IoT in Arctic Tourism – A Case-study of the Tourist Information Office in Narvik

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***Abstract*—The internet of things (IoT) provides linkage between physical objects and their virtual counterparts so that things can be done much faster, cheaper, and in a more convenient manner for users. IoT is an important element in the "smart tourism city", a concept based on data sharing between the public and private sectors, and visitors of the smart city. This paper discusses the potential challenges and applications of IoT in smart tourism. In the case-study, the daily routines at the Tourist Information Office in Narvik, a city located in Northern Norway, are investigated. As a result, four social and managerial challenges are brought into sharp focus. Possible IoT solutions and advancements, providing better customer service, while still maintaining a high level of technological ease and common usability, are suggested. The solutions suggested in this paper have been developed and tested in smart tourist destinations and may hence be applied to other tourist information offices in the Arctic region.**

I. Introduction

The tourism sector is one of the most significant business sectors globally [1] and is a key component of socioeconomic activity worldwide [2]. The tourism industry saw a growth of more than 100% in the ten-year period from 2005 to 2015 and is expected to grow to 1.8 billion global tourism arrivals by 2030 [3]. The tourism industry was worth more than $2.5 trillion in 2017 [3]. The steady growth of this industry has established its high importance in all modern economies, especially in the age of social media where certain travel destinations become immensely popular among tourists in a very short span of time. Thus, understanding tourists' needs and behaviour has become highly significant.

Since its debut in the 90s, the internet has been expanding and penetrating almost all aspects of human life [4]. It has become an integral element of our daily lives. The network of connected devices which communicate through a central server and among each other is constantly growing and at the same time becoming cheaper, smarter, and easier to use. This concept, where objects can exchange data over a network without human intervention is known as the Internet of Things (IoT). It involves three types of interactions: humans to humans, humans to machines, and machines to machines [5]. The IoT empowers substantial objects and transforms them to smart objects capable of sharing information by manipulating their underlying technologies such as pervasive computing, embedded devices, communication technologies, sensor networks, protocols, and applications [6]. IoT is based on smart devices and sensors connected to each other through the internet, exchanging data freely so that the computer can interact with the physical world around it and become a part of human life [7]. This connection between the physical and digital worlds provides new opportunities to various industries, such as tourism, to enable more direct and active interaction between tourists, tourism service providers, hotels, tourism products and destinations [8].

Norway is technologically advanced in many aspects. People do not have to carry cash, as every place they go to purchase anything is obligated to have card payment terminals, or another form of online payment. This also applies to buses and short-time markets such as Christmas markets, or food caravans.

During the pandemic year of Covid-19 and international lock-down between 2020-2021, Norwegians preferred to do domestic tourism [9]. Based on statistics provided by the Tourist Information Office in Narvik, there was a noticeable increase in online bookings made that year by people themselves without requiring further assistance. This demonstrates that Norwegians are used to technology-based solutions and are ready for further digitalization in tourism services.

This study aims to investigate the applications of IoT in the tourism industry in smart cities around the world. Firstly, the paper defines what smart tourism and smart city are, and the common aspects between the two. Secondly, the paper discusses the use of technology and the internet in Norway with respect to the tourism sector. Thereafter, the paper introduces Narvik region, and the Tourist Information Office located in Narvik city. Finally, the paper presents examples of IoT-based solutions which can be implemented at the Tourist Information Office in Narvik for an overall better tourist experience.

II. Methodology

The methodology adopted in this work is an extensive literature review based on research papers dealing with smart tourism and IoT in tourism in recent years. The key search criterion is to select papers that are peer-reviewed and published in platforms of considerable impact. The main sources for articles are DBLP [9], Google Scholar [10], Scopus [11], Academia [12] and ResearchGate [13], using key words such as Internet of Things (IoT), smart tourism, tourism management, and seamless travel, bid data, smart tourist destinations etc. The papers were sampled under various headings based on a systematic review summary of the papers and the most relevant papers with respect to content and applications of IoT were selected as final sample papers. The review results were presented in this paper in accordance with the objectives of this research.

