The necessity of developing mobile applications for people with disabilities

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Abstract. Many modern mobile applications and online services aim to stimulate online purchases. However, the potential impact of tourism-specific applications on the tourism market and related industries has not been thoroughly investigated, indicating a significant need for further scientific research in this area. This article analyzes the global development of the Internet and the necessity for creating mobile applications to promote tourism services, examining advanced international experiences. The authors present specific proposals for the development of the InclUZ mobile application and offer conclusions relevant to the topic.

1 Introduction

The "Convention on the Rights of Persons with Disabilities" (https://www.un.org/ru/documents/decl_conv/conventions/disability.shtml) was adopted in New York on December 13, 2006, to support the participation of persons with disabilities in society fully and to transform their lifestyle positively. It outlines important requirements for creating a comfortable environment for individuals in this category. Specifically, Chapter 9 of the Convention mandates that countries consider adapting and developing the physical environment, transportation systems, and information and communication technologies for people with physical disabilities. Additionally, Article 30 stipulates that persons with disabilities should have the opportunity to access sports, recreation, and tourism facilities.

Systematic reforms in this regard are being implemented in our country. Notably, the Decree of the President of the Republic of Uzbekistan, dated September 11, 2023, No. PF-158, on the strategy "Uzbekistan - 2030,"[1] includes the 23rd goal focused on supporting persons with disabilities by creating a new system and a comfortable, favorable environment for them.

At the 16th session of the UN Convention on Human Rights held on June 13, 2023, the Secretary-General of the organization, Antonio Guterres, stated that more than 80 percent

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of people with disabilities live in developing countries. He highlighted three main directions to address this issue, with the first being the expansion of opportunities for people with disabilities to use digital technologies. This approach recognizes the new perspectives that innovations and technologies offer for people with disabilities in the social, economic, political, and cultural spheres.

2 Literature review on the Topic

Numerous scientists have researched the necessity and possibilities of developing mobile applications for persons with disabilities. For instance, A. Izzah, I. Kusuma, Y. Irawan, T. Cinderatama, and B. Nugroho [2] have explored an Android-based city tour application.

According to N. Ostdick [3], travel mobile apps directly assist tourism companies in communicating with customers and supporting them before, during, and after their trips. These apps act as essential communication channels.

V. Briliana and A. Prasetio [4] have conducted research on information satisfaction and how mobile applications can stimulate tourists' desire to repeat their trips through a deeper analysis.

H. N. Do, W. Shih, and Q. A. Ha [5], in their scientific research, focused on integrating the Technology Acceptance Model (TAM) using the PLS-SEM (Partial-Least-Squares Structural Equation Modeling) model to study the impact of mobile applications on tourists' shopping behavior.

Z. Liu, N. Glassey Balet, and M. Sokhn [6] analyzed several applications, including Axs Map, Wheel Map, AmiWheelChair, Wegoto, and Access Earth. They also provided integration for the WEMAP application, highlighting two main functions: data collection and route service visualization in HTML5. They developed an improved version using PHP and JavaScript.

3 Research methodology

This study is based on analyzing international and local statistical data regarding the global expansion of Internet and mobile device usage, as well as the popularization of mobile applications. Additionally, the research involved isolating, comparing, and studying over 30 applications designed for people with disabilities to determine their level of popularity. Based on the existing needs in Uzbekistan, a specific proposal was made to create the InclUZ mobile application for tourists, demonstrating the necessity of developing such applications.

4 Analysis and results

In 2024, the world's population will reach 8.08 billion people, which means an increase of 74 million (+0.9 percent) compared to the previous year. At the beginning of 2024, the number of mobile phone users in the world will exceed 5.61 billion people, covering 69.4% of the total population of the planet. If we take the last year, this indicator has increased by 138 million (+2.5%). It should also be noted that in 2024, more than 66 percent of the world's population (5.35 billion) will use the Internet. Statistics show that the number of Internet users increased by 97 million over the last year (https://www.byyd.me/ru/blog/2024/02/digital-2024-datareportal/).

