Zbornik 20. mednarodne multikonference

INFORMACIJSKA DRUŽBA - IS 2017

Zvezek E

Proceedings of the 20th International Multiconference

INFORMATION SOCIETY - IS 2017

Volume E

Delavnica AS-IT-IC
AS-IT-IC Workshop

Uredila / Edited by
Matjaž Gams, Jernej Zupančič

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9.–13. oktober 2017 / 9–13 October 2017
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Urednika:

Matjaž Gams
Odsek za inteligentne sisteme
Institut »Jožef Stefan«, Ljubljana

Jernej Zupančič
Odsek za inteligentne sisteme
Institut »Jožef Stefan«, Ljubljana

Založnik: Institut »Jožef Stefan«, Ljubljana
Priprava zbornika: Mitja Lasič, Vesna Lasič, Lana Zemljak
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PREDGOVOR MULTIKONFERENCI INFORMACIJSKA DRUŽBA 2017

Multikonferenca Informacijska družba (http://is.ijs.si) je z **dvajseto** zaporedno prireditvijo osrednji srednjeevropski dogodek na področju informacijske družbe, računalništva in informatike. Letošnja prireditev je ponovno na več lokacijah, osrednji dogodki pa so na Institutu »Jožef Stefan«.

Informacijska družba, znanje in umetna inteligenca so spet na razpotju tako same zase kot glede vpliva na človeški razvoj. Se bo eksponentna rast elektronike po Moorovem zakonu nadaljevala ali stagnirala? Bo umetna inteligenca nadaljevala svoj neverjetni razvoj in premagovala ljudi na čedalje več področjih in s tem omogočila razcvet civilizacije, ali pa bo eksponentna rast prebivalstva zlasti v Afriki povzročila zadušitev rasti? Čedalje več pokazateljev kaže v oba ekstrema – da prehajamo v naslednje civilizacijsko obdobje, hkrati pa so planetarni konflikti sodobne družbe čedalje težje obvladljivi.

Letos smo v multikonferenco povezali dvanajst odličnih neodvisnih konferenc. Predstavljenih bo okoli 200 predstavitev, povzetkov in referatov v okviru samostojnih konferenc in delavnic. Prireditev bodo spremljale okrogle mize in razprave ter posebni dogodki, kot je svečana podelitev nagrad. Izbrani prispevki bodo izšli tudi v posebni številki revije Informatica, ki se ponaša s **40-letno** tradicijo odlične znanstvene revije. Odlične obletnice!

Multikonferenco Informacijska družba 2017 sestavljajo naslednje samostojne konference:

- Slovenska konferenca o umetni inteligenci
- Soočanje z demografskimi izzivi
- Kognitivna znanost
- Sodelovanje, programska oprema in storitve v informacijski družbi
- Izkopavanje znanja in podatkovna skladišča
- Vzgoja in izobraževanje v informacijski družbi
- Četrta študentska računalniška konferenca
- Delavnica »EM-zdravje«
- Peta mednarodna konferenca kognitonike
- Mednarodna konferenca za prenos tehnologij - ITTC
- Delavnica »AS-IT-IC«
- Robotika

Soorganizatorji in podporniki konference so različne raziskovalne institucije in združenja, med njimi tudi ACM Slovenija, SLAIS, DKZ in druga slovenska nacionalna akademija, Inženirska akademija Slovenije (IAS). V imenu organizatorjev konference se zahvaljujemo združenjem in inštitucijam, še posebej pa udeležencem za njihove dragocene prispevke in priložnost, da z nami delijo svoje izkušnje o informacijski družbi. Zahvaljujemo se tudi recenzentom za njihovo pomoč pri recenziranju.

V 2017 bomo petič podelili nagrado za življenjske dosežke v čast Donalda Michija in Alana Turinga. Nagrado Michie-Turing za izjemen življenjski prispevek k razvoju in promociji informacijske družbe bo prejel prof. dr. Marjan Krisper. Priznanje za dosežek leta bo pripadlo prof. dr. Andreju Brodniku. Že šestič podeljujemo nagradi »informacijska limona« in »informacijska jagoda« za najbolj (ne)uspešne poteze v zvezi z informacijsko družbo. Limono je dobilo padanje slovenskih sredstev za akademsko znanost, tako da smo sedaj tretji najslabši po tem kriteriju v Evropi, jagodo pa »e-recept«. Čestitke nagrajencem!

Bojan Orel, predsednik programskega odbora
Matjaž Gams, predsednik organizacijskega odbora

FOREWORD - INFORMATION SOCIETY 2017

In its **20th year**, the Information Society Multiconference (http://is.ijs.si) remains one of the leading conferences in Central Europe devoted to information society, computer science and informatics. In 2017 it is organized at various locations, with the main events at the Jožef Stefan Institute.

The pace of progress of information society, knowledge and artificial intelligence is speeding up, and it seems we are again at a turning point. Will the progress of electronics continue according to the Moore's law or will it start stagnating? Will AI continue to outperform humans at more and more activities and in this way enable the predicted unseen human progress, or will the growth of human population in particular in Africa cause global decline? Both extremes seem more and more likely – fantastic human progress and planetary decline caused by humans destroying our environment and each other.

The Multiconference is running in parallel sessions with 200 presentations of scientific papers at twelve conferences, round tables, workshops and award ceremonies. Selected papers will be published in the Informatica journal, which has **40 years** of tradition of excellent research publication. These are remarkable achievements.

The Information Society 2017 Multiconference consists of the following conferences:

- Slovenian Conference on Artificial Intelligence
- Facing Demographic Challenges
- Cognitive Science
- Collaboration, Software and Services in Information Society
- Data Mining and Data Warehouses
- Education in Information Society
- 4th Student Computer Science Research Conference
- Workshop Electronic and Mobile Health
- 5th International Conference on Cognitonics
- International Conference of Transfer of Technologies - ITTC
- Workshop »AC-IT-IC«
- Robotics

The Multiconference is co-organized and supported by several major research institutions and societies, among them ACM Slovenia, i.e. the Slovenian chapter of the ACM, SLAIS, DKZ and the second national engineering academy, the Slovenian Engineering Academy. In the name of the conference organizers we thank all the societies and institutions, and particularly all the participants for their valuable contribution and their interest in this event, and the reviewers for their thorough reviews.

For the fifth year, the award for life-long outstanding contributions will be delivered in memory of Donald Michie and Alan Turing. The Michie-Turing award will be given to Prof. Marjan Krisper for his life-long outstanding contribution to the development and promotion of information society in our country. In addition, an award for current achievements will be given to Prof. Andrej Brodnik. The information lemon goes to national funding of the academic science, which degrades Slovenia to the third worst position in Europe. The information strawberry is awarded for the medical e-recipe project. Congratulations!