The study-case of the Tourist Information Office in Narvik was mainly based on personal working experience of three and a half years at the Tourist Information Office. In addition, two interviews were conducted with the Manager of the Tourist Information Office to get managerial insights into the relation between tourism and IoT. Encountered problems have been discussed and IoT based solutions are proposed.

III. SMART TOURISM

Smart tourism is the progression from traditional tourism to a smart experience based on personalization coupled with real-time data access [14]. Smart tourism is different from e-tourism [15]. Smart tourism is based on integrated efforts of finding innovative methods to collect and present data derived from physical tourism infrastructure, social connections, government infrastructure, and human resources, and translates it to useful data that enhances human experiences and business value with the objectives of achieving efficiency, sustainability, and enrichment of users' experiences. It deviates significantly from e-tourism, which defines the digital connections between businesses and consumers through the web. Smart tourism goes a step further and connects the physical world with the digital world via IoT, cloud computing and social media to create meaningful multi-dimensional user experiences [16], [17], [18]. A smart tourism destination [19] offers an improved, interactive, and high-quality tourist experience while also improving the quality of life of the residents of the location. IoT is an important element in what is known as "smart tourism city". This concept is based on data sharing between the public and private sectors on one hand, and inhabitants and visitors of the smart city on the other hand. The concept of the smart city is defined by two types of factors identified as hard and soft domains, including eight areas of sub-domains, such as mobility, building, health care, entertainment, education, public safety, the environment, and economy [20], [21], [22]. The main objective of a smart city is to improve the quality of life of its inhabitants through optimizing the infrastructure [23]. IT connectivity is an important element of modern city infrastructure, which enables the implementation of IoT in smart cities. Other elements of the infrastructure include transportation and efficient urban mobility, water and power supply, waste management, e-governance, and citizen participation [24]. Location-based systems also track user behaviour and present relevant advertisement [25]. Jasrotia et al. [26] reviewed the existing literature on concepts of smart cities and smart tourist destinations.

The smart tourism sector is far from fully developed and is yet to be fully explored and matured. Currently, intensive research is being done in smart tourism to study the theoretical, methodological, and practical challenges and one study discusses eleven such papers comprehensively to present an overview of the current progress in smart tourism [27]. Many challenges arise when dealing with smart tourism, such as the personalization of content for users [19], data sourcing, data filtering [28], privacy management [29], connectivity and data presentation. The new EU General Data Protection Regulation (EUGDPR) imposes strict regulations on data protection [30]. Various sensors, cloud computers, smartphones, radio-frequency-identification (RFID), wireless internet etc. also pray a crucial role in developing and maintaining a smart tourism destination. Mobile recommender systems are an attempt at offering highly relevant services to tourists in smart tourist destinations [31]. Such systems offer personalized information filtering and decision support tools to suggest relevant information to tourists.

Smart destinations and smart cities share many common features, where digital technologies and sustainability concepts are implemented concurrently [32]. Many recommender systems (RSs) have been developed recently to aid smart tourism [31]. As far as tourism is concerned, a tourist destination is classified as smart if it fulfils six following requirements [33].

1) *Smart governance*

This relates to governance, which is transparent, inclusive, and caring for its citizens.

2) Smart environment

This relates to destinations that are conscious about the environment and follow sustainable approaches in resources and energy management.

3) Smart mobility

This refers to utilizing modern forms of mobility and transportation that are ICT-connected, accessible and sustainable.

4) Smart economy

This refers to destinations that utilize digital and smart technology in their businesses to create innovative new businesses and business models.

5) Smart living

This refers to a high living standard and social cohesion of the inhabitants, providing cultural immersion for tourists and guests supported by new technology.

6) Smart people

This refers to the population of the destination which is highly qualified human capital able to participate in the new digital ecosystem.

In such a setting, tourists and residents of the smart destination digitally and physically share their experiences to enhance the smart tourism experience [21]. This data sharing is the basis of the smart tourist city in which visitors and residents play a significant role in providing and receiving that information. In a smart tourist city, the components of smart city (service, infrastructure, land) are combined with the elements of smart tourism (transportation, accommodation, gastronomy, attraction, and ancillary service). In other words, the active implementation of smart city elements enhances the smart tourism experience before, during and after the traveling experience. One of the most important elements in the smart tourism city is IoT, as it makes traveling easier and more enjoyable for the traveller.

