieved, also to support several functions that the system wants to provide, including tourism itinerary planning, basic information of destination querying, road traffic condition inquiry and reminder, assessing the condition of a regional disaster, weather condition inquiry, and prediction, assessing safety information, emergency disposal and consultation, etc.

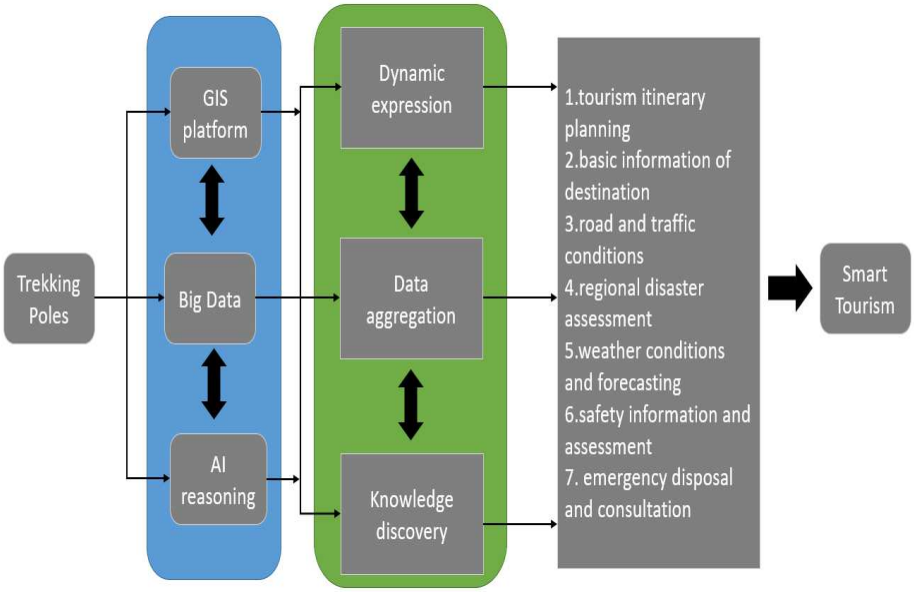


Figure 5: The Framework of Smart Trekking Poles.

In addition, in terms of functionality, this study proposes seven prime design functions (as shown in Fig. 6), which are briefly described as follows:

- Planning tourism itinerary: Including tourism route selection, distance calculation, time estimation, scenic spot selection, tourism, footprint tracking, etc.
- Querying the basic information of destination: Including the introduction of scenic spot information, ticket price, characteristics and specialties, natural and cultural conditions, recommendation of popular scenic spots, conditions for surrounding food, housing, traveling, shopping and entertainment, etc.
- Querying the conditions of road traffic: Including reminder and query of road grade, alternative road, road construction, road closure, traffic accident, speed, traffic jam, and other conditions information.
- Assessing regional disaster: it mainly inquires, reports, and reminds the recent disaster conditions in the region, including flood, wind, debris flow, forest fire, landslide, broken bridge, etc.
- Weather conditions query and forecast: As for tourist attractions and places provide that including the temperature, wind speed, humidity, sunny or rainy forecast, ultraviolet index, air quality, etc. Then users can check for weather details of all the places as for weather conditions.
- Assessing safety information: Such as the assessment of safety factors for tourist destinations, the numbers, and status of disaster events, etc.
- Emergency response and consultation: that could provide the contacting phone number of government departments for an emergency consultation, and the contacting phone number and address of hospitals.