Bojan Orel, Programme Committee Chair
Matjaž Gams, Organizing Committee Chair

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Invited lecture

AN UPDATE FROM THE AI & MUSIC FRONT

Gerhard Widmer
Institute for Computational Perception
Johannes Kepler University Linz (JKU), and
Austrian Research Institute for Artificial Intelligence (OFAI), Vienna

Abstract
Much of current research in Artificial Intelligence and Music, and particularly in the field of Music Information Retrieval (MIR), focuses on algorithms that interpret musical signals and recognize musically relevant objects and patterns at various levels -- from notes to beats and rhythm, to melodic and harmonic patterns and higher-level segment structure --, with the goal of supporting novel applications in the digital music world. This presentation will give the audience a glimpse of what musically "intelligent" systems can currently do with music, and what this is good for. However, we will also find that while some of these capabilities are quite impressive, they are still far from (and do not require) a deeper "understanding" of music. An ongoing project will be presented that aims to take AI & music research a bit closer to the "essence" of music, going beyond surface features and focusing on the expressive aspects of music, and how these are communicated in music. This raises a number of new research challenges for the field of AI and Music (discussed in much more detail in [Widmer, 2016]). As a first step, we will look at recent work on computational models of expressive music performance, and will show some examples of the state of the art (including the result of a recent musical 'Turing test').

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Getting Closer to the Essence of Music: The Con Espressione Manifesto.
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KAZALO / TABLE OF CONTENTS

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Ljubljana, Slovenia

PREDGOVOR

Projekt Avstrijsko-Slovenski inteligentni turistčno-informacijski center (AS-IT-IC) je bil sprejet na razpisu Programa sodelovanja Interreg V-A Slovenija-Avstrija v obdobju 2014-2020. Glavni rezultat projekta bo delujoča mreža ljudi s podpornimi orodji, kot so: virtualni asistent (ta bo omogočal komunikacijo z uporabnikom v naravnem jeziku ter integracijo z zunanjimi storitvami), komunikacijske storitve (rešitve, ki bodo omogočale komunikacijo med turisti, virtualnimi asistenti, ponudniki turističnih informacij in lokalnimi skupnosti), turistične vsebine, priporočilni sistem za načrtovanje izletov ter mreža turističnih ponudnikov in njihovih storitev.

Delavnica AS-IT-IC je organizirana v sklopu Multikonference Informacijska Družba. Delavnica naslavlja naslednje teme na področju turizma: raziskovalne aktivnosti, inženirske aplikacije in pogled na informacijsko komunikacijske rešitve z vidika ponudnikov turističnih informacij.

Matjaž Gams, Jernej Zupančič

FOREWORD

Austrian-Slovenian Intelligent Tourist-Information Center project (AS-IT-IC project) was approved in the Cooperation Programme Interreg V-A Slovenia-Austria in the period 2014-2020. The main project output will be the operational center with humans involved, having support of the following tools: Virtual assistant (providing automatic answering in natural language to the questions and performing services), Communication service (web-based solution that will enable conversation between the tourists, virtual assistants, tourist information officers and local communities), Information sources of tourism-oriented data, Recommender system for tour planning, Network of tourist services and services from local communities.

The AS-IT-IC Workshop is organized within the Multiconference Information Society. It covers research activities, engineering applications, as well as tourist-information providers view of the information-communication technologies solutions in the field of tourism.

Matjaž Gams, Jernej Zupančič

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Intelligent Society

Greg Evseev
"Jožef Stefan" Institute
Jamova cesta 39
Ljubljana, Slovenia
greg.evseev@ijs.si

Jani Bizjak
"Jožef Stefan" Institute
Jamova cesta 39
Ljubljana, Slovenia
jani.bizjak@ijs.si

Gregor Grasselli
"Jožef Stefan" Institute
Jamova cesta 39
Ljubljana, Slovenia
gregor.grasselli@ijs.si

Aleš Tavčar
"Jožef Stefan" Institute
Jamova cesta 39
Ljubljana, Slovenia
ales.tavcar@ijs.si

Blaž Mahnič
"Jožef Stefan" Institute
Jamova cesta 39
Ljubljana, Slovenia
blaz.mahnic@ijs.si

Matjaž Gams
"Jožef Stefan" Institute
Jamova cesta 39
Ljubljana, Slovenia
matjaz.gams@ijs.is

ABSTRACT

In this paper we will present some of our systems and solutions that will allow local societies and municipalities to become well-suited in the modern world. By providing services such as:

- Live Television
- Interactive 3D Virtual Reality navigation
- Intelligent virtual assistant with natural language interface for municipalities, societies, tourists and tourism organizations
- Health-related solutions

Keywords

virtual assistant; streaming service; smart tourism; healthcare system

1. INTRODUCTION

There are many challenges for societies to be known and keep their members informed about recent actions and events. Most of the time they need some instruments to deliver rich information in the most simple and user-friendly way. The best ways are classic newspapers delivered to members and interested people and accessible television shows or even a channel.

While having all content it is still complicated to deliver it to all curious individuals more so it is still a challenge to make it easy to understand and simple to get.

That is why research prototypes of Institute "Jožef Stefan" are coming to municipalities, retirees and other societies.

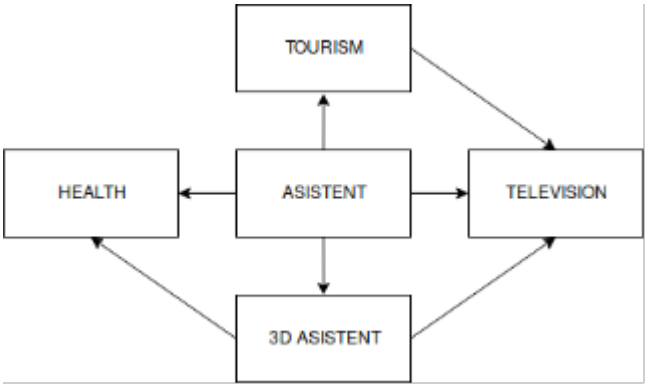

Figure 1: Ecosystem

To bring plain and straightforward services for people that need digestible information about municipality offers, touristic sightseeing destinations, accommodation and health.

Artificial intelligence as well as Information and Communication Technologies are getting better every day and the Department of Intelligent Systems is a part of this arduous process.

In addition to researching new ways of understanding information we are exploring ways of not only presenting but also maintaining information.

2. TELEVISION

By adopting our internet television solution any municipality could be enabled to broadcast their festivals, events, news and general information blocks live 24 hours per day with ease. This solution is prepared to be deployed without professional help nor special equipment since we already have a public web page with a handbook for setting up your own broadcasting server.

The simplest live streaming solution is well-suited for the most popular use-case - a PC with modern OS like Linux with GUI (tested on X and Wayland), macOS or Windows. It has a rich interface and is easy to use by inexperienced users (it is also well documented).

