urban science

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Smart City Concept: Implementation Features in Various Territories

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Abstract

Modern software solutions have a multiplicative effect on enhancing quality of life across various urban sectors, including the environment, education, public health, security, transportation, time efficiency, employment, and other key aspects of city living. This article addresses a specific issue concerning the organisation of leisure activities for both local residents and tourists, using the Chechen Republic as a case study. In response, the study aimed to develop a digital solution to address this challenge, with potential for integration into the Republic's unified digital ecosystem. By employing system analysis methods, the authors identified the key objects and stakeholders involved in the problem domain. They also defined the software product's functionality and classified user categories. Using Unified Modelling Language methods, a use case diagram was developed to illustrate the conceptual operation of the system. Furthermore, object-oriented design methods were applied to create a user interface prototype for the software product. As a result, a digital service was developed that enables users to create personalised leisure routes, taking into account individual goals, time constraints, traffic conditions, and the real-time status of urban infrastructure. The resulting software solution is both customisable and scalable. The article also presents selected examples of project development.

Keywords: smart tourism; digital transformation; sustainable development; system analysis; urban environment; urbanisation; smart tourist destination

Academic Editor: Jianming Cai

Received: 7 June 2025
Revised: 21 July 2025
Accepted: 23 July 2025
Published: 25 July 2025

Citation: Mintsaev, M.; Murtazaev, S.-A.; Saydumov, M.; Aliev, S.; Abumuslimov, A.; Murtazaev, I. Smart City Concept: Implementation Features in Various Territories. *Urban Sci.* **2025**, *9*, 290. https://doi.org/10.3390/urbansci9080290

1. Introduction

The Smart City concept integrates a broad spectrum of end-to-end technologies and systems designed to manage natural resources and urban lifestyles. Its objectives include fostering the development of social and human capital, enhancing economic competitiveness, implementing integrated transport systems, promoting environmentally friendly modes of transportation, engaging citizens in decision-making processes, and expanding the provision of digital public services [1–3]. Given the complexity and breadth of these dimensions, a unified definition of a "Smart City" remains elusive. As such, the term is interpreted variably across national and international contexts, shaped by differing priorities and applications [4,5]. While the Smart City paradigm revolves around the deployment of digital and technological solutions, its effective implementation is contingent upon

the adaptability of the population and the governance strategies underpinning territorial resource management [6].

To standardise approaches to defining smart cities and integrating smart technologies into the urban environment, the international standard ISO 37120:2018, "Sustainable Cities and Communities—Indicators for City Services and Quality of Life" [7], was developed. This global framework has informed the creation of several national standards, including PAS 182:2014, "Smart City Concept Model—Guide to Establishing a Model for Data Interoperability, IDT", developed by the British Standards Institution [8]. It has also inspired the formulation of national programmes (e.g., Smart Nation Singapore, Japan Smart Community Alliance) and legislation (e.g., the Smart Cities Creation and Industry Promotion Act in Republic of Korea) [9]. In contrast, the legal framework governing the development of smart cities in Russia remains limited. Regulatory measures are primarily confined to directives issued by the Ministry of Construction, Housing and Utilities. As noted by Larichev [10], "the main purpose of creating 'smart cities' in Russia was the need to organise an advanced system of urban management, as well as to create comfortable and safe living conditions for people". The "Smart City" project in Russia was launched in 2018 as part of the national project "Housing and Urban Environment" and the broader "Digital Economy" programme.

According to the current regulatory framework, a Russian city is considered to align with the "Smart City" concept if it demonstrates a sustainable and safe urban environment, ensures the balance of interests and development principles, provides accessible and user-friendly services, and adheres to the principles of integration, interaction, and openness. Additionally, it must continually enhance the quality of governance, pursue economic efficiency, utilise the best available technologies, and prioritise long-term solutions over short-term gains [11]. To assess compliance with these criteria, the urban digitalisation index "IQ of Cities" is calculated annually, based on 46 indicators across 18 sectors. The rating categorises cities into four groups: largest cities, large cities, big cities, and administrative centres, enabling more nuanced benchmarking. Grozny, classified as a large city within the Chechen Republic, ranked fourth in the 2023 index with 89.45 points. For comparison, Tyumen, the top-ranked city, received 118.92 points. The remaining cities in the Republic fall under the category of administrative centres and are ranked as follows: Argun (15th place—88.07 points), Achkho-Martan (25th place—82.45 points), Shali (51st place—71.76 points), Sernovodskoye (59th place—66.69 points), Kurchaloy (62nd place—61.68 points), Gudermes (65th place—57.11 points) and Urus-Martan (66th place—57.11 points) [12]. The leader in the rating of administrative centres is the Chernushinsky Urban District of the Perm Region—116.94 points [12].