In Uzbekistan, the number of subscribers connected to the Internet is growing regularly, and this indicator reached 82.6 in 2023 from 26.6 in 2015 (Table 1).

Table 1. The number of subscribers connected to the Internet in Uzbekistan from 2015 to 2023.

Regions	2015	2016	2017	2018	2019	2020	2021	2022	2023
Republic of Uzbekistan	26.6	30.2	34.5	40.4	48.8	58.4	65.8	75	82.6
Republic of Karakalpakstan	28.2	29.2	33.2	41.4	49	56.1	63.7	68.6	75.7
Andijan region	21.5	24.9	28.2	32.6	39.9	47	55.6	61.4	68.3
Bukhara region	23.9	26.4	29.5	36.9	44.8	52.2	61.4	69.4	75
Jizzakh region	21.4	23.6	28.3	35	41.6	47.8	55.6	61.4	67.5
Kashkadarya region	16.4	18.9	22.5	27.6	35.8	43.6	50.3	55.3	60.6
Navoi region	30	33.4	36.9	45.6	56	64.4	74.4	83.9	88.8
Namangan region	20.3	23.6	28	35.3	43.1	48.6	56.5	62.9	67.2
Samarkand region	21.4	23.9	27.6	32.6	39.2	45.9	53.5	59.1	65
Surkhandarya region	15.6	17.8	22.2	28.4	36.9	43.4	48.9	55.4	59.9
Syrdarya region	27.1	28.8	35.2	42.4	52.7	59.2	68.5	75.8	82.8
Tashkent region	9.9	12.6	12.4	17.6	34.5	42.5	50.9	56.9	64.7
Fergana region	21.6	24.9	29.2	34.1	41.8	51.2	74.4	86.7	93.4
Khorezm region	22.6	25.5	32	39	47.1	53.9	62.1	68.4	75
Tashkent city	103.5	118.7	129.7	135.1	139.7	174.9	151.5	185.1	209.2

The number of subscribers connected to the Internet at the expense of individuals in Uzbekistan in 2023 was 28,166.7 million (Table 2).

Table 2. The number of subscribers connected to the Internet in Uzbekistan, natural persons (by region) [7].

Regions	2015	2016	2017	2018	2019	2020	2021	2022	2023
Republic of Uzbekistan	8073.6	9279	10764.3	12883.3	15750.8	19241.3	22112.1	25167.9	28166.7
Republic of Karakalpakstan	487.5	511.8	589.5	748.6	890.8	1032.8	1184.9	1386.5	1438.3
Andijan region	604.1	712.1	821.5	967.7	1206.8	1451.6	1752.6	1918.9	2228.4
Bukhara region	415.9	463	523.1	670.9	812.1	962.5	1147.6	1393.3	1449.2
Jizzakh region	263.4	295.3	359.9	451	542.4	636.9	756.7	1620	955.5
Kashkadarya region	475.5	556.9	677.2	848.8	1125.6	1400.8	1646.8	1650.6	2068.2
Navoi region	264	285.5	330.5	420.9	517.3	608.6	714.9	996	892.9
Namangan region	508.9	603.6	729.9	936.9	1164.9	1342.3	1585.5	1745.5	1962.1
Samarkand region	745.7	848.5	997.1	1199.9	1468.4	1745.5	2069.8	2088	2624.7
Surkhandarya region	363.2	422	534.3	702.1	933.6	1123.7	1287.7	1312.3	1644
Syrdarya region	208.1	225	278.5	340	426.4	488.5	570	791.4	710.5
Tashkent region	259.3	330.3	317.2	474.1	957	1198.1	1418.7	1811.5	1906.3
Fergana region	723	849	1013.5	1214.2	1502.9	1882.4	2809.6	3184.6	3669.4
Khorezm region	381.3	436.8	559.3	693	848.1	985.5	1149.3	1435.4	1423.9
Tashkent city	2373.4	2739.2	3032.8	3215.1	3354.4	4382.1	4018	3834.1	5193.2

According to the latest data provided by Stat.uz, the number of subscribers connected to the Internet through mobile communication is 24,017.6. As of January-December 2023, 50.1% of the population aged 10 years and older used the Internet via a mobile network. According to the statistics agency's data on household sample observations, this figure was 36.8% in 2021 and 44.5% in 2022 [7].