Figure 2: IJS TV interface

There's also a headless solution with an intuitive web interface (Figure 2). It is advised to deploy it with help of the specialist since it requires some special knowledge like Linux administrating and the Docker container system.

3. 3D ASISTENT

To provide effortless navigation in public locations like museums, parks or even government facilities our team prepared a virtual reality solution.

Figure 3: 3D Asistent VR

There are ways to access the virtual helper via special applications but there's an option where a web browser is sufficient.

This product can be used for helping to navigate facilities like: Hospitals - to help patients navigating in a maze of departments and rooms, Museums - to help visitors to get to desired masterpiece or historical item. Also it open possibility to have a virtual tour (with a chosen virtual guide) for people who cannot access the museum in person, Government facilities - to guide visitors to desired office, person before or during the visit,

It is also possible to enrich and combine 3D Assistant with other solutions like Television and our Text-to-Speech solution 'Govorec'.

4. ASISTENT

Figure 4: Asistent view

There are about 200 municipalities in Slovenia and every single one of them[1] already has it's own "Asistent" which helps the public to interact with their local government and guides tourists to desired destinations.

The system [2] has prepared answers for a variety of questions starting from simple ones like renting a bicycle to complex ones like getting a list of documents needed for a land use certificate.

The "Asistent" is made up by combining systems like:

1. Cloud-based service that offers API calls and has it's own web interface. It is built on MAS (multi-agent system) with several agents communicating in various environments depending on the intent of the user.

2. Administrative tools for maintaining databases and smaller services, it has it's own separate web interface.

3. A modern client-side application with a rich graphic interface that allows the end-user to have a meaningful conversation with multiple services and APIs in a comfortable and convenient way.

4. Mobile applications that are easy to download via appropriate mobile application store. Currently among supported mobile OSes there are iOS, Android, BlackBerry an Windows Phone.

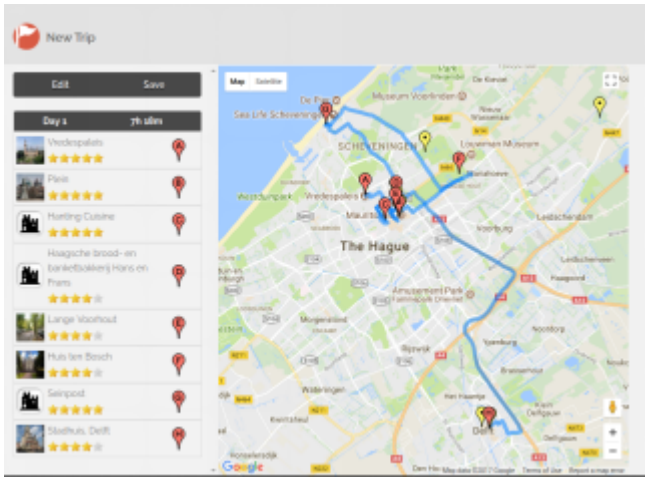

Figure 5: e-Turist Explorer

5. TOURISM

Project "e-Tourist"[2] [1] is a service for planning itineraries in Slovenia. The project was founded in 2013 within the "Call for proposals for co-funding of projects developing e-services and mobile applications for public and private non-profit organizations" funded by the European Union and Slovenian Ministry of Education, Science and Sport.

It allows to plan trips within selected regions it also tailors the route to user's defined preferences like gastronomy trip or a hiking tour.

This project is an important step in developing Austrian-Slovenian Intelligent Tourist Information Center (AS-IT-IC) project. The project addresses the problem of not getting the desired information about natural and cultural heritage sites in the Slovenian-Austrian cross-border area in an integrated way.

6. HEALTH

Figure 6: IN LIFE smart watches

Most of the medical professionals understand that Artificial Intelligence is going to revolutionize the healthcare system.

In recent years the Institute "Jožef Stefan" was developing solutions and researching algorithms for identifying types and measuring levels of stress, detecting heart problems as well as several solutions fitted for elders. There are various modules that are already available for no price - some of them were developed or are still in development at our Department. The electronic health system has numerous components - First Aid assistant, information from the National Institute of Public Health, Self Care advice suggester, modules that work in collaboration with EkoSMART subprojects like "e-Health and Mobile Health", the Repository of Domains and Prototypes, Stress detectors and system for the care of elderly.

Here are the projects involved:

1. IN LIFE[3]: aims to prolong and support the independent living of seniors with cognitive impairment, through interoperable, open, personalized and seamless ICT solutions that support such everyday tasks as home activities, communication, health maintenance, travel, mobility, socialization tasks.
2. E-gibalec[4]: Smartphone game for children that will encourage them to do exercises, empowered with statistics for supervisors.
3. ASPO[5]: An online application for identifying and informing about sexually transmitted infections
4. Stress detector: Students project for identifying stress type and level via text web interface
5. EkoSmart, EMZ[6]: One of the important features of the program is the integration of the solutions in different areas into a common ecosystem. Too often the practice of introduction of smart cities shows limited focus on certain areas and lacks connection with others. One of the important objectives of the EkoSmart program is therefore the development of the platform with the same name (EkoSmart platform) which will allow easy integration of sector-specific solutions into a common ecosystem (featured in the program, as well as others) and will, as such, facilitate the identification and support of inter-sectoral value chains. This platform will be compatible with global solutions and will include concepts such as the Internet of Things (IoT).Within EMZ (e-Health and Mobile Health) we collect domain repositories and prototypes, so you can see who stores what data and what prototypes in Slovenia. We are developing an EMZ assistant here.

7. INTEGRATION WITH AS-IT-IC

To help the AS-IT-IC project to create a joint Austrian-Slovenian center. A network of services that help to navigate and deliver useful information will be necessary to collaborate with service providers and tourist offices, municipalities, tourists and citizens to enhance continuous cooperation between them. These projects are going to be part of the touristic ecosystem that is still developing.

[1] http://projekt-asistent.si/meta-asistent
[2] http://turist.ijs.si
[3] http://www.inlife-project.eu/
[4] https://www.e-gibalec.si/
[5] https://aspo.mf.uni-lj.si/static/ASPO_new/#/
[6] http://ekosmart.net/sl/ekosmart/

8. CONCLUSION

In this paper we presented different systems that are going to help societies, municipalities and organizations to become more visible in the modern world, become more accessible and transparent for interested parties and collaborate with each other. With help of Artificial Intelligence and Natural Language Processing societies could build modern information systems now with no need of special knowledge and deliver services for more customers in the nearest future.

9. ACKNOWLEDGMENTS

Part of the work was co-funded by Cooperation Programme Interreg V-A Slovenia-Austria 2014-2020, project AS-IT-IC.