The uneven distribution of scores among regions in the "IQ of Cities" index can be attributed to the absence of unified priorities in the development of Smart City initiatives across Russia. This disparity highlights the importance of identifying region-specific key development areas. For example, the Chechen Republic has announced plans to implement digital and intelligent technologies in the management of its urban economy and transport systems by 2035 [13]. To date, the region has launched several initiatives aligned with these goals. Notably, the "intelligent pedestrian crossing" project integrates video and data transmission capabilities into higher-level decision-making systems and supports the synchronisation of external data sources—such as real-time positioning of emergency vehicles. Additionally, an IT park has been established in Grozny, further signalling the region's commitment to digital transformation [14].

All developments within the Smart City framework aim to create a comfortable, safe, and environmentally sustainable urban environment for local residents. However, tourists

also constitute an essential component of this environment. Therefore, the development of a Smart City ecosystem must include digital solutions that facilitate effective management of tourist flows through the integration of advanced technologies. In this context, the objective of the present study is to design a digital system for tourists as part of the broader "Smart City" digital ecosystem.

To achieve these objectives, the study sets out to identify the key objects and processes within the region's tourism industry, define their characteristics, determine the necessary types of digital tourism services and their respective users, develop a model for user interaction within the digital ecosystem of the "Smart City", and design a user interface prototype for the proposed digital solution.

The authors developed the concept of a software tool that implements real-time data analysis algorithms to create optimal travel routes for tourists in an urban environment. The scientific novelty lies in the peculiarities of determining the "optimal route" for the tourist. The authors consider the route as a set of certain characteristics. In the classical sense (most often used in existing software), the route is the distance from the starting point of movement to the final point, the time and duration of movement, as well as the permissible types of means for movement. To determine the "optimal route", in addition to the classical characteristics, the authors propose to take into account factors related to the individual needs of the person forming the route (the number and profile of tourist and other city objects desired for visiting, their operating time, total time to visit, the density of pedestrian and traffic flows along the route, etc.). Such additional characteristics are dynamic and their rate of change depends on many factors, including those of a random nature.

This approach involves the integration of artificial intelligence technologies to manage tourist flows in the concept of "Smart City", allowing the formation of a more harmonious environment for local residents and tourists. Thus, the hypothesis of the study is the possibility of reducing the load on infrastructure, expanding the coverage of urban infrastructure in tourist flows by creating personalized trajectories.

The theoretical significance of the work can be considered from both technical and sociocultural perspectives. From a technical standpoint, it lies in the opportunity to explore emerging technologies such as the Internet of Things, big data, and artificial intelligence, as well as the specific features of their integration. This exploration aims to enhance user experience, increase the efficiency of urban digital services, and improve data collection methods for analysis and decision-making. From a sociocultural perspective, the study focuses on understanding the behavioural patterns of tourists and local residents, with the goal of developing effective models for managing tourist flows and analysing the demand for tourism services.

The practical significance of the work lies in the development of a digital solution that enhances the openness and accessibility of tourist services in the region. This includes providing up-to-date information about attractions, events, transportation, accommodation, and other relevant services. The system also offers flexibility in planning tourist routes, allowing for the creation of personalised itineraries that take into account not only time constraints but also individual interests. Additionally, the solution contributes to improved safety through features such as emergency notifications. The results of this study can be utilised by local authorities in the planning and development of urban areas, thereby supporting the sustainable growth of domestic tourism and contributing to broader economic development within the country.

2. Literature Review

An analysis of domestic research reveals that scholars often propose development strategies tailored to the specific conditions of individual regions—taking into account

factors such as geographical location, transport infrastructure, and economic capacity. These regional strategies are intended to be incorporated into broader digital ecosystems, ensuring compatibility with national regulatory frameworks and strategic directives from the President and Government of the Russian Federation. The research by Detter [15], Didenko [16] and Gorbacheva [17] can be highlighted as examples of works based on the principle of geographical location underlying the "Smart City" concept. They consider problems and solutions for urban areas of the Arctic region characterised by harsh climatic conditions, the focal nature of the industrial and economic activity, remoteness from the main industrial centres, and low population density. A number of numerical solutions are proposed for regions with less harsh conditions; these studies are supported by big data analytics as well as parametric or simulation models which enable scenario-based system modelling for more informed decision-making. Of special interest are the works by Krasnikov [18], Boikova [19], Logachev [20], Smirnova [21], Krasnikova [22] and Martyushev [23] which develop digital twins of urban systems such as pedestrian networks and transport infrastructures. These models facilitate predictive analysis of policy impacts, such as traffic restrictions, speed limit adjustments, or the installation of new infrastructure. The authors of these works underscore the value of digital solutions in standardising urban transformation processes, thereby supporting the sustainable development of cities.