Globally, over 5 billion people use mobile applications daily for a variety of services, ranging from playing games to performing banking operations and receiving medical consultations. According to statistics from 2019-2020, mobile phone users downloaded an average of 250 million applications daily. In 2023, the total number of application downloads reached 255 billion [8].

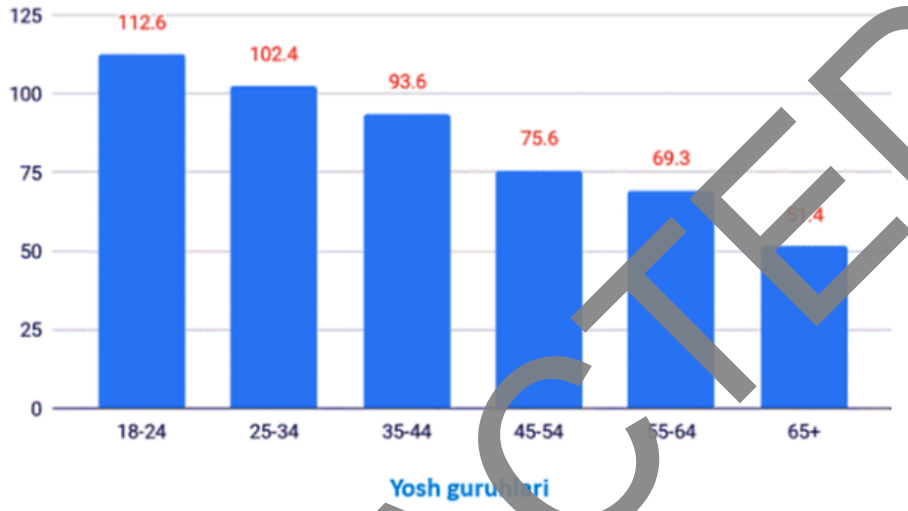

Fig. 1. Mobile applications of people of different ages hours spent each month (Made by the authors according on the basis https://www.un.org/ru/documents/decl_conv/conventions/disability.shtml).

According to the index of time spent on mobile applications, individuals aged 18-24 spend the most time globally, with an average of 11.6 hours per month (Figure 1). This is followed by those aged 25-34, who spend 102.4 hours, and those aged 35-44, who spend 93.6 hours using mobile applications.

In terms of mobile application downloads, China leads the world with 98.3 billion downloads (Table 3). India follows with 26.6 billion downloads, and the USA ranks third with 12.1 billion downloads. Chinese mobile app users open apps an average of 67 times per day, spend approximately 7.56 hours on apps daily, and use an average of 7 different apps each day [9].

Table 3. App download rates by countries (https://www.byyd.me/ru/blog/2024/02/digital-2024-datareportal/).

Country	Downloads (billion)
China	98.3
India	26.6
USA	12.1
Brasil	10.3
Indonesia	7.3
Russia	5.5
Mexico	4.8

According to observations, 67% of users will leave an app immediately if they encounter too many sequences to find information or achieve the desired result. Additionally, nearly 67% of app users pay attention to whether the device's battery drains quickly while using the app. Another notable point is that 73% of users make purchases via mobile phone an average of up to 4 times a week.

Modern mobile devices have evolved beyond traditional functions like making calls; they have become essential tools for saving both money and time [9]. Digital

transformation has fundamentally changed nearly all aspects of life, particularly in the social sphere [10, 11], IT [12, 13], and tourism [14-16]. Travel mobile applications, for example, are revolutionizing how people book transportation, hotels, and tours, and how tourism companies engage with customers [17].

Today, technology is widely accessible, and consumers experience a range of emotions throughout the day as they interact with their gadgets, especially tablets and smartphones. The advancement of the Internet and social networks has proven to be a valuable resource for customers, particularly for travelers. These tools provide extensive information and enable the creation of visual representations of tourism destinations through graphic illustrations and video clips before the trip [18].