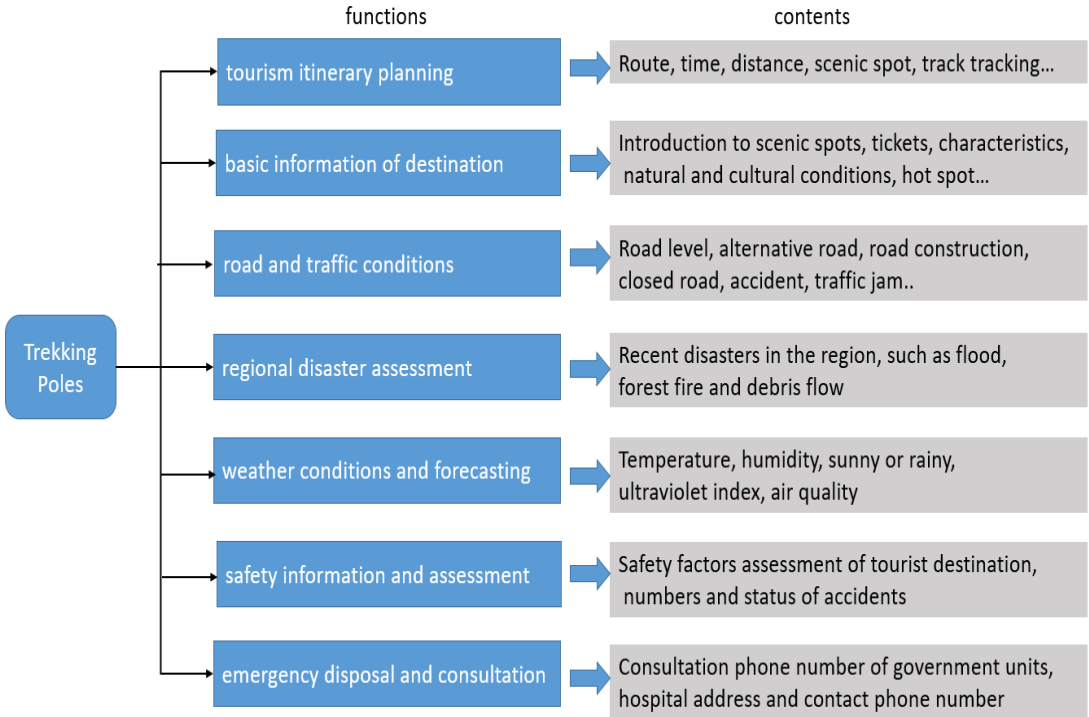


Figure 6: The Functions and Contents of Trekking Poles.

The Framework for Function and Problem Solving

The intelligent design of Trekking Poles proposed in this study is equipped with a terminal display. On this basis, the Trekking Poles are combining with software to enable users to receive the latest information in real-time. The software interface provides specific positioning, altitude, temperature, longitude and latitude, humidity, wind force, PM2.5 conditions, and wind direction. Through this interface, the route planning of tourists can be carried out (as shown in Fig. 7). The user can select the starting point and endpoint for the walking route by their own will. The software can calculate the time and distance of the whole route, put forward the guidance conditions of the walking path for locating and tracking in real-time. It can also preview and guide various topographic and geomorphic conditions in the path, and query basic information such as geological and soil conditions, weather situations, disaster status, safety conditions, elevation difference, etc. It can also explain and navigate scenic spots according to the planning route to meet the user's experience.

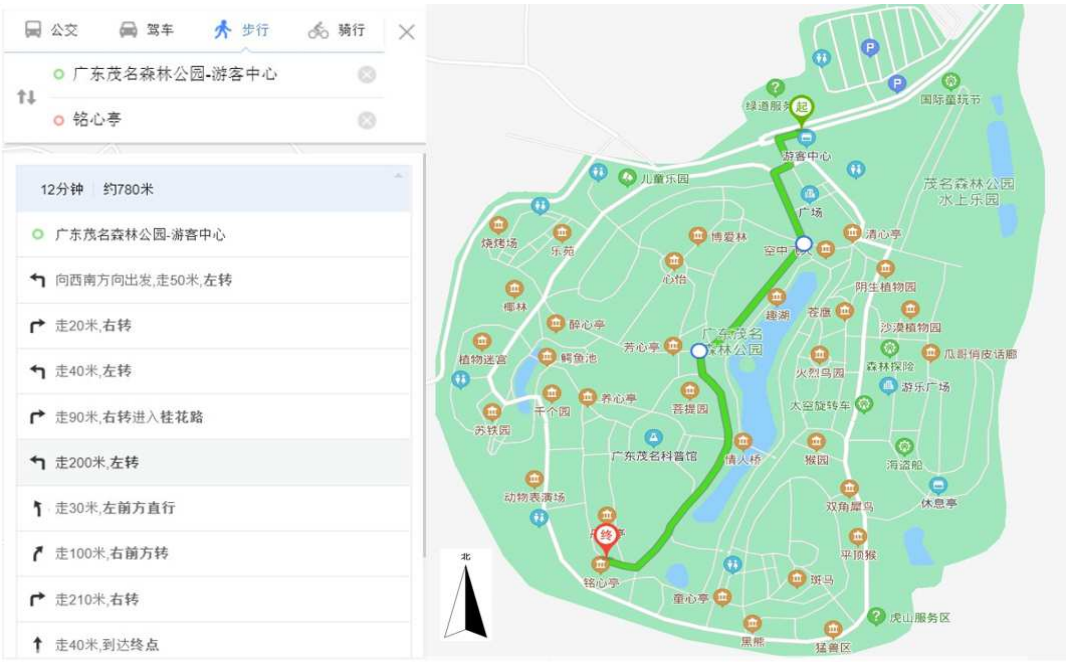


Figure 7: The Schematic Diagram of Route Planning.