Tourist activities have become more popular recently due to changes in world demography and the boom in smart technologies. Newer generations use technology intensively and display growing needs for communication, consumption, and tourist orientation. The upcoming generations are growing under sufficient resources for tourism, with more demand for personalized services and security [34]. The lifestyle based on leisure, socialization, and health maintenance will demand more complex tourist packages, which are easier to manage by

tourists through intelligent digital transformation in coherence with the dynamics of life. The services will become highly personalized, and tourists will demand direct interaction with the suppliers. All those factors lead to increased demand on smart solutions including IoT [34].

In this context, eleven key concepts [35] hold significance: privacy preservation [14], [25], [19], [36], [37], context awareness, cultural heritage, mobile recommender systems, social media, IoT, user experience improvement, real-time data, user behaviour modelling, augmented reality, and big data [38]. In the last ten years, significant research interest has spiked in smart tourism and many different approaches, their application, challenges, insights and variations have been studied and discussed [35], and these are important to understand if smart tourism is to be holistically implemented at a destination. Soon, blockchain technology could have significant technological implications on smart tourism and thus the future challenges in this domain also merit attention [39].

IV. Case Study

Narvik is a small city located in Northern Norway, with a size of about 3 100 km², and a population of about 22000 people [40]. Narvik municipality is located in Nordland district, and has borders with the following municipalities: Evenes, Tjeldsund, Gratangen, Bardu, Hamarøy, and borders with Sweden. Although the area of Narvik is not very large, its central location gives it its high value. If one is travelling between the big cities, such as from Tromsø to Bodø, then one will most likely travel through Narvik. Fig. 1 demonstrates where Narvik is located in relation to nearby bigger cities.

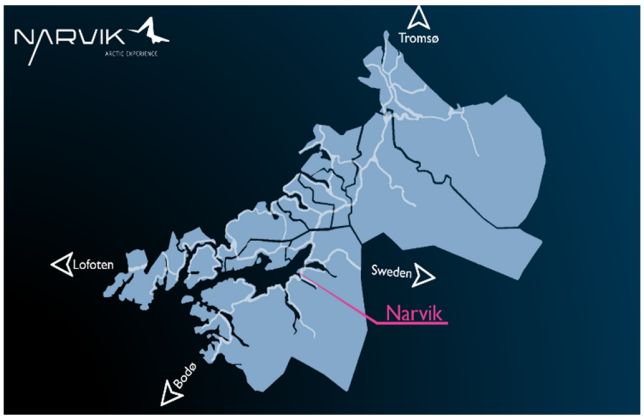

Fig. 1. Narvik region map designed by Thomas Berg-Nilsen

Narvik region as a touristic destination has very much to provide for its tourists, ranging from beautiful hikes, midnight sun during summertime, northern lights (aurora borealis) during wintertime, rich history of the WWII war, dog-sledding experiences, fishing, tourist train into Sweden, and the northernmost zoo in the world. However, one can say that Narvik region is an upcoming touristic destination, as it is yet to reach its full potential as a popular tourist destination.

2) Tourist Information Office in Narvik (Tourist Information office)

The tourist information (TI) office is located in the city centre of Narvik. The Tourist Information office is able to provide resources to have one Tourist Information officer assisting people for 6 hours daily. The Tourist Information officer usually has various roles at work, the most important being assisting tourists and providing the best customer service experience to them. Customer satisfaction is one of the most important aims for the Tourist Information office.

Fig. 2 below shows the responsibilities of a Tourist Information officer on daily basis:

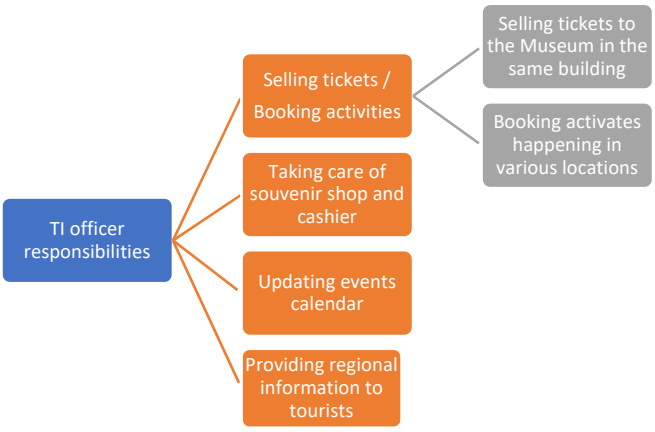

Fig. 2. Tourist information officer responsibilities

While on some days, it is possible to expect the number of tourists, in most cases, it is not as easy to predict the number of tourists coming on a certain day. A large number of tourists in one day may cause some chaotic situations if the queue of people waiting to get assistance becomes long. It is also important to mention that some people are in a hurry to catch a bus, a train, or a boat and need immediate assistance.

When the Tourist Information officer is busy assisting people, while others are waiting to be able to purchase museum ticket, then they can easily use the self-service tickets machines, and get into the museum without further assistance. There is free Wi-Fi in the building, which allows people to search for relevant information. There are computers for tourists to borrow and make online bookings by themselves. All these solutions allow tourists to be independent and find the information they need in the least time possible. Although these solutions are helpful for some people, they may create an obstacle for other people. Elderly people from different countries may find it hard to deal with self-service possibilities and would rather ask for assistance. This shows that even though IoT aims to make things smarter, it could create undesired barriers.

The following part of the paper presents 4 different frequently faced obstacles at the tourist office in Narvik, and how they can be solved using IoT, while at the same time being inclusive of all of people.

V. Case Study: Narvik Tourist Information Office

A. City map

Information about the region and its attractions is usually provided to the tourists through one-to-one on-the-spot communication, by pointing out the attractions on a paper-based city map. The city map is well-marked and aims to be visually well-described, so that tourists easily find their way through the

important highlights of the city. However, the map being paper-based, it cannot provide information which is subject to change, such as the opening hours of a restaurant, and the timetable of the train departures, since it may vary depending on the time of the year; summer or winter season. At the same time, the map can differentiate activities/attractions mainly based on location, rather than based on both location and category. The city map, a pocket-sized piece of paper, is a very important tool for tourists of all ages; convenient and lightweight.

1) Problem

The problem lies within the time usually spent by the tourist information officer providing extra information, such as listing activities of the same category, the opening hours of a certain restaurant, if the train is running or not due to the weather conditions, or if the Museum is open on a day. These small questions require a lot of time-consuming online searches, unless all these updates are provided to the tourist information officer at once beforehand.

2) The aim of the solution

The solution aims for tourists to be able to find answers to these questions without having to wait while being physically present at the tourist information office, as well as to make it easier for the tourist information officer to receive all the necessary updates from the different operators in the region.

3) IoT based solution

Smart Dashboard

The solution is to implement an interactive touch screen inside the Tourist Information office. The screen divides the activities/attractions based on category. One must first choose a category, then the screen shows where these activities/attractions are located on the map. When a tourist clicks on the desired activity/attraction, a whole screen of necessary information appears. This information varies depending on the type of activity. For a restaurant, it may show its location, opening hours, and price range, as well as a QR code which takes them directly to the restaurant website to check the menu or reserve a table if wanted. For the touristic train, it would show the timetable of departures, the location of the train station, information about ticket purchases, and a QR code which leads them to the page where they can purchase tickets online.

However, real-time data is also necessary in some cases. If the train is not running on a certain day for unexpected reasons, the screen should have this information updated. This is easily done if the train company has direct access to the tourist office to update this sort of information. This means that the information does not have to go from the train company, to the Tourist Information officer, to the tourists. The information flows easily from the train company, directly to the tourists, through a smart screen using real-time information. The example of iTour [7], a Java-based IoT framework which involves the residents in smart tourism development, is significant. It uses a real-time smart map of the city which the tourist information officers, government officials, and tourism department can use to view resources on the map in real-time to enable them to plan their itinerary based on their own choices. This means that every activity/attraction operator will have direct connection to their designated database with the tourist office, where it is their responsibility to ensure that their database is always synchronized.