Analysing the market for software solutions, we can conclude that, indeed, the research results are actively used in the "Smart City" segment. It is important to note that such software products can be conditionally divided into two groups: professional and public.

Professional software products include solutions used by authorities and organizations carrying out certain activities in the region (for example, air quality monitoring systems, drinking and wastewater conditions, lighting of territories, monitoring and management of urban transport). In general, such systems manage urban processes for the sustainable development of territories. As an example, we give the following digital solutions:

- Hardware and software complex "Helios" (Russia). Designed for city utilities to control city lighting in order to save electricity, reduce the cost of operating and maintaining outdoor lighting and optimize the operating time of lighting infrastructure.
- Digital platform "Digital resource supply" (Russia). It provides intelligent management of heat consumption and accounting of resources, control of emergency situations and the quality of services, generation of reports on non-compliance with the quality of resources and filing complaints with regulatory authorities. Creates a single digital ecosystem for resource-supplying organizations, industrial enterprises, budget organizations, apartment buildings, management companies, production bases, etc.
- Digital system "City Brain" (Hangzhou, China). Monitors, manages and eliminates problems with urban traffic, optimizes resource consumption, supports emergency services and implements many more processes related to a dozen major areas of urban life.

Regardless of the purpose of the digital system, they are based on intelligent processing of data obtained from various sources (surveillance cameras, sensors, mobile device data, etc.). To do this, digital twins are created, allowing not only analysis of the state of current processes, but also prediction of changes.

Public software products include those that allow citizens to access certain functions and resources of professional digital solutions (for example, receive data on public transport, traffic congestion and other road events in real time; leave applications for public services; receive current weather data and forecasts of its changes). Here are the most popular software solutions related to this segment:

- Official portal of the Mayor and the Government of Moscow (mos.ru, Russia). It is a digital ecosystem that allows you to access not only reference information (current

news, events in the city), but also receive services for residents and businesses from different areas in digital form to issue social support, make an appointment with a doctor in a clinic, view your medical record, contact government departments, etc. At the moment, the portal has about 1000 digital services in the field of education, health, real estate, sports, recreation, transport, nature management, construction, etc. It should be noted that each region provides residents with access to such digital platforms.

- Digital service "Yandex Maps" (yandex.ru/maps). It is a digital ecosystem for the provision of information related to the cartographic service (information on the infrastructure of the territories of settlements, the actual movement of public transport, information on traffic routes on an individual request, etc.). This category includes digital Google Maps systems, 2GIS that provide the user with similar functionality.

Summing up the analysis of software solutions related to the public segment, we can conclude that they are inherently aggregators of various digital services. The functionality of such aggregators is based on data to which a certain level of access has been granted.

Accordingly, the concept of developing a digital solution for smart tourism should be based on the principles of existing software solutions, namely, to obtain data from available sources (both from public digital systems and private ones), and have an intuitive interface with similar software products (for example, Yandex Maps (https://yandex.ru/maps/ (accessed on 22 July 2025)), Google Maps (https://www.google.ru/maps/ (accessed on 22 July 2025)), 2GIS (https://2gis.ru/ (accessed on 22 July 2025))).

3. Materials and Methods

The object of the study is the tourism industry of the Chechen Republic.

The subject of the study is the processes involved in developing personalised itineraries for various types of recreational activities.

The analysis indicates a positive trend in the tourism industry, marked by a growing number of visitors to the North Caucasian Federal District, including the Chechen Republic as part of it [24,25]. This increase is primarily driven by domestic tourism and is relatively unaffected by tourism activity in neighbouring regions, as only one in ten visits originates from residents of adjacent districts [26]. The main tourist centres within the Republic—Grozny, Shali, and the Veduchi ski complex—are predominantly visited for short stays, typically in the form of one-day excursions or weekend tours. The region offers the potential to support a wide range of tourism types, including cultural and educational tourism, ecotourism, health and wellness services, and sports and adventure tourism [27,28]. Accordingly, the problem area is the need to create a unified digital platform capable of delivering integrated tourist navigation and up-to-date information services, while also enabling the creation of personalised travel routes based on individual interests and preferences.

The design and development of any digital product should adhere to a structured methodology, shaped by the project's goals, objectives, scope, applied technologies, and the roles of stakeholders involved in its implementation [29].

To identify the key objects and processes within the problem area, the method of system analysis was employed, which enables an interdisciplinary approach to solving complex, formalised problems and is particularly suitable for addressing practical challenges related to the development or enhancement of software products across various domains, including technical, informational, organisational, and economic systems [30]. The comprehensive application of system analysis procedures—such as abstraction, concretisation, analysis, synthesis, formalisation, decomposition, structuring, and clustering—facilitated the identification of cause-and-effect relationships underlying potential issues. This, in turn, allowed the authors to develop well-founded recommendations for their resolution.