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Tourist Information Center Slovenj Gradec as a Part of the AS-IT-IC Interreg Project

Marija Lah
SPOTUR Slovenj Gradec
Glavni trg 1
Slovenj Gradec, Slovenia
marija.lah@slovenjgradec.si

Jernej Zupančič
"Jožef Stefan" Institute and
Jožef Stefan International
Postgraduate School
Jamova cesta 39
Ljubljana, Slovenia
jernej.zupancic@ijs.com

ABSTRACT

We present the Tourist Information Center Slovenj Gradec and the organization within which it operates. Additionally we provide a short description of the Austrian-Slovenian Intelligent Tourist-Information Center (a project within the Cooperation Programme Interreg V-A Slovenia-Austria, period 2014-2020) and the role of the Tourist Information Center within the project. We also provide our view of Information and Communication Technologies impact on tourism and discuss the need for a nation/region-wide platform for services and tools for tourist services providers and tourists.

Keywords

tourism; information society; AS-IT-IC project

1. INTRODUCTION

SPOTUR Slovenj Gradec (Slovene: "Javni zavod za turizem, šport, mladinske in socialne programe SPOTUR Slovenj Gradec") is a public institution, established in 2009, with a view to carry out various tasks of public interest in the field of tourism, sports, youth, and social programs in the municipality of Slovenj Gradec. SPOTUR cooperates with several similar institutions in the area of Koroška as well as in the wider region and is an important operational partner in the Regional Development Agency for Koroška (which operates under the auspices of the Regional Development Agency).

1.1 SPOTUR Objectives

Objectives of the SPOTUR Public Institution in the field of tourism are the following:

1. Organized, constant and professional approach to the development of new integrated tourism programmes (excursions, weekend programs, holidays).
2. Coordination an cooperation with all tourist providers in the municipality.
3. Promotion and marketing of Slovenj Gradec as a tourist destination on the domestic and foreign markets.
4. Creating and ensuring the strategic development of tourism in the region.
5. Linking the public and entrepreneurial interests and services.
6. Developing of new tourist products.
7. Encouraging the development and regulation of tourist infrastructure facilities in the area of the founder's municipality.
8. Organizing and marketing public events.
9. Graphic design and editing of the web presence.
10. Providing tourist information.

2. AS-IT-IC PROJECT

2.1 About the Project

Austrian-Slovenian Intelligent Tourist Information Center (AS-IT-IC)[1] is a project that was accepted in the cross-border Cooperation Programme Interreg V-A Slovenia-Austria in the programme period 2014-2020. The project has two main goals:

1. To develop information and communication technology (ICT) tools to support a tourist when he or she wants to create a personalized itinerary for the visit of the Slovenian-Austrian cross-border area.
2. To create a sustainable community that will support the use and maintenance of the developed tools.

The project consortia comprises 5 partners from the Slovenian-Austrian cross-border area.

1. Jožef Stefan Institute,
2. Graz University of Technology, Institute for Software Technology,
3. SPOTUR Slovenj Gradec,
4. The Association of Municipalities of Slovenia, and
5. Graz Tourismus und Stadtmarketing GmbH.

[1] https://as-it-ic.ijs.si

2.2 Relation to the Project

The Tourist Information Center of Slovenj Gradec is a department within the Public Institution SPOTUR, which is the main office involved with the AS-IT-IC project. With the participation to the project we want to improve and update the quality of our tourist information services and cooperate with Austrian and Slovenian partners in building the next generation tourism-oriented ICT tools.

2.2.1 ICT Project Tools

Currently, a tourist cannot get the desired information about Slovenj Gradec in an integrated way from both the humans and Web services, much less from the joint Austrian-Slovenian services. Our tourist office provides local information in traditional ways through printed materials, brochures, web sites and social media, and face-to-face communication with tourists when they visit our office. According to the world-wide trend, the tourists increasingly obtain more information about sights and attractions on the Internet or through mobile applications. They do that either in advance, when planning their trip, or on the spot, when they find themselves in an unknown place with some time to spend and do not know what to do. In both cases they do not have the access to the human tourist information officer or the printed brochures - all available at the tourist information office. By relying on third party applications such as Google Search[2], Google Maps[3] and TripAdvisor[4], they find only the most popular places and spend a big part of their time searching and deciding on where to go. Consequently, tourists may miss locations they might be interested in and have less time for sight-seeing.

The lack of information and non-personalized trip planning is two-fold: first, tourists may visit the places that receive most publicity but skip the ones that they might really be interested in, and second, some interesting smaller tourist locations may get less visits, because they cannot afford the publicity of bigger attraction managers.

ICT tools that we help to develop will provide personalized recommendations to the tourist and allow him or her to communication with a human tourist information officer through the familiar chat-like interface.

The ICT tools will consist of Virtual assistant, Chat platform, and Tour planner.

1. **Virtual assistant** will provide automatic answering in natural language and will be an important addition to classic means of providing information, which nowadays exist in the Tourist Information Centers. Virtual assistant is available 24/7 and has the access to a vast knowledge of tourist attractions available on the Internet.
2. **Tour planner** will enable better planning of cross-border visits for the tourists - they will be able to discover less popular sites that would otherwise be missed, stay longer, and better satisfy their needs.
3. **Chat platform** will allow the tourists to communicate with the tourist information officer or the virtual assistant in the same familiar chat interface. This will provide a single access point to the information on sights in the Slovenian-Austrian cross-border area.

Within the scope of the project we will assist in building a modern interface to approach the tourists and the services for continuous availability of information. This is of great importance to us and every other tourist office. By participating in the project and the advantage to be the first to add new content to the project platform and use it we expect to increase the visibility of our tourist offer and thus increase the number of tourists who decide to visit our tourist destination.

2.2.2 Tourism Network

The most important goal of the project for us is to create a joint cross border Tourist Information Center - an ICT supported network of service providers and tourist offices, to enhance continuous cooperation that is practically non-existing at the present time. In our opinion the cross-border tourist exchange, collaboration and transfer of expertise between providers is very important and can increase the visibility of the tourist attractions to a wider range of tourists. Of particular interest are the possibilities to cooperate with tourist offices from the neighboring Austria, since the diverse tourist offer from both countries nicely complement each other.

3. SLOVENJ GRADEC TOURIST OFFER

The wider area of Slovenj Gradec has a lot to offer. Slovenj Gradec is the cultural and economic centre of the Mislinja valley. With its number of inhabitants, it is a small town, but when you take its creative tradition and institutions into account, its importance extends over many borders. Numerous exhibitions in the art gallery and events (some of them under the aegis of the UN) have brought the town closer to its foreign neighbours - that is why in 1989 Slovenj Gradec got the distinguished title of the Peace Messenger City.

