Dean&Francis
ISSN 2959-6157

Improve mobile intelligent sightseeing vehicles through A and mobile technology

Jinning Zhang [1, *]

[1]Shanghai United International School Wanyuan Campus, Shanghai, China

*Corresponding author: choiyongman@ldy.edu.rs

Abstract:
As a newly emerging tourist transportation tool in recent years, intelligent sightseeing vehicles adopt advanced automatic driving technology and energy-saving electric drive technology. However, there is still much room for improvement, so the research theme of this paper is the combination of mobile intelligent sightseeing vehicles and AR technology. Based on the traditional intelligent sightseeing vehicles, this research applies new technologies: planning and driving on different terrain by using the method of self-performance margin estimation of vehicles; Through computer algorithms and GPS positioning to capture object attractions and in the form of AR on the OLED screen, various cultural and historical information of the attractions are provided to customers through tracking bubbles, giving them a new sightseeing experience. In the future, with the development of The Times and the continuous progress of science and technology, this mobile AR sightseeing vehicle will provide tourists with a deeper immersive sightseeing experience and will also bring new development to the tourism industry.

Keywords: augmented reality, mobility.

1. Introduction

With the continuous progress of science and technology, intelligent sightseeing vehicle technology has made remarkable development in recent years. Intelligent sightseeing vehicles not only enhance the tourist experience, but also make a great contribution to environmental optimization. Intelligent sightseeing vehicles generally use electric drive technology, which reduces energy consumption and exhaust emissions and is friendly to the environment. This zero-emission, low-noise feature not only improves the air quality of the scenic spot, but also conforms to the global trend of sustainable development. By adopting advanced autonomous driving technology, the intelligent sightseeing vehicle realizes the automatic navigation and obstacle avoidance functions of the vehicle. These vehicles are equipped with multifarious sensors that can detect their surroundings and take responses, and autonomously plan their driving routes such as cameras and ultrasonic radar. For example, in recent years, the bear intelligent sightseeing car in many domestic botanical gardens and parks has adopted the L4 level automatic driving system, which can realize the dual mode free conversion of automatic driving and active driving in the scenic spot, greatly improving the safety and efficiency of driving. There is a screen in front of the seat to view the body condition and scenic spot introduction, so that the machine instead of manual explanation, more efficient, but also has a lot of room for improvement. This article will discuss, for example, expanding the space inside the vehicle to make passengers more comfortable; Enhanced mobility and mobility of vehicles to enable visitors to travel to a variety of terrains; Increase the interaction between people and cars, so that the sightseeing on the way is no longer boring; Increase the content and way of scenic spot introduction, so that tourists have a deeper impression and understanding of the scenic spot. The envisioned smart sightseeing car combines mobility with augmented reality (AR) technology and uses driverless technology to remove the space-taking driving position and give tourists more room to move. The car is equipped with various practical facilities, the original glass Windows are replaced with OLED transparent screens on both sides and the front end of the vehicle, and cameras are installed on the front end of the vehicle to detect target attractions.

2. Detailed exploration of the use of mobility and AR technology

2.1 The mobility of the envisaged sightseeing car

Lots of cities are facing problems of how to provide continuable mobility to citizens and what measures need to carry out.[1] As an intelligent sightseeing car that can visit major scenic spots, its mobility and mobility performance need to be taken into account. Unlike products such as “Bear Smart sightseeing car” that drive on fairly flat terrain, smart sightseeing cars also replace the actions of tourists on sightseeing, including difficult actions such as going up and down hills and crossing mountains. According to Wong’s definition [2], maneuverability relates to a vehicle’s performance in soft terrain, obstacle negotiation and avoidance, ride quality over rough terrain, and water crossing. In reference[3],they proposed a fleet mobility control strategy that is characterized by longitudinal and lateral vehicle mobility. The following methods can be used to make the envisaged sightseeing car drive stably on various terrain and slopes: Make the vehicle self-evaluate its maneuverability status while traveling, and promote the maneuverability characteristics of the vehicle as needed, so as to use its maneuverability potential to complete the vehicle tasks and tasks. [4]The method of Dynamic interaction modeling between autonomous vehicles and terrain and design of low-level maneuvering control of vehicle systems should be combined with AI technology to detect around vehicle and make decisions of routes, autonomous vehicle observation and maneuvering state assessment. The main content is divided into two points: 1. To predict the terrain maneuvering margin of the vehicle in the process of movement, that is, to evaluate the maneuvering condition of the vehicle in a partially or completely stationary state. [4] When the vehicle maintains a certain maneuvering margin, the terrain maneuvering performance is estimated to provide factors for control vehicles’ performance. [4] At this juncture, it’s essential to establish evaluation processes that are centered around the management of tire performance for vehicles. The mobility capabilities of the wheels are initially defined by the force exerted around the wheel’s circumference and the wheel’s actual linear velocity. A new index for wheel maneuverability has been introduced, which quantitatively links the wheel’s circular force and velocity to its theoretical peak performance. This allows for an assessment of the wheel’s actual performance relative to its theoretical optimum, akin to comparing actual energy efficiency against its theoretical upper limit. This index is then expanded to encompass vehicles with multiple wheels. The current index is proposed, which correlates the traction and velocity attributes of all wheels to their theoretical maximum capabilities. By considering the wheel’s circumferential force and speed attributes, the VMP index mathematically captures the impact of power distribution among the wheels on the vehicle’s overall driving performance. Hence, the optimization of the Vehicle Maneuverability Performance is approached by ensuring the ideal tire slip for optimal traction. The optimal combination of forces and speeds across the wheels is crucial for achieving the best power distribution, which in turn maximizes maneuverability under specific terrain conditions. Tire skid is governed by both minimum and maximum thresholds. The minimum threshold guarantees a positive skid, ensuring the wheel maintains traction. Conversely, the maximum threshold is set to prevent the wheel from entering a highly non-linear traction zone, where exceeding it could lead to a significant reduction in wheel mobility, potentially causing the wheels to lock up. The optimization process also takes into account the vehicle’s longitudinal dynamics, which dictate that the sum of the circumferential forces on the wheels must equal the resistance to motion. By incorporating the Lagrange multiplier into the objective function, a system of equations can be formulated to determine the optimal tire slip for uneven terrain, aligning with the conditions necessary for the objective function’s extremum. This involves verifying the strict monotonicity of the equation based on the Lagrange multiplier and demonstrating the solution’s uniqueness. Ultimately, the Hessian theory for constrained optimization problems is employed