In case of emergencies during hiking, it can provide decision support and judgment for problem-solving. The intelligent design of Trekking Poles in this study can not only explore and describe the terrain and landform then guide the mountain conditions through GIS technology, but also optimize the relative safety hazards of mountaineers through integrating with Big Data information and AI knowledge reasoning and judging. Meanwhile, it can provide relevant decision support for users in dangerous situations.

For example, if you are lost in the jungle, you can quickly locate, find out the relevant path and away from the dangerous area as soon as possible through the GNSS and GIS functions, to ensure the safety of climbers in the wild. This is the contribution and benefit that providing by intelligence. Further, the intelligent trekking poles are mainly to facilitate climbers solving common problems in hiking, and to eliminate unexpected dangers during hiking to the greatest extent. In the field, the primary problem is to find a more suitable route for walking, then the network analysis and spatial analysis module can be used to simulate and detect the nearby terrain environment. For example, take the slope with multiple abrupt changes and the maximum slope value greater than our setting as the threshold value to facilitate users finding a feasible route.

Secondly, there are some common problems, such as sudden weather changes, earthquakes, and landslides. GIS can collect the latest data in time and by integrating with Big Data figure out a solution to remind users to avoid risks. It also includes that the information system can use factors such as air humidity, slope, geology to find the best area for camping and resting through overlay analysis algorithms.

In addition, the Trekking Poles designed in this study has the analysis and processing technology by using geospatial information, which can display and describe various emergencies or dangerous elements that may occur in the user's geographical environment, and remind the user to take precautions as much as possible before the accident. When an accident occurs, it can take risk avoidance measures to ensure outdoor safety for users and reduce the occurrence of accidents. Relying on GIS technology, it can realize the precise layout of space, to achieve the effect of rapid estimation by using Big Data and AI calculations, accurately grasp the measurement results of various information, and provide user condition judgment and decision support.

More thinking on the solution and application of the situation, including that when the user goes to a place, after the analysis and processing of geospatial information, the application interface can query the relevant articles of local recommendation and netizen dynamic information, so that the user can better understand the local situation and make better security decisions. If the user encounters flash floods, avalanches, and other emergencies during climbing, it is recognized that the user can obtain the emergency shelter and the best escape path through GIS spatial analysis and decision-making, to ensure the safety of the user. Obtaining the relationship between the user's locations and surrounding features through GIS, locating the spatial distribution of geographical objects such as water resources, crops, and residential areas, allowing users to improve their survival knowledge in the wild, find safe food, and improving the survival probability of self-rescue are critical essential capabilities to ensure the user's safety in smart tourism.

CONCLUSION

The aims of this study are realizing the situation of the current market, understanding the trend of hiking leisure tourism after economic development, evaluating the practical value and prospect of trekking poles, and trying to improve the practical function of trekking poles. Therefore, this study puts forward a set of design ideas, including the combination of software and hardware, and supporting the development of fundamental tools for smart tourism.

In addition to optimizing the structure of the hardware for functionality, this study also introduces and combines technologies and theories such as GIS, Big Data, and AI. In this article, the practical status of related theories was reviewed and discussed and put forward the design mode and framework of innovative thinking, which is also a new design that exceeds all product functions in the current market. In terms of software design, the main conceptual advantage lies in evaluating the current rationality and future trends of existing mobile devices, integrating GIS, Big Data, and AI with positioning systems and related smart devices to present Big Data aggregation, knowledge mining, and dynamic display and other benefits. It also proposes several functions to support smart tourism equipment, such as itinerary planning, scenic spot guides, traffic consultation, regional assessment, weather forecasting, safety assessment, and emergency response, etc.

Overall, the prime contributions of this study include as follows:

Firstly, explore the development prospect and feasibility: Through theory and design concepts, a new idea of trekking pole design is proposed. In addition to optimizing its hardware structure to enhance several functions, it also adds

software function design and demonstrates its rationality and practical value in combination with the development trend of new technology.

Secondly, conceiving integrated innovative design: The design concept proposed in this study has not yet been found in the current market. Besides the new concept of appearance function, the software design concept also belongs to innovative thinking. However, with the development of science, technology, and basic design, such products will emerge in the future, and the design concept of this study will lead to the trend of the times.

Thirdly, Propose a new model of Smart Tourism: From the discussion of the theory and model in this study, it can be understood that in the future when the foundation of digital and smart is becoming more and more perfect, smart tourism will also be integrated into everyone's tourism activities, and various smart tools will also become popularized day by day, just like today's smartphones for each person. Then, the application technology conceived in this study will be an indispensable practical tool in the future.

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