3.1 Town History

The historical image of Slovenj Gradec and its surrounding area stretches back to pre-historic times. This may be traced in the remains of Illyrian and Celtic settlement called Colatio. The medieval town was (like other oldest Slovene towns) founded in the 13th century. It has survived centuries of turmoil but the town folk (most often artisans and merchants), together with foreign and native masters and artists, have managed to care for the image of the town. The old town center has remained the focus of cultural and social life right up to the present day.

3.2 Cultural Heritage

Slovenj Gradec has always been and still remains rooted within its historical and cultural tradition. The most important artistic monuments in the town are to be found in the Gothic church of the Holy Spirit and in the church of St. Elizabeth; it is also interesting to examine the old town center which has been preserved in its original design. In the nearby surroundings, there are quite a few cultural and

[2]https://www.google.si
[3]https://maps.google.com
[4]https://www.tripadvisor.com

historical monuments, whose particular characteristics resonate in a wider cultural context. The most important are the church of St. George at Legen, the ruins of Vodriž castle, and the church of St. Pancras above the Stari trg (the Old Square). There are also some sites of ethnological interest that have been preserved. Among them we find many traditional Slovene hayracks (Slovene: "kozolci"), old peasant houses, chapels, and old watermills and sawmills.

3.3 Natural Heritage

Many diverse environments to be found around Uršlja gora and Pohorje offer the visitors peace and its simple charms, which are the reasons on why they are worth discovering. The town and surrounding area offer many different opportunities for recreation: skiing on Kope, horse riding, biking, gliding, and mountaineering, which make one appreciate the nearby natural sights.

4. ICT TECHNOLOGIES

Slovenj Gradec with its surrounding area offers a wide range of smaller, attractive products. The promotion of the tourist offer is mainly based on the printed materials, brochures, web sites[5] and social media[6]. However, due to the small size of Slovenj Gradec and low budget, some attractions might remain undiscovered.

In the last years we have tried to involve some modern tools of promotion, such as virtual tour [7] on Google maps and mobile applications.

4.1 Virtual Tour

Virtual tour (Figure 1) includes the integration of 360deg spherical images of points-of-interest in the Slovenj Gradec area and a map with the locations of the chosen points. The application enables the user to interact with the spherical images, zoom-in/out, share the view or like it using the social media "Like" button. We provide 14 spherical images of churches, squares and tourist infrastructure.

4.2 Problems with ICT Tools

Due to the lack of professional support and resources the novel ICT products have been more or less a short terms solutions that didn't bring us many positive results, although the ICT tools are of great importance for successful promotion (as evident in [1]).

We see the same obstacles to innovative ICT supported solutions in other Tourist information centers and municipalities as well. Municipality is able to reserve some resources for an innovative ICT tool (web or mobile application or advanced interactive content), however, due to the lack of sustainable resources the tool is only developed to the prototype stage where it remains unchanged for years. Lacking the marketing power even great ideas go unnoticed by the general public for which the solution was intended. This goes hand in hand with the problem of discoverability - each organization hosts its web applications on its own web site that is usually not optimized for search engines.

[5]http://www.spotur.si/
[6]https://www.facebook.com/spotursg/
[7]http://www.turizem-slovenjgradec.si/slovenj-gradec/virtualna-panorama

Slovenia lacks a common ICT platform (such as the one described in [2]) with tools and services that can be used by any tourist information provider or a provider of a tourist service. Some tourist-oriented points-of-interest such as sights, services, accommodation and activities are highlighted with a short description and a photo or a video on the main Slovenian tourist information site[8] managed by the Slovenian Tourist Board. According to the website: "The Slovenian Tourist Board (STB) is a national tourist organisation responsible for planning and carrying out marketing policies in regard to Slovenia's comprehensive tourist offerings. Furthermore, this organisation is also entrusted with the task of developing Slovenian tourism."[9]. While STB does a great job at promoting the Slovenian tourism destinations at fairs and social media and provides a great entry point for a tourist that is yet to decide whether to visit Slovenia, it lacks a platform that would be useful for providers of services (high quality sights entries, access to reservation system, tools for innovative sights presentations, high availability access to potential customers over the Internet, a platform for establishing B2B contacts etc.) and the consumers (tour planners, live chat support, dynamic information providers etc.).

Each municipality deals with the same problem - there is no sustainable solution that would help in creating innovative ICT tools that would be of use for all municipalities at affordable cost. A tourism platform would have to be a cloud native ecosystem with:

1. Open application programming interfaces (APIs) that would enable the solution providers to develop useful services for tourist service provider and tourists.

2. Ready-to-use modules (provided as a service) with a pay-per-use subscription models that would enable tourist service providers a one-stop shop to useful services.

3. Tourist applications gallery that gives the access to the applications relevant for tourists, which integrate into the platform and use the platform databases and services.

5. CONCLUSION

We have presented the tourism oriented goals of the SPOTUR public institution, our role in the AS-IT-IC project and our views of the ICT tools and services for tourism. We have also discussed the problems of smaller tourist points-of-interest in promoting the attractions, obtaining the visitors and managing the destinations. To this end we proposed a larger-scale platform with built in services available to tourists and tourist service providers. We are convinced that the AS-IT-IC project is a step in the right direction of enabling such a platform.

With the participation in the AS-IT-IC project and with the help of well-known institutions we expect to lay the groundwork for good practice of a modern Tourist Information Center also for other Information centers in Slovenia

[8]https://www.slovenia.info/
[9]https://www.slovenia.info/en/business/about-slovenian-tourist-board