ISSN 2959-6157

to confirm that the derived solution represents a global minimum. By employing these methods, it becomes feasible for the envisioned sightseeing vehicles to self-assess their performance across various types of uneven terrain. This capability allows for the planning of optimal routes and ensures a secure and comfortable journey for tourists.

2.2 The application of AR in imagined sightseeing car

AR technology helps provide users with information and experiences that cannot be obtained with their senses alone. While AR has several potential benefits in the travel industry, there is still little research and research into how these benefits can be used to enhance the user experience. [5] In this case, in this proposed sightseeing car, an innovative idea can be created: the integration of augmented reality (AR) technology with the large Windows of the mobile intelligent sightseeing car, so that tourists can get the best sightseeing experience and impression by displaying real-time tracking information about many object attractions on the transparent screen in a comfortable environment. At the same time, tourists can experience the sense of science and technology and practicality given by AR technology when visiting scenic spots will get great results. Although there is no detailed technology to display and annotate the tracking target on the transparent screen, I think it can be achieved by the following method: The choice of sightseeing car screen application OLED screen, because of its high contrast, short time to response and wide viewing angles and other advantages, is very suitable for augmented reality applications and can enable tourists to clearly see the scene outside. Organic light-emitting diode (oled), has the advantages of low power consumption, light weight, wide color gamut and low price, and is considered to be the most widely used device in the next generation of lighting and display devices. [6] OLeds with bendable properties have a wide range of potential applications in many fields. Compared with traditional liquid crystal displays (LCDS), OLED displays do not require a backlight, so they can achieve higher contrast and faster refresh rates, which is crucial for real-time updates of virtual information attractions in augmented reality applications and the visitor's look and feel experience. In terms of technology, through the use of transparent OLED array: the use of multi-layer OLED screen with equal spacing can realize the display of three-dimensional frames, so as to improve the quality of virtual reconstruction image. This technology enables augmented reality without the need for additional optics, while improving image brightness and clarity. Then, in order to display clear images on the transparent OLED array, an optimized image reconstruction algorithm is required. This algorithm can compress the stereo frame into multiple two-dimensional images, and display them in turn on the multi-layer OLED screen, while controlling the area of the screen that is not covered by the image to be transparent, so that the screen can look more concise. For the tourists' mood to consider, simple and clear information will appear more soothing, more suitable for relaxation. Then, the target building is captured and tracked by the camera, and the coordinates of the target image are detected by the YOLOv5 algorithm frame by frame, and the building outline is framed and output on the OLED screen. Then call the stored information base, will select the appropriate introduction to the architectural attractions outside the screen, and show the major introduction information of the attractions to the tourists by tracking the moving bubbles.

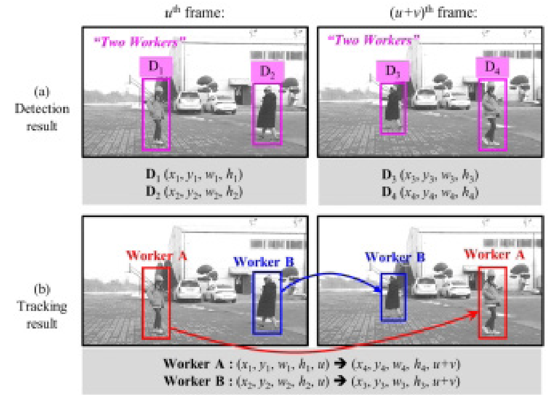

Fig. 1 Method to track objects that are moving [6]