The results obtained from the analysis were used to develop the functional capabilities of the digital software product, taking into account their applicability across different categories of users. To this end, a use case diagram was constructed using modelling methods to illustrate the system's responses to external inputs and the relationships between its internal states during the execution of user tasks. The Unified Modelling Language (UML) was employed to represent the system at a conceptual level. This diagram serves to visualise individual system services, their operational scenarios, and typical interaction methods, thereby providing a detailed specification of the system's functional requirements as a whole [31–33].

Object-oriented design methods were applied to develop a prototype of the user interface. This method allowed for the alignment of system functionalities with the corresponding graphical interface elements. It also enabled an assessment of the complexity of user interactions with the software, ensuring the product's usability and relevance for its target audience [34]. Based on the previously designed and modelled functional features of the software product, a representational model was created to demonstrate how the system operates from the end user's perspective.

4. Results

4.1. Digital System Architecture

The digital system is built on a client–server architecture comprising a multilayered structure that includes several client and server tiers, along with a centralised database. This architecture enables efficient load distribution, allowing users—through client interfaces such as a mobile application—to initiate specific actions on the server. These interactions are facilitated by a defined protocol that governs the format of requests and responses. The server component functions in accordance with predefined business logic rules, which allow it to manage data, process incoming requests, and coordinate the operation of various system components.

As an example, we will give some technical characteristics of the elements of the digital system.

For a user accessing functionality, it is recommended to install the application on any mobile device with periodic access to the Internet (LTE) and providing access to geolocation. For such an application to work correctly, you will need the Android (version 8 and higher) or iOS (version 15 and higher) operating system; 1.5 GB of RAM; and access to the camera, geodata, microphone, energy saving, and gallery.

For server hardware, a processor with support for virtualization and multithreading (at least 8 cores), RAM of at least 256 GB for simultaneous processing of millions of requests per unit of time, NVMe SSD drives with high bandwidth and low latency for databases and temporary files, and high-speed network interfaces are required. Linux operating system, containerization support for easy scalability, distributed database for efficient spatial data analysis, fast processing of user requests and requests from internal digital system services are mandatory elements for security, load balancing and energy infrastructure.

4.2. Functional Features of the Digital System

The functionality is shown using the precedent diagram (Figure 1).

In use case diagram notation, ovals represent functions that consist of a defined set of user actions required to interact with the digital system. This modelling approach supports the implementation of a microservice-based client–server architecture, in which the business logic is divided into discrete units, each responsible for performing a specific function. To achieve certain outcomes, multiple functions may need to be executed collectively. In such cases, relationships between functions are indicated using stereotypes connected by arrows:

the <include> stereotype denotes that one function incorporates another as a mandatory component, while the <extend> stereotype signifies that a function is executed only under specific conditions.