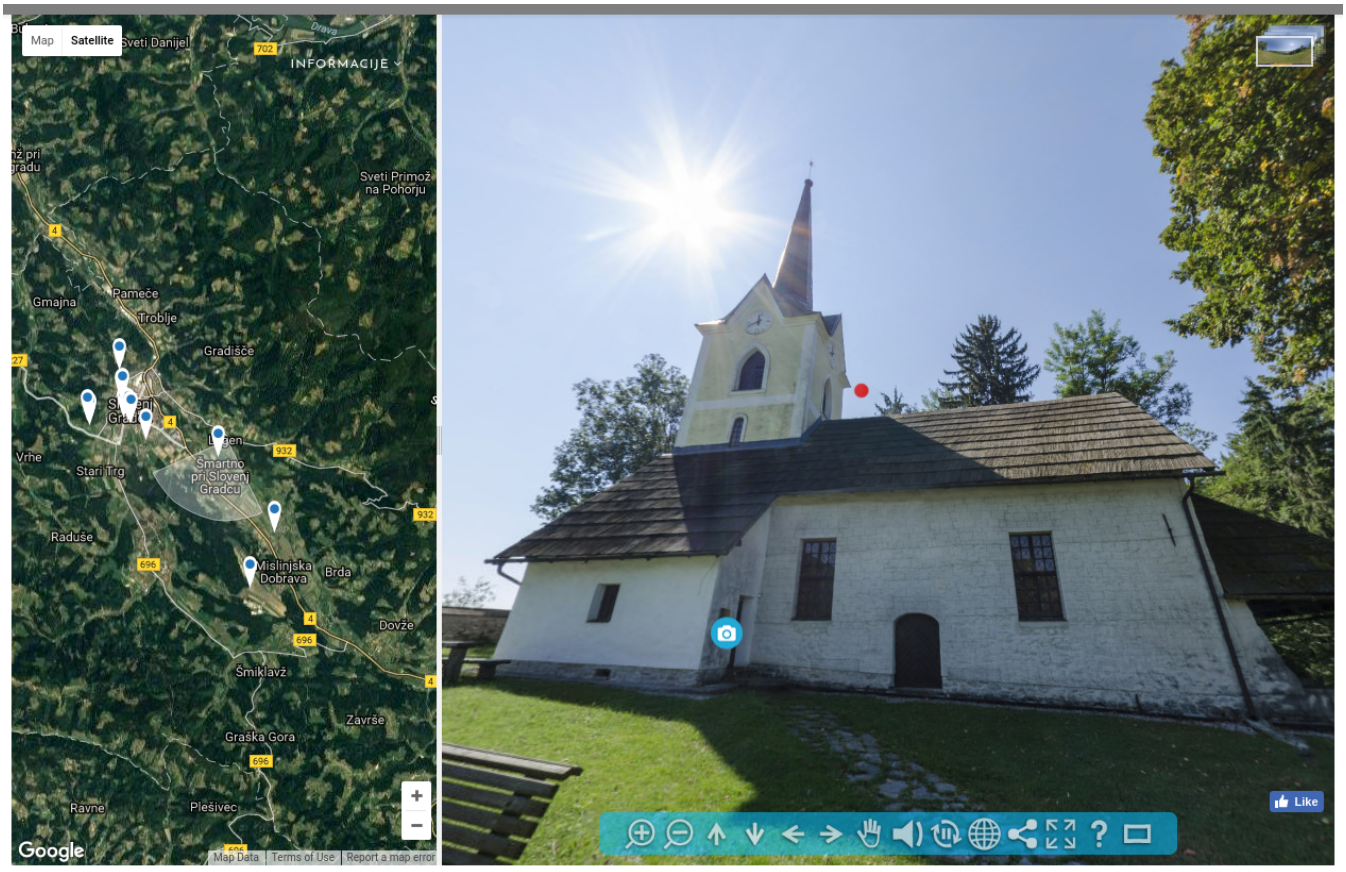

Figure 1: Web-application with 3D views of points-of-interest in the Slovenj Gradec area

and Austria, with whom we expect to build a fruitful and long term cooperation.

6. ACKNOWLEDGMENTS

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[2] U. Gretzel, M. Sigala, Z. Xiang, and C. Koo. Smart tourism: foundations and developments. *Electronic Markets*, 25(3):179–188, 2015.

Nadgradnja Sistema e-Turist in Integracija s platformo AS-IT-IC

Blaž Mahnič
Institut Jožef Stefan
Jamova cesta 39
Ljubljana, Slovenija
blaz.mahnic@ijs.si

Vesna Koricki
Institut Jožef Stefan
Jamova cesta 39
Ljubljana, Slovenija
vesna.koricki@ijs.si

Lana Zemljak
Institut Jožef Stefan
Jamova cesta 39
Ljubljana, Slovenija
lana.zemljak@ijs.si

POVZETEK

Slovenski turizem in turizem v sosednjih državah beleži v zadnjih letih rekordne številke. Slovenija se uvršča nad povprečje Evrope. V letu 2016 je bilo v Sloveniji za 9,9% več prihodkov in 8,1% več prenočitev glede na leto 2015. [1] Z večanjem števila turistov, se veča tudi število tistih turistov, kateri se ne udeležujejo organiziranih izletov. Taki turisti si po navadi v kratkem času ogledajo veliko število turističnih znamenitosti. Kljub dostopnim informacijam na spletu pa je planiranje poti in ogledov za povprečnega turista težak zalogaj.

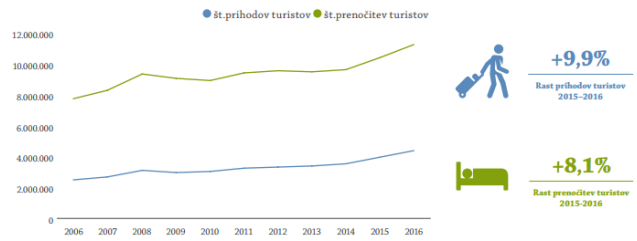
Sistem Turist pripravi za turista program izleta, prilagojen njegovim željam. Turistu so ponujene turistične znamenitost iz izbranega območja, izriše pa se tudi pot ogleda turističnih znamenitosti na zemljevidu. Ponujeni so mu tudi pisni in govorni opisi, fotografije in ocene drugih uporabnikov, kateri so že obiskali te turistične znamenitosti.

Sistem smo nadgradili z dodatnimi tri tisoč turističnimi znamenitostmi na Slovenskem. Znamenitosti so bile avtomatsko dodane v bazo podatkov s pomočjo modula za avtomatsko dodajanje novih znamenitosti katerega bomo opisali v nadaljevanju.

Cilj dodajanja novih turističnih znamenitosti je povezava obstoječega informacijskega sistema Turist z novim naprednejšim informacijskim sistemom imenovanim AS-IT-IC.

1. UVOD

Turizem je ena izmed najpomembnejših in hitro rastočih panog slovenskega gospodarstva. Slovensko turistično gospodarstvo prispeva 13% BDP, neposredno ali posredno zaposluje 12% aktivne delovne populacije in predstavlja 40% izvoza storitev.
Slovenija je mednarodno prepoznana kot »zelena, aktivna in »zdrava« turistična destinacija.
Slovenski turizem in turizem v sosednjih državah beleži v zadnjih letih rekordne številke. Slovenija se uvršča nad povprečje Evrope. V letu 2016 je bilo v Sloveniji za 9,9% več prihodkov in 8,1% več prenočitev glede na leto 2015. [1]



Slika 1: Povečevanje obiska turistov v Sloveniji za leto 2016[1]

Z večanje števila turistov, se povečuje tudi število posameznikov in manjših skupin, kateri se ne udeležujejo organiziranih izletov pod vodstvom strokovno usposobljenih turističnih vodičev in katere zanimajo tudi manj znane turistične znamenitosti. Ti turisti si po navadi sestavijo program ogleda sami, kar pa običajno ni lahka naloga, saj so na spletu podatki razdrobljeni in ne povezani med sabo.