How to accurately capture the object and transmit it to the tourists on the OLED screen is a difficult problem. It is not easy to rely on the camera to capture the fixed building on the moving vehicle, especially the possibility that it will be blocked by other buildings or objects, resulting in the target tracking disconnection. Through computer algorithms, these problems can be solved to the greatest extent, but it is obviously not enough in such a complex scenic spot; In this case, with the help of GPS positioning, tracking accuracy will be greatly improved. The YOLOv5 and StrongSORT systems are employed to detect and track buildings within the camera's field of view in video sequences. Each captured video frame is meticulously analyzed to recognize and monitor the presence of buildings. The process of pinpointing these structures on the image plane is a two-step procedure. Initially, the algorithm of YOLOv5 is deployed for object detection, which successfully identifies architectural features within the images. It then outputs the image coordinates of these structures as bounding boxes for each individual frame. However, this detection process categorizes objects into different classes, yielding a set of bounding boxes for each class per frame. [6] This implies that the outcome of each frame operates independently, without establishing connections between frames.[6] Consequently, detection alone is insufficient for tracing the trajectory of each object across frames, and it also necessitates the correlation of the image objects with GPS information. To align the tracking outcomes on the 2D image plane with GPS data, it is essential to transform the 2D image data into a 3D format. This is achieved by positioning a virtual 3D image plane at the center of the user's view, onto which the tracking results are then projected. This conversion allows for a more comprehensive understanding of the spatial relationships and movements of the buildings within the video frames. The virtual image plane is automatically placed at a consistent distance that corresponds with the user's direction. Adjust the dimensions of the plane and its proximity to the user based on the camera's resolution and field of view (FOV). This allows for the three-dimensional conceptualization of the coordinates for an architectural image object. Next, compute the ray projection from the position of the sightseeing vehicle to the image object on the virtual plane. The image object that was tracked in the previous step is then correlated with the building's GPS data. The GPS data within the digital twin pinpoints the exact location of the target building. This GPS data is essential for aligning the tracked object with its real-world match, ensuring that the system can supply precise and pertinent information to the user. To initiate the matching process, identify n GPS data points that fall within the camera's FOV. These points are then matched with the m image objects previously described, just like what shows in figure 1. Calculate the distances between the ray projected to each image object and the corresponding GPS point to create an $m \times n$ distance matrix. Subsequently, apply the Hungarian algorithm to determine the initial pairings of m image objects. [6] Finally, accurate information is transmitted to the OLED screen control system and relevant information bubbles are displayed next to the borders of each object. At this point, tourist users can receive information and distance of the scenic buildings they see on the OLED screen.

3. Conclusion

If This paper combines the two features of AR and mobile to create a new AR mobile sightseeing car. By using estimation and combining power, the sightseeing car can always drive stably on different roads, so that tourists have a more comfortable experience. At the same time, by capturing many building objects in motion to track the way of computer algorithms and GPS positioning, and with augmented reality technology output information overlapping to give visitors a very scientific and fresh experience. Mobile AR sightseeing vehicle, as a kind of envisaged sightseeing transportation, makes up for the shortcomings of traditional sightseeing vehicles in terms of tourist experience, operational efficiency, security and environmental protection. First of all, the AR intelligent sightseeing car provides an immersive virtual reality experience, allowing tourists to feel more diversified cultural and natural information during the tour, thus improving the experience satisfaction of tourists. Secondly, the autonomous driving technology and intelligent navigation system of intelligent sightseeing vehicles have significantly improved operational efficiency, reduced labor costs, and ensured the safety of tourists. Finally, the use of intelligent sightseeing vehicles helps to reduce traffic congestion and environmental pollution in the scenic spot, and realize the sustainable development of the scenic spot through intelligent management and scheduling. With the continuous development of technology, AR mobile sightseeing cars are likely to have a place in the future market, and more and more technologies are about to improve this set of ideas, making people's travel experience richer.

References

[1] Nima Dadashzadeh, Seda Sucu, Kate Pangbourne, Djamila Ouelhadj.Socially Sustainable Mobility as a Service (MaaS): A practical MCDM framework to evaluate accessibility and inclusivity with application,2024.

[2] J. Y. Wong and A. R. Reece. Prediction of rigid wheel performance based on analysis of soil-wheel stresses. J. Terramechanics,1967.

[3] Jeremy P. Gray , Vladimir V. Vantsevich.Multi-vehicle convoy mobility in severe terrain conditions: Factor impact analysis, estimation and control strategy,2015.

[4] Vladimir V. Vantsevich , David J. Gorsich , Jesse R. Paldan , Masood Ghasemi , Lee Moradi .Terrain mobility performance optimization: Fundamentals for autonomous vehicle applications. Part I. New mobility indices: Optimization and analysis,2022.

[5] Shi-Wei Wang, Peng-Fei Qian, Di Zhang, Wen-Hao Geng , Yi-Song Zhang , Xuan-Chen Liu , Lu-Yao Tian , Qingxia Zhu, Hong-Zhang Geng.Preparation of PEDOT flexible transparent conductive film by Solution shear method for OLEDs,2024.

[6] Linh Nguyen,Htoo Thiri Htet,Yong-Ju Lee *ORCID ,Man-Woo Park.Augmented Reality Framework for Retrieving Information of Moving Objects on Construction Sites,2024.