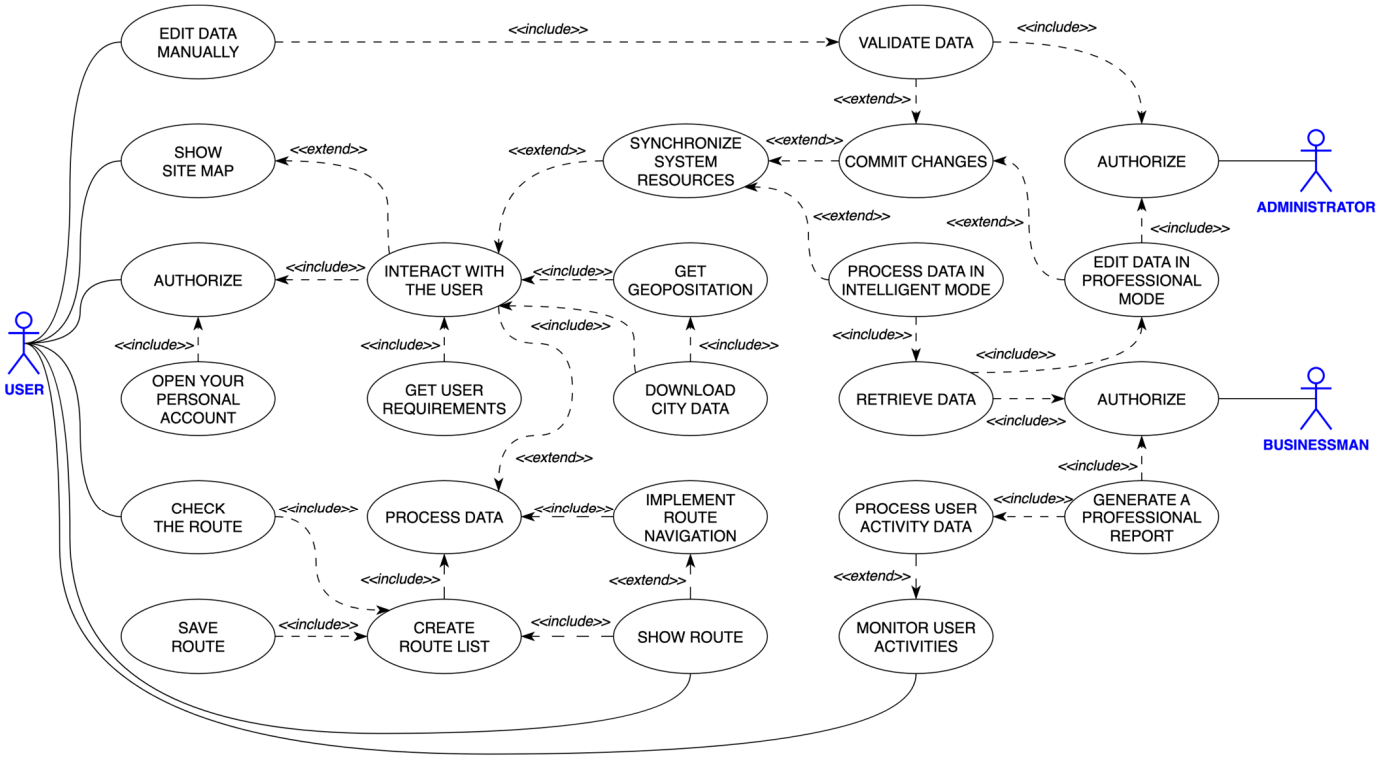

Figure 1. The operation model of digital system components (use case diagram).

The digital system provides the following functionalities to users, depending on their role within the system:

1. Constructing a route depending on the user's request. The following are the conditions determining the location structure and visit sequence: the planned duration, the purpose of the visit (e.g., walking, outdoor sports, tourism involving specific modes of transport and thematic locations, or walking with a pet), and the inclusion of essential locations such as catering facilities or souvenir shops.
2. Location of urban infrastructure facilities related to the tourism industry and their description on the city map. These include transport systems, accommodation, dining, and retail establishments. Information about each location—such as its position on the city map, operational status, and opening hours—is either provided by the private property owner or automatically integrated based on data from relevant public agencies (e.g., public transport stops, railway stations, museums, and parking areas).
3. Mapping of sports infrastructure accessible to visitors. This includes facilities such as outdoor fitness equipment, running tracks, individual mobility vehicle paths (for bicycles, scooters, rollerblades, etc.), and fitness centres. The details for each location—such as usage regulations and hours of operation—are either supplied by the facility owner or added automatically via official data sources.
4. Mapping of pet-accessible infrastructure. The system includes manually marked locations for pet-friendly infrastructure, such as fenced pet walking areas, specialty shops, and related services.
5. Thematic search of infrastructure objects. Users can apply thematic filters to the city map to view only the objects relevant to a specified category, such as tourist attractions, cafes and restaurants, or sports facilities.

6. "Smart search" functionality of infrastructure objects. This enhanced search feature uses a virtual assistant powered by artificial intelligence to guide users through a dialogue, helping them refine their search based on imprecise or fuzzy criteria. The system interprets the user's intent and returns a tailored list of relevant infrastructure objects.
7. Analysis of user activity within the city. The system monitors user interactions in the background through the mobile application, tracking location views, route adherence, and data from smartphones or wearable devices (e.g., fitness trackers). Based on this data, the system generates personalised recommendations for points of interest and can dynamically adjust the user's route. Users have the option to disable data collection, in which case only information actively selected during specific queries is processed.

4.3. Characterisation of Digital System Users

The set of functionalities available to each user is determined by their assigned role within the system:

- Unauthorised user—any person who has installed the application but has not created a personal profile. Such users are granted access to view the city map, including descriptions of all available locations, and may construct routes based on general parameters, such as the distance between selected points.
- Authorised user—a user who, after installing the programme, has created a personal account and set up a personal profile. The range of functionalities available to them depends on the selected profile category—such as local resident, tourist, athlete, or local resident with a pet. Such users do not require professional knowledge in the field of information systems and technologies. It is enough for them to be able to use mobile applications at the household level (to be able to enter a text request, select items of interest from the provided list, confirm actions by pressing buttons). Accordingly, there are no age nor other restrictions on access to functionality according to role. To work with the application, you need an email address and access to the phone settings and functions specified in Section 4.1.
- Administrator—professional users who are responsible for maintaining, configuring, and synchronising the system's components to ensure stable and efficient delivery of digital services. Their responsibilities include moderating content related to tourist sites (based on submissions from business owners and user feedback), updating infrastructure information, and configuring suggested tourist routes. Users with this role should have experience in information systems and server and system administration. Mandatory registration of labour obligations in accordance with the current legislation is required.
- Business user—users who are service providers operating within the city who have completed the required verification process in the digital system. They are permitted to upload and manage information about their own infrastructure facilities, which can be made visible to both authorised and unauthorised users.