Sistem Turist sestavlja spletna aplikacija v katero uporabnik vnese svoja zanimanja glede na lokacijo znamenitosti katere si želi ogledati, namen potovanja, čas za potovanje, ki ga ima na voljo, prevozno sredstvo s katerim potuje in čas katerega bo namenil za obrok, če tako želi. Na podlagi zbranih podatkov, program s pomočjo priporočilnega sistema organizira izlet prilagojen turistovim željam. V ta namen, sistem uporablja priporočilni sistem in metode za iskanje najkrajše poti z najzanimivejšimi znamenitostmi. Vsako znamenitost je mogoče tudi oceniti, kar priporočilni sistem upošteva pri načrtovanju poti v prihodnje. Del sistema Turist so tudi administrativne strani, ki turističnim delavcem omogočajo vnos novih turističnih znamenitosti in pregled ocen obiskovalcev ter obiska Slika 5.

Obstoječi sistem smo nadgradili z dodatnimi tri tisoč turističnimi znamenitostmi na Slovenskem. Znamenitosti so bile avtomatsko dodane v bazo podatkov s pomočjo modula za dodajanje novih znamenitosti katerega bomo opisali v nadaljevanju.

Cilj dodajanja novih turističnih znamenitosti je povezava obstoječega informacijskega sistema Turist z novim naprednejšim informacijskim sistemom imenovanim AS-IT-IC. Naloga informacijskega sistema AS-IT-IC je pomoč turistom pri načrtovanju njihovih čezmejnih obiskov, spodbujanje k odkrivanju manj znanih zanimivosti in omogočanje kvalitetnejših izpolnjevanj želja. V nadaljevanju bomo opisali arhitekturo Sistema Turist, vnos novih turističnih znamenitosti, povezavo med sistemom Turist in priporočilnim sistemom za načrtovanje poti glede na želje uporabnikov, kateri je del sistema AS-IT-IC.

2. PRIPOROČILNI SISTEM IN UPORABNIŠKI VMESNIK SISTEMA TURIST

2.1 Priporočilni sistem

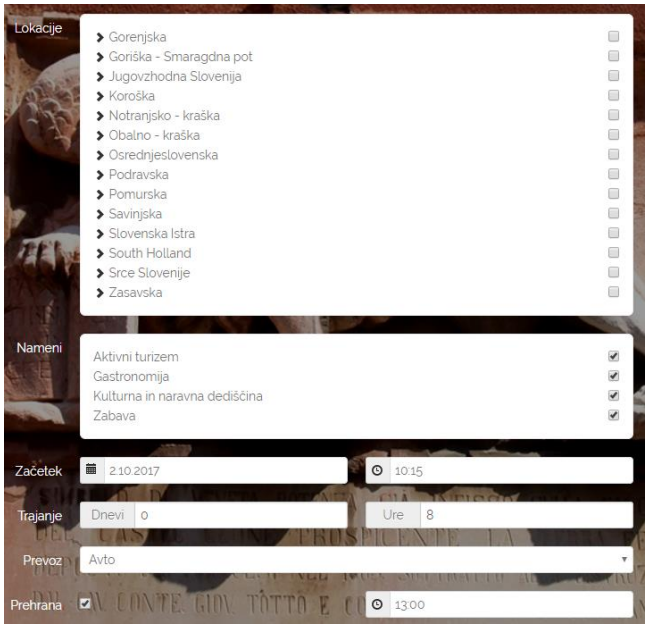
Sistem deluje kot spletna storitev, uporabniki lahko dostopajo do sistema preko spletnih brskalnikov. Priporočilni sistem v dveh korakih sestavi program ogleda. V prvem delu za vsako znamenitost izračuna primernost za danega turista. V ta namen uporablja kombinacijo priporočanja na podlagi znanja in skupinskega filtriranja (collaborative filtering). Priporočanje na

podlagi znanja primernost znamenitosti izračuna iz strokovnega mnenja o njeni pomembnosti in tega, katere znamenitosti so primerne za katere turiste na podlagi starosti, izobrazbe, narodnosti in finančnih sredstev turistov, ki jih ti lahko vnesejo v svoj profil. Če je profil na voljo, je prednost tega načina priporočanja, da deluje takoj – ne potrebuje nobenih predhodnih ocen znamenitosti ali turista. Skupinsko filtriranje pa primernost izračuna iz ocen, ki so jih znamenitosti dali drugi turisti, ki so v preteklosti izkazali podoben okus kot turist, za katerega se primernost računa.

V drugem koraku se znamenitosti na podlagi primernosti, ki jih izračuna priporočilni sistem, in njihovih zemljepisnih položajev uvrstijo na program ogleda. [2]

2.2 Uporabniški vmesnik

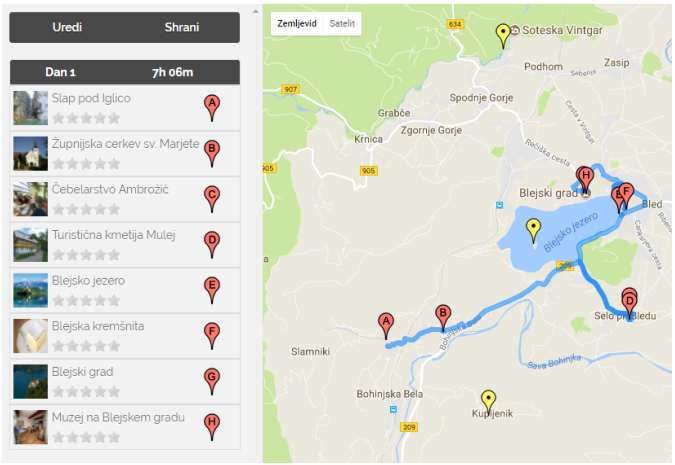
Načrtovanje ogleda (slika 2) se prične z izbiro regije katero si želimo ogledati. Če v regiji lahko obstaja več občin, te se nam prikažejo ob kliku na regijo. Uporabnik lahko na to izbere določene občine ali pa pusti izbrano celotno regijo. Trenutno pokriva sistem 13 regij v Sloveniji, preko administrativnega vmesnika pa je mogoče regije poljubno urejati ali dodajati. Potem, ko si uporabnik izbere regijo oz. kraj, si lahko po želji nastavi tudi čas kosila, pričetek izleta, čas katerega ima na voljo, število dni trajanja izleta in prevoz s katerim bo odšel na izlet. Ta je lahko peš ali pa z avtomobilom.