The screen may also have a page of *Frequently asked Questions* updated by the Tourist Information officer after conducting a study on the main concerns of the tourists in the region. Fig. 3 shows a demonstration of interactive screen.

Fig. 3. Demonstration of interactive screen (undraw.co)

HotCity [41] is such an application, developed in 2017, which uses social context crowdsourcing to utilize users' social geo-tagged data on the internet such as check-ins, likes and reviews to highlight popular spaces for other tourists. It utilizes Deep Learning and Fuzzy Logic algorithms to classify users' preferences from social data and classifies relevant information as historical, cultural, adventure, urban, shopping, leisure, landscapes, and such. This makes it easier for users to look for activities within a certain domain of preference without requiring much effort to browse through all options that a tourist destination has to offer. Such an application makes it easier for new tourists to recognize the major tourist attractions at a smart tourist destination quickly without needing much help. Another mobile application specifically for this purpose is UTravel [42], developed in 2017 based on UTA algorithm [43] and K-Means clustering algorithm, which utilizes users' profiling algorithms to highlight points of interest through collaborative filtering principles.

Authors in Ref. [44] propose an IoT architecture to be used in Cagliari in Italy where sensors are used at Points of Interest connected to a mobile application and helps in monitoring the waiting times and queues at tourist information centres in the city, based on a typical Travelling Salesman problem. Their solution also looks at security requirements, flexibility, and data requirements for this system to work.

B. Activities booking system

The Tourist Information office has an activity booking system which allows tourists to book different activities provided by different operators at the same time. Tourists usually have the option of 1) purchasing activities by themselves through the Tourist Information office website, or by 2) receiving assistance from the Tourist Information officer, and paying on the spot, either by card or cash. A lot of planning must be done beforehand by tourists, in order to know which activities/overnight possibilities they can choose from. Some people prefer cheap overnight places, while others are mainly concerned about the location.

1) Problem

Tourists must manually book different activities, transportation options, accommodation, and other tourism

services. As a result of this heterogeneity, many tourists find the booking process a cumbersome task in tourism experience. In addition to that, further complications in the planning and booking phase of tourism result from the intricacy of choosing the desired and available options based on tourists' preferences. Finally, the language barrier also presents another inconvenience for some tourists in the planning phase.

2) The aim of this solution

The solution for this problem aims to remove any gaps and heterogeneity in the booking phase in addition to providing services and options customized based on tourists' preferences. This would create a better travelling experience and higher quality customer service.

3) IoT based solution

A solution for this is to use an application that allows users to register and create a user profile. The application would then be able to automatically match and present booking options to tourists for them to choose from. One such application is CURUMIM [45], a smart recommender system developed in 2017 and based on content based (CB) and collaborative filtering (CF) algorithms, which uses data available on social networks to predict the degree of curiosity of a user and combines it with the level of technological advancement of the user to suggest the most appropriate recommendations. After approving the options, the application can automatically do the booking procedure for tourists by having access and permission to APIs of different booking platforms. Furthermore, the application can be able to learn user preferences by asking certain questions, tracking customers booking history, and learning from other tourists booking history that can be related to a customer's profile. Furthermore, using AI, the application can be able to understand different spoken languages by which users can convey to the application their trip needs, duration, location etc. Based on this, the application can generate a list of options that might be of interest to a tourist to choose from.

A real use case of such an application is the TreSight [46] context-aware recommendation system developed in 2016 and put to use in Trento in Italy. It integrates IoT and big data analytics from smart tourism databases in Trento. Users' context includes information such as the location, weather, etc. and the user profile includes information such as tip length, interaction mode, preferred time and mode of traveling, etc. ARTS [47] is a smartphone based augmented reality system which was developed in 2019 for the purpose of linking urban spaces, cultural heritage and pedagogical resources by using 3D scans to make the information interactive and easy to use for a wide consumer base. Madrid Live [16] is another highly successful system in place, developed in 2017 and based on case-based reasoning (CBR) algorithm, which combines users' preferences with factors such location, weather, popular spaces etc. to suggest leisure activities in Madrid, the capital of Spain. This significantly reduces the need to guide tourists, especially during rush hours, where most tourists can get the information they need without the need of waiting for the tourist information officers. South Tyrol Suggests [28], developed in 2017, is another successful recommender system which is based on a dataset of more than 27,000 points of interest. It utilizes Largest Deviation method to measure the usefulness of factors.

In terms of making the payments faster and more secure, BloHost [48] can be used, which is a framework developed in 2019, that uses a wallet identifier connected with cryptocurrency servers to initiate payments. There are strong indicators to suggest that more and more people are beginning to use cryptocurrencies to initiate payments so this system can become highly significant. Three-dimensional IoT based systems [49] based on Improved Simulated Annealing (ISA) algorithms have also been developed in 2019 and tested for the case of forests and national parks where communication challenges are common. This is highly significant for a destination like Narvik which has forests and parks such as the Polar Park in vicinity. Moreover, AudioNear [50] is a promising prototype developed in 2018, which enriches tourists' experiences in urban environments by providing speech-based assistance, reducing the need for guided tours when guides may not be available to some tourist groups during peak travel season.

C. Activities with a port entrance

There are some activities which require having a barcode to be scanned, in order for the port to open up for customers. Examples on such activities could be the Cable Car that leads up to Narvikfjellet. When tourists purchase cable car tickets by the Tourist Information office, they receive tickets with a barcode on their email, which they have to scan by the port, along with a physical receipt just as a confirmation for their payment. This is a very simple procedure, which requires no further assistance from the operators of the Cable Car.

1) *Problem*

Since the Cable Car station is located far from the Tourist Information office – about 2km away - some tourists, mainly elderly people, find it hard to use their phones for this purpose, or the idea of being connected to the internet somewhere else once they leave the Tourist Information office. While having access to email is easy for some people, receiving immediate notifications on it around the clock, it is not the case for many others. Some people do not have a need to use email in their daily lives, and therefore find it a bit advanced to receive tickets per email. Some people may not remember the password to their emails, making the situation complicated for all parties. This leads to the Tourist Information officer having to manually print out the tickets with barcodes for tourists. This is not ideal, as it neglects the idea of using less paper, uses extra time, and adds an unnecessary cost on the Tourist Information office.

2) The aim of this solution

The aim here is to make the procedure of entering the port of an activity as easy as possible for all parties, to avoid the miscommunication that may appear if tourists expect physical tickets even though they are informed otherwise, and to avoid the uncertainty of having the ticket available only on email.

3) IoT based solution

There are two possible solutions suggested for this problem using IoT. The first solution is easy to implement, while the second solution needs some further investigation before it can be taken into consideration.

- Solution 1

This solution suggests that with every booking confirmed, a 4-digit random number is generated. This number, along with the last name of the person, can be entered on a screen by the entrance port, allowing the port to open for that purchased ticket. Tourists may be asked if they prefer to receive the 4-digits code by SMS, email, take a picture of it using their phone, note it on their phone or have the receipt printed out. This requires the booking system to be directly connected to the payment system, and for the post system to receive information of the purchased tickets and their 4-digited codes. A similar, highly effective yet simple solution was implemented in Barcelona for the Barcelona Smart City project [51] where charging ports were also provided in bus shelters in case tourists need access to charging ports.

- Solution 2

This solution is very similar to self-service-based passport control systems, where one is able to enter the border of a country in the airport just by using their passport and face-ID. In our case, this means that the face-ID of the customer should be taken once he/she purchases the ticket by the IT office. It also means that, the customer does not need any further confirmations/codes/barcodes and can directly go to the entrance port of the activity, where the port should be smart to be able to identify the face-ID of that customer who purchased a ticket. This means that direct communication takes place between the booking system at the Tourist Information office and the entrance port of the activity. Real-time data should be transmitted and communication signals between both systems should be immediate.

The drawbacks of this solution lie within the fact that *1)* Any sort of personal ID is very confidential. Based on the Norwegian law, one is not allowed to take a picture of someone (Face-ID) without their consent. This means that, if this solution is applicable at some point, it cannot be the only way of passing a port of an activity, as some people would not consent to having their Face-ID taken. *2)* Systems have to be advanced in a way that leakage of information or being hacked is not possible. Having a very secure system is very hard to implement. This is therefore very costly and requires a lot of extra resources.

The second solution would give the simplest remedy to the problem if implemented without any possible drawbacks.

D. Access to translated texts inside Narvik War Museum

The texts inside the museum are offered in the English language for tourists. Every object in the museum has a description label written in English. However, the museum aims to be as inclusive as possible, and is considerate of other languages. Therefore, the same descriptive texts are offered in various languages accessible through an app which can be downloaded on each person's phone. There are six available languages on the app. If somebody would like to read the texts in German for example, then they can simply connect to the free Wi-Fi accessible in the museum, download the museum app, choose German language in the setting, and read the same texts in German.

1) *Problem*

As convenient and simple the solution may appear, several tourists struggle to get this to work for various reasons the Tourist Information officer is unable to assist with, such as (1) some people do not remember the password for their app-store, and (2) some have no additional space on their phone to download an extra app. These troubles may lead to frustration and could be seen as an unsatisfactory customer service experience.

This problem was taken further into consideration, and parts of it were solved by switching the idea of downloading an app, into being able to read the description texts through a website. People are kindly asked to scan a QR-code, which takes them directly to a website which has all the texts in different languages available.

However, this leaves us with the second drawback consisting of less obvious problems: (3) some have trouble connecting to the free Wi-Fi because of some specific settings they have previously turned-on, (4) some do carry phones which happen to be not smart, and (5) some do not carry a phone, or 6) some may need access to phone charging ports. These problems, even though small, create an obstacle for both the tourist and the Museum.

2) The aim of this solution

The solution aims to be as inclusive as possible. Although all information is available inside the Museum in English language, and it being the lingua franca of the world means that many people can understand it, still many people, especially the older generation, prefer to read material in their native language. This is quite important for the Museum, as the aim of the Museum is conveying a "meaning" rather than the conveying of a "text" or a "set of words".

3) IoT based solution

The museum can provide the visitors with smart glasses accompanied by the augmented reality [52] application allowing not only reading the descriptions of the objects in the Museum in various languages, but also simulating historical events, visualizing the popular tourist places, etc, hence offering an overall enriched cultural tourism experience. One such mobile application is MuseFy [53], developed in 2017 specifically for museums, which adapts its user interface based on personalized assistance algorithms to provide best experience to the visitors by using IoT and big data analytics. AudioNear [50] is an AR-based application, also discussed in an earlier solution, that has huge potential in this domain. Moreover, wearable devices [54], [55] such as smart glasses and wrist bands/bracelets [46] can extend the way tourist sense, comprehend, process, orient, and interact with information, especially in museums. Furthermore, to address the issue of tourists requiring access to phone charging stations, the Barcelona Smart City project [51] presents good solutions.

VI. CONCLUSION

IoT has revolutionized tourism by significantly improving customer experiences through the introduction of technological solutions as discussed in this paper. Furthermore, it is important to note that these technological advancements in tourism are simple to use for customers of all age groups and all education levels. The solutions suggested in this paper do not require the customers to read any complex instructions and can be navigated through easily. Moreover, it is important for such solutions to be equally accessible to tourists from all

backgrounds, irrespective of age or language, and must also conform with data protection and privacy preservation. With the application of the solutions discussed herein, tourism in Narvik and other similar locations in the Arctic can be advanced to new levels of tourist satisfaction, and it could lead to more opportunities of income through increased popularity and ease of travel. Future works in this domain may involve the development and testing of prototypes of the solutions discussed in this paper, followed by gradual integration of these solutions into the tourism infrastructure of Narvik and other similar locations in the Arctic.

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