The market for accessible tourism is substantial [19]. With 16% of the world's population living with some form of disability, mobile devices and gadgets have become integral to their lives, just as they are for everyone else. The most effective way to encourage travel and attract this segment to specific destinations is through the development and promotion of mobile applications tailored to individuals with disabilities.

More than 300 million people worldwide have color vision impairments and need color adjustment features when using web pages [20-26].

By 2050, nearly 2.5 billion people on the planet are projected to have some degree of hearing loss, and at least 700 million will need hearing rehabilitation.

According to the estimates of the International Labor Organization, 386 million of the world's population of working age are persons with disabilities (https://dislife.ru/materials/4320).

According to the data, 4.9% of adults in the USA experience absolute blindness or severe vision impairments. Additionally, 5.7% of individuals live with complete hearing loss or severe hearing difficulties. Furthermore, 10.8% of people have cognitive disabilities, which encompass issues with concentration, memory, and decision-making [20].

On an international scale, several practical initiatives have been undertaken to create and popularize mobile applications tailored for persons with disabilities. Below, we analyze some of the most notable apps specializing in tourism for people with disabilities.

A number of applications have been developed to facilitate the location of accessible facilities for individuals with disabilities. One such app is Access Earth. This application includes a brief video in the manual section, which effectively communicates the app's features in a concise and understandable manner. On the map within Access Earth, white objects indicate the absence of amenity information, while blue objects denote that such information is available.

Another example is the iAccesslife app. The iAccesslife app allows users to select objects across various categories, including coffee shops, gyms, residences, parks, restaurants, shopping centers, supermarkets, stadiums, and other similar locations. The app's main page features sections such as Explore, Profile, Favorites, Notifications, and Settings. The Settings section also includes a FAQ section. Users can leave comments and provide ratings regarding accessibility aspects such as entrance, parking, and interior.

Table 4. Mobile applications for finding hygiene stations [9].

Name	Focus	Size	Downloads
Flush toilet finder	Finding toilet facilities	9 mb	More than 500 thousand
Toilet finder	Finding toilet facilities	12.70 mb	More than 1 million
Where is public toilet?	Finding toilet facilities	5.6 mb	More than 1 million
Toilet Locator	Finding toilet facilities	4.9 mb	More than 500 thousand
WC Locator Pro	Finding toilet facilities	12 mb	More than 500

			thousand
Berlin toilet	Finding toilet facilities	8.5 mb	More than 10 thousand
Toilets4London	Finding toilet facilities	5.4 mb	More than 10 thousand

Source: Made by the authors

The importance of accessible applications extends beyond tourism to daily life processes. One notable example is the Flush Finder app, which helps users locate restrooms around the world (Table 4). With over 500,000 downloads, the app offers features for finding free, paid, and accessible restrooms (Figure 2).

In Bukhara, the app identified a total of 26 hygiene stations located on Sulaiman Murodov Street, Gijduvan Street, Nurabad Street, Bahauddin Naqshband Street, and other areas. However, none of these locations provided specific information about facilities for persons with disabilities or whether services were free or paid.

Wheelmap platform, in collaboration with the OpenStreetMap community, has evaluated over 1 million locations. With support from partners such as Foursquare, City Guide, Jaccede, AXSMap, HERE, and Parkopedia, it is anticipated that information on an additional 1 million locations will be added soon. To date, Wheelmap users have reviewed more than 2 million properties. Germany, the USA, India, South Africa, and Canada are the leading countries in terms of the number of evaluations. The application is available in 32 languages and categorizes facilities into full accessibility, partial accessibility, or no accessibility. For locations lacking assessments, the information is marked as unknown (Figure 3).