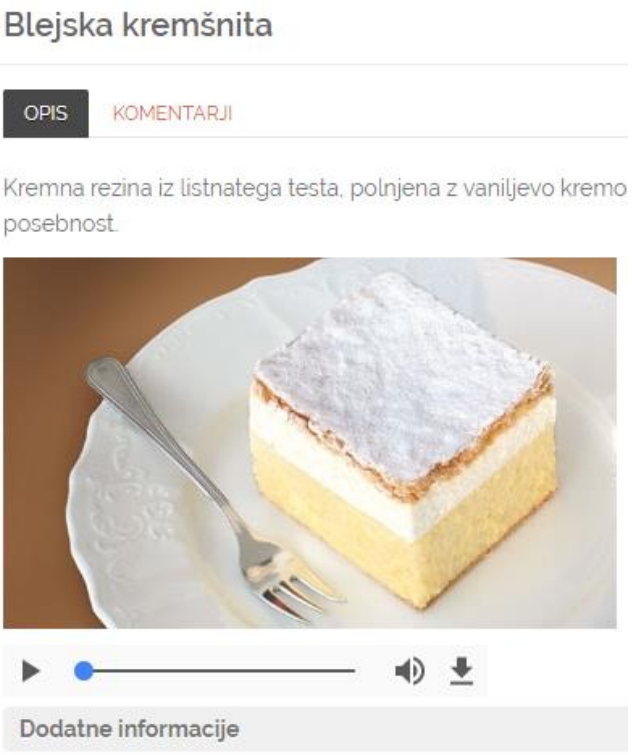
Slika2: Načrtovanje ogleda

Program ogleda (slika 3) je sestavljen iz znamenitosti in podznamenitosti. Ob kliku na znamenitost se nam na zemljevidu prikaže naslov znamenitosti in trajanje ogleda. Več o znamenitosti si lahko uporabnik ogleda s klikom na gumb "več" (**slika 4**). Tam je na voljo tudi govorni opis in slika znamenitosti.

Zemljevid ogleda (slika 3) prikazuje pot ogleda, Z različnimi barvami so prikazane znamenitosti na programu, znamenitosti ob poti, turistična infrastruktura (npr. informacijske točke) in ogledane znamenitosti.



Slika 3: Program in zemljevid ogleda



Slika 4: Ogled podrobnosti turistične znamenitosti

2.3 Administrativne spletne strani

Administrativne strani omogočajo uporabniku urejanje lokacij in urejanje turističnih znamenitosti.

Urejanje lokacij določita geografski položaj in okvirna velikost (polmer).

Urejanje znamenitosti med urejanjem znamenitosti se vnesejo opis s slikami in bogati metapodatki. Med metapodatke spadajo: naziv, naslov, vrsta, strokovna ocena, geografski položaj, odpiralni čas, čas ogleda, dostopnost za osebe z gibalnimi omejitvami, raznovrstna dodatna ponudba, podatki o starših in otrocih, ki sestavljajo hierarhijo podznamenitosti, ter podatek o

tem, ali znamenitost v resnici ni znamenitost, temveč del turistične infrastructure in podatek za kakšne profile turistov je znamenitost primerna.

3. POVEZAVA SISTEMOV TURIST IN AS-IT-IC

AS-IT-IC sistem je še v fazi razvoja, naloga sistema bo pomoč turistom pri načrtovanju njihovih čezmejnih obiskov, spodbujanje k odkrivanju manj znanih zanimivosti in omogočanje kvalitetnejšega izpolnjevanja želja kot obstoječi sistemi. Lokalne skupnosti bodo obiskovalcem učinkoviteje ponujale lokalne storitve in informacije, npr. organizator lahko vključi obisk obrtnika/umetnika glede na želje in tako poveča prodajo.

Glavna prednost sistema bo pogovor turista in sistema v naravnem jeziku npr. “Vse reke na dolenjskem”.

Cilj povezave sistemov je, enostavno načrtovanje krajše in večdnevne poti, ki vključujejo obisk naravne in kulturne dediščine, z možnostjo primerne nastanitve. Pri načrtovanju večdnevne poti, zlasti pri čezmejnem območju, je običajno potrebno veliko truda za zbiranje informacij od začetne točke, nastanitve, do najboljših poti - informacije o ciljnih lokacijah so razpršene, opisi za mesta so na voljo v različnih jezikih, itd. Računalniški programi so dobri pri vključevanju in analiziranju velikih količin podatkov, filtriranju informacij ter računanju optimalnih rešitev. Zato je potrebno orodje, ki omogoča uporabniku, da hitro ustvari pot v skladu z željami in parametri.

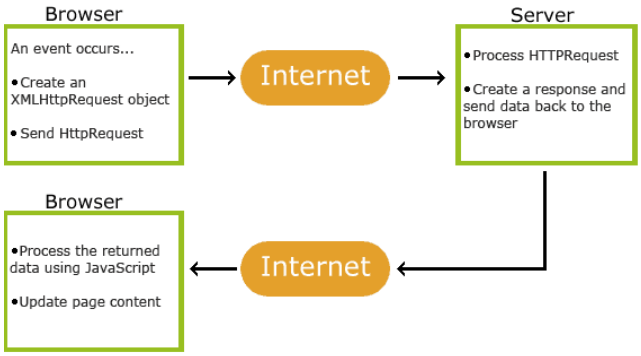
3.1 Potrebne nadgradnje Sistema Turist

Za povezave sistemov bo potrebno razviti različne API (“Application Programming Interface”) vmesnike za namensko programiranje. [4] API je namenjem naprednejšim uporabnikom ter razvijalcem in omogoča dostop do storitev sistema preko HTTP zahtevkov. Storitve bodo vračale tekstovne odgovore v formatu, kot je npr. JSON.

Do sedaj smo že razvili API za dodajanje novih znamenitosti v podatkovno bazo, kateri je opisan v nadeljevanju. Potrebno pa bo še razviti API za priporočanje znamenitosti, in gradnjo načrta poti.

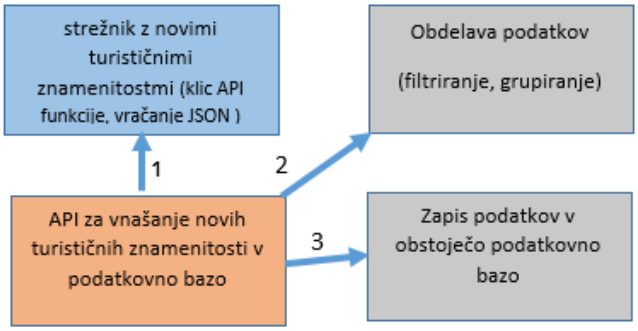
3.2 API za vnos novih turističnih znamenitosti

V obdelavo smo dobili veliko količino podatkov o turističnih znamenitosth v Sloveniji, katere smo predhodno na strežnik zapisali v podatkovni obliki JSON. V ta namen smo razvili API preko katerega so nam bili podatki na voljo, ta nam je ob klicanju vračal objekt tipa JSON. JavaScript Object Notation ali JSON, [3