Please note that all data processing is carried out in accordance with the current legislation of the Russian Federation.

4.4. User Interface Prototype and Options for Its Use

Upon launching the application, the user gains access to an interactive city map displaying all available infrastructure objects. The mobile application interface is conventionally divided into three main areas: the map area, which can be scaled and adjusted

manually; the dialogue area, where users can enter queries or interact with the system; and a menu area for the user to work with their profile.

Each user who creates a personal profile within the digital system is automatically assigned the category of "Local resident," linked to the city specified as their place of residence. This default setting is permanent and cannot be modified. However, users may select additional categories from the menu based on their current location and interests. These selections are treated as temporary overlays that influence the conditions of the current search session.

The "Tourist" category may be selected by individuals seeking to explore tourism-related infrastructure within the city and its surrounding areas. In addition to manually browsing relevant locations on the map, users can utilise the "smart search" function in the dialogue area to define personalised search parameters. These parameters may include the number and thematic focus of sites to be visited, the expected duration of the route, and the desired start and end points (e.g., a railway station upon arrival or a booked accommodation facility in the city). Users may also specify their preferred mode of travel—on foot, by private vehicle, public transport, personal mobility aids, or a combination thereof—and indicate preferences such as the availability of dining options, souvenir shops, parking facilities, and other points of interest. Figure 2 presents prototypes of the mobile application screens illustrating the realisation of these functions.

Artificial intelligence algorithms are employed to process user queries, enabling dynamic interaction and personalisation. During the query process, users may be prompted with additional questions to clarify specific details. Based on the analysed input, the system generates a list of preliminary routes, which users can review, modify, and select according to their preferences. If desired, the application can also function in navigation mode, guiding the user along the chosen route. Throughout the journey, user metrics may be collected—subject to user consent—which allows the system to refine dialogue interactions, improve recommendation accuracy, and update information on infrastructure facilities when feedback is provided.

The functionality available to other user categories is similar to the one developed for the "Tourist" category.

In the "Sportsman" mode, route generation for physical activities is facilitated through the "Smart Search" function. In addition to specifying start and end points, users can define parameters such as the desired intensity of physical activity, workout duration, and preferred environmental conditions. These may include pedestrian traffic density, nearby vehicular traffic levels, the type of road surface (e.g., asphalt, gravel, or park trails), exercise locations (such as parks, forests, or urban streets), and the presence of equipment along the route, including outdoor fitness installations.

The "Local resident with a pet" mode enables users to create routes suitable for walking pets. By adjusting the settings, users can display appropriate walking paths on the map—such as park zones or quieter streets with low pedestrian or vehicle flow—and identify infrastructure equipped with dedicated facilities. These may include fenced areas for off-leash exercise and outdoor equipment designed for pet training.

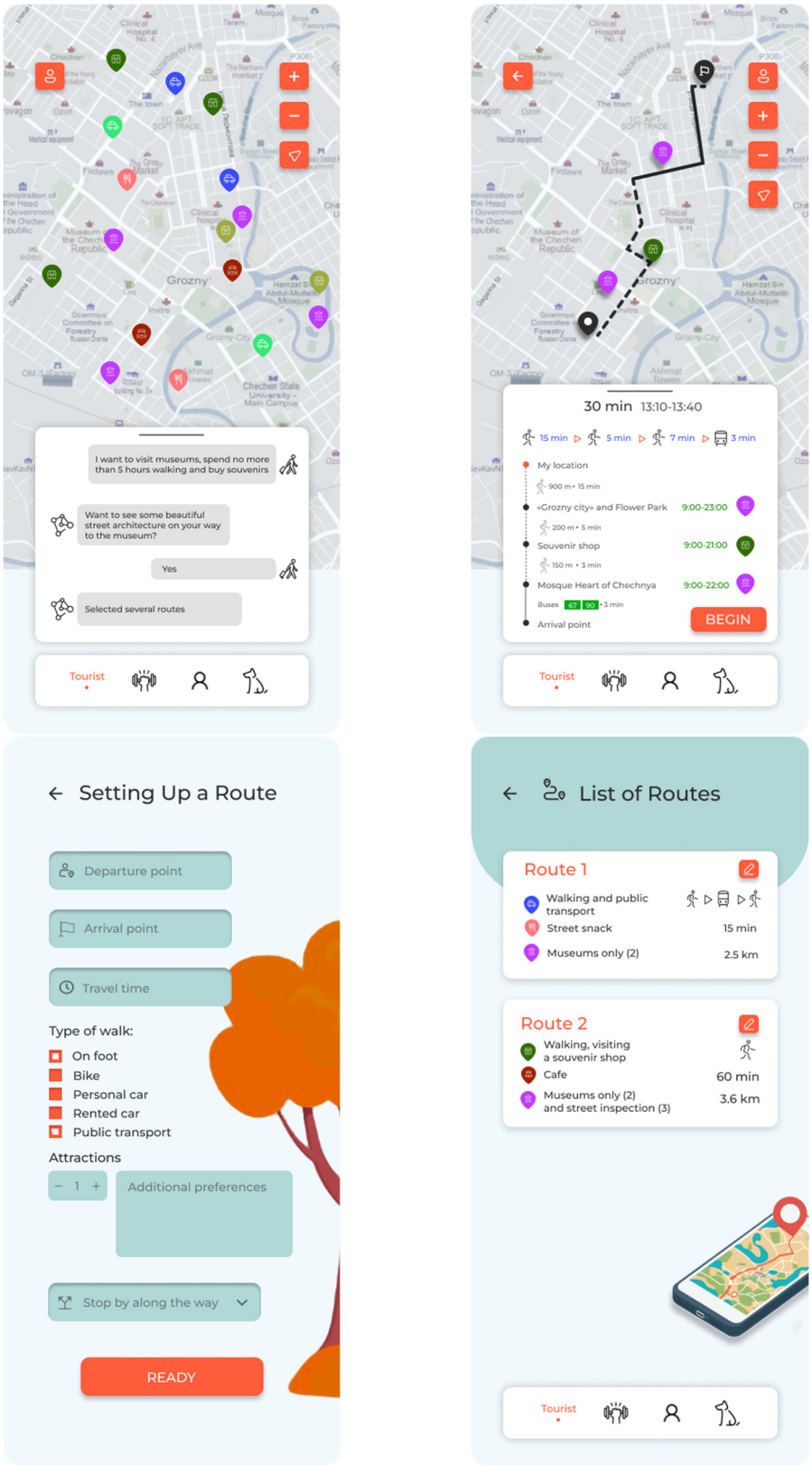

Figure 2. Prototypes of mobile application screens for the "Tourist" category user.

5. Discussion

Currently, the concept of the "Smart City" is popular, as its tools enable the optimisation of resource consumption through effective management approaches, aimed at enhancing the urban environment. These tools contribute to improving living standards

for local residents by ensuring the accessibility of infrastructure and services [35]. Modern digital innovations are focused on facilitating the digital transformation of specific urban processes and services. Notably, various simulation models have been developed that allow for the estimation of pedestrian and traffic flow density in response to changes in urban space or public transport schedules. These models support the modernisation of transport infrastructure within urban settlements [36–38]. In addition, such models can serve as the foundation for expert systems that operate in real time to enhance the dynamic management of the urban environment [39–41]. Researchers have observed that well-organised and accessible urban spaces contribute not only to the comfort of residents but also to the attractiveness of cities for tourists—even when the region has a limited set of recreational resources [42]. Despite the ongoing digital transformation, the complexity and variability of process evaluation indicators currently limit the ability to conduct an accurate analysis of how different categories of tourists perceive and benefit from the digital services available in the ecosystem of a Russian "Smart City". Therefore, the solutions proposed in this study are consistent with the modern approach of "identifying the most significant smart destination tools and studying their perception by the professional tourism community" [35].

The developed digital product project is designed to support the digital transformation of multiple urban processes by integrating them into a unified digital environment. These processes include the generation of personalised routes based on travel methods, time availability, user goals and interests, as well as other adjustable parameters; the provision of reference information about cultural heritage sites; and the mapping of tourism-related infrastructure such as hotels, souvenir shops, and other urban facilities. Each of these functions can operate as a standalone component within the broader "Smart City" system. This conclusion aligns with ongoing discourse in the scholarly literature, where there is no single, universally accepted definition of the "Smart City" concept [35,43]. A review of various interpretations reveals common themes, which include the following: "investments made in human and social capital and traditional and modern communication infrastructure contribute to the sustainable economic growth and high quality of life" [44], "technical solutions and organisational measures creating due conditions for comfortable life, work and business" [45], "competent management of all city elements enhanced by the digital communication and management environment" [46], and "the centrepiece of the city's development is its society and the benefits achieved by the system of digital solutions and activities" [47].

If we compare the resulting project with actively used software products (for example, Yandex Maps, Google Map, 2GIS), then, of course, we should highlight the coincidence of certain functionality that tourists can now use. Such features include detailed viewing of a geographic map of the area (for example, Yandex Maps allow you to view not only a city map with information on each infrastructure object, but also a floor plan of public buildings), build routes from one object of urban infrastructure to another with a choice of methods of movement and time of day, view the current traffic congestion, view the schedule of public institutions, leave and view reviews of such institutions, etc. However, such functionality is static and independent of user preference. For example, the Yandex Maps service will build a route from point A to point B, taking into account the driving time and the means of transportation used. For a tourist, especially in an unfamiliar city, this option is inconvenient, since the tourist will have to establish all the points of the route through which they want to go. The developed digital system will allow the user to set the starting and ending route time, total travel time and additional parameters (for example, the presence of catering points, shops with souvenirs, tourist infrastructure facilities on the route) and get options for the route depending on preferences, current workload, operating

time, etc. Thus, not only an individual approach to the organization of tourist routes is carried out, but also the load on the urban infrastructure and the creation of favourable and comfortable conditions for tourism is addressed.

At the current stage of work on the project, alpha testing of the declared functional capabilities has been carried out using the example of tourist infrastructure facilities in the city of Grozny (Chechen Republic, Russia). Verification of the results made it possible to establish that the declared hypothesis is confirmed.

However, it was found that the study has limitations. These include subject (the content and variability of the system responses depends on the amount of data representing the description of a particular territory), empirical (the need to maintain data on infrastructure facilities in an up-to-date state, since the change in their characteristics depends on random factors, for example, closing an object for reconstruction, changing the museum schedule, liquidating a souvenir shop, etc.), spatial (the settings of the digital system depend on the current legislation of the territory of the country in which it operates, as it implies a change in the policy of processing and storing data, its protection, ensuring confidentiality, etc.).

6. Conclusions

The convergence of the concepts of sustainable, compact, environmentally friendly, creative, and smart cities has become a prevalent theme in the scientific literature, mass media, and political discourse. These evolving visions of urban design are reshaping the goals of future urban development, guided by principles that emphasise pragmatic and accessible implementation by planners, ecologists, urbanists, and architects. In the modern Smart City, priority is placed on the needs of individuals and communities—needs that extend beyond the scope of information and communication technologies. Smart City development strategies are increasingly aligned with knowledge-intensive and creativity-driven approaches, aimed at generating positive outcomes across the socio-economic, logistical, environmental, and competitive dimensions of urban life.

Advancements in modern software and hardware have enabled the efficient organisation of numerous functional verticals within the urban environment. Within the Smart City framework, digital solutions increasingly require the integration of data and resources from multiple information systems. The proposed project facilitates the inclusion of data related to both the travel industry and everyday urban activities into this broader system. From a city management perspective, the implementation of this digital solution supports the identification of emerging urban trends, particularly in terms of service demand across categories such as residential leasing, spatial planning, active recreation, and the cultural utilisation of urban territories. This information is essential for formulating development strategies and informing city budget planning. For local residents, the system provides real-time insights into changes within the urban environment, enabling them to plan personalised routes for a variety of purposes, including recreational activities, daily commutes using public transportation, or travel via personal mobility aids. For tourists, the platform offers a structured way to plan city routes based on current data—allowing them to optimise the number of sites visited according to their available time, transport options, and the operating hours of key infrastructure. Overall, the project contributes to the sustainable development of the urban environment and local economy, enhances the quality of life, and promotes the rational use of urban resources.

The results of this study can be applied within the digital ecosystems of individual cities or regions and scaled to the national level. The architecture of the developed digital system is designed to support scalability through the expansion of digital services and the implementation of software capable of receiving, processing, and storing large volumes of region-specific data. This scalability enables the creation of a unified platform that offers

locally adapted services to citizens across the country, as well as to international visitors. Through an integrated approach, the system facilitates the planning of recreational activities, travel routes, and other user-specific tasks based on individual interests, objectives, and preferences.

Author Contributions: Conceptualization, S.-A.M.; methodology, M.M., M.S. and S.A.; software, I.M.; validation, M.S. and S.-A.M.; formal analysis, M.M.; investigation, S.-A.M. and A.A.; resources, I.M.; data curation, A.A.; writing—original draft preparation, A.A. and S.-A.M.; writing—review and editing, M.M. and S.A.; visualization, I.M.; supervision, S.A.; project administration, M.M. All authors have read and agreed to the published version of the manuscript.

Funding: The work was carried out within the framework of the state assignment of Grozny State Oil Technical University named after Academician M.D. Millionshchikov FZNU-2024-0003.

Data Availability Statement: The original contributions presented in this study are included in the article.

Conflicts of Interest: The authors declare no conflicts of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

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