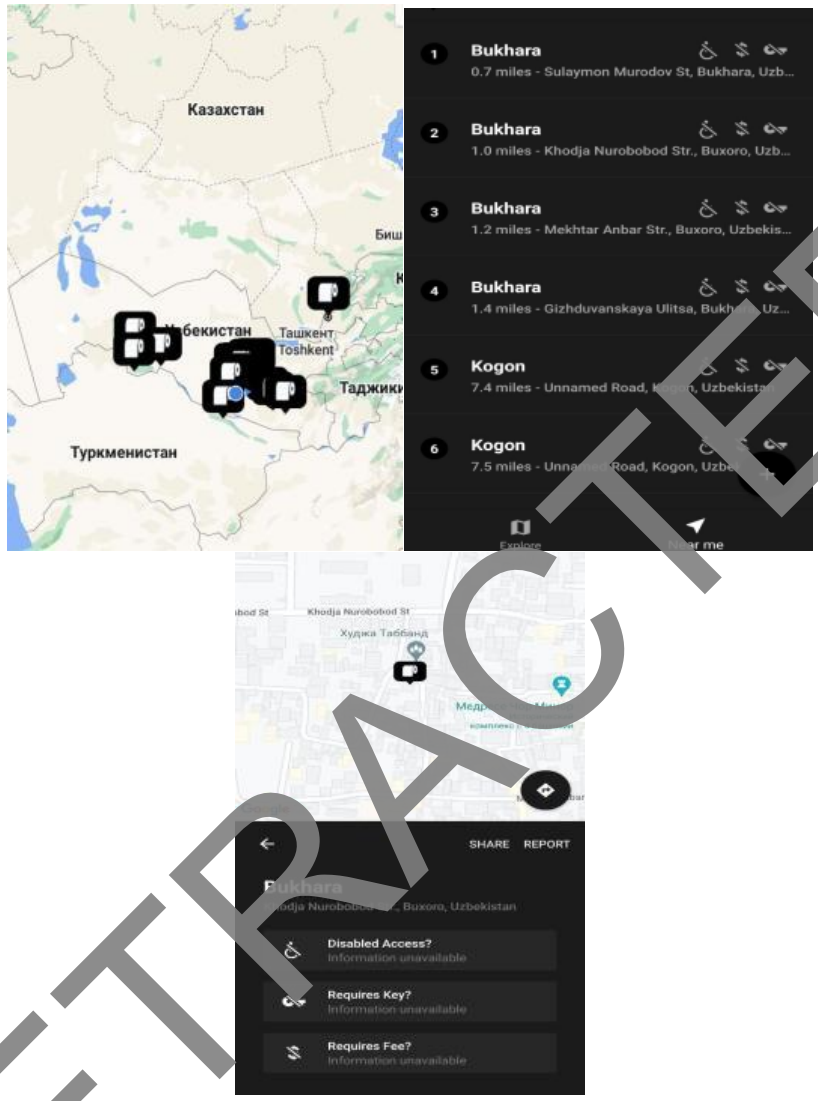

Fig. 2. Flush toilet program search results. Source: Made by the authors according to based on the information of the Flush toilet program.

Fig. 3. Appearance and features of the Wheelmap application. Source: Made by the authors according on the basis of data from the Google Play application.

The Wheelguide accessibility application was developed to indicate the availability of facilities for people with disabilities worldwide. However, upon reviewing the objects in the Bukhara region using the application, the results were unsatisfactory. No evaluations or information were available for criteria such as parking, ease of access, comfortable bathrooms, amenities for children, or internal circulation.

The search results using the Yandex Maps program identified 20 hygiene stations in the Bukhara region (Figure 4). While reviews of these facilities are available, there is no information regarding their accessibility for people with disabilities.

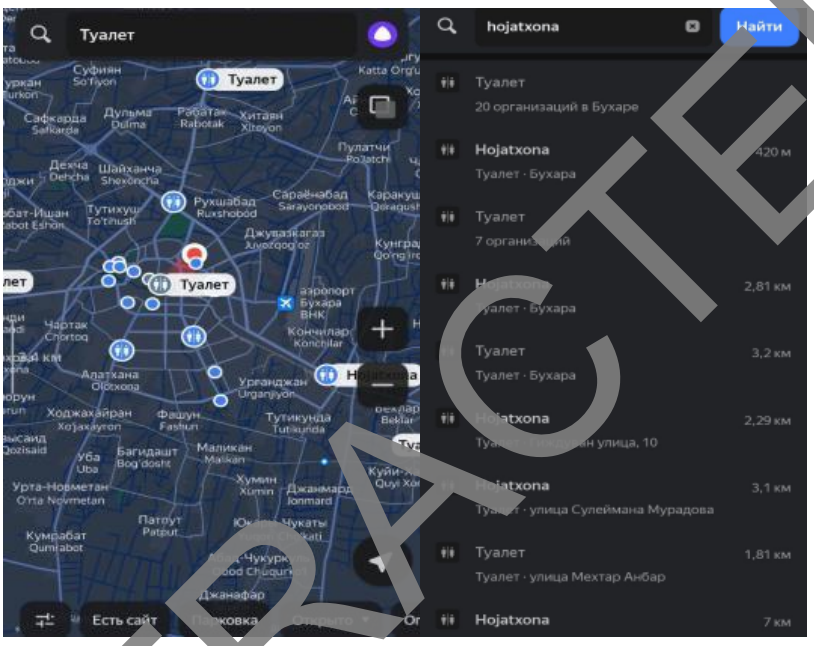

Fig. 4. Available in the Bukhara region in the Yandex map system results of hygiene stations search results. Source: Made by the authors according to based on the information of the Flush toilet program.

The Google Maps search system revealed over 20 hygiene stations in the Bukhara region (Figure 5). However, there is no detailed information about the facilities, and user reviews did not provide the necessary insights. This highlights the need for programs that specifically show the locations and accessibility features of hygiene stations in the Bukhara region, aiming to enhance comfort for both tourists and local residents.

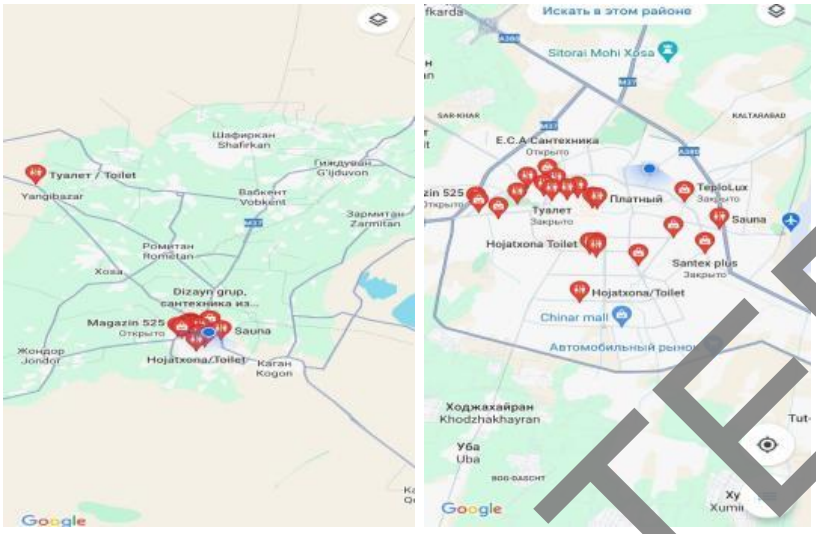

Fig. 5. Google map results [9]. Source: Made by the authors according on the basis of Yandex map data.

In 2023, Google leads the market share of search engines with 92.38%, a slight increase from 92.07% in 2022. Searches for information on "national mobile applications for persons with disabilities," "Uzbek mobile applications for persons with disabilities," "national mobile applications for tourists with disabilities," and "Uzbek mobile applications for tourists with disabilities" on Google yielded unsatisfactory results, with no information on locally developed mobile applications.

The rapid advancement of technology and growth in tourism underscores the need for applications adapted to persons with disabilities that provide essential information about tourism centers in our country. Developing applications that highlight the accessibility features of tourism infrastructure in our historical cities—Bukhara, Samarkand, and Khiva—is crucial. Given the broad scope of such projects, we propose developing the "IncUZ" mobile application and implementing it in phases. Specifically, starting with Bukhara, the initial phase of the application will gather experience before integrating the project into a nationwide system. This approach will not only enhance international and domestic tourism but also support socially vulnerable groups, including the elderly, families with young children, and individuals with disabilities, thereby strengthening their participation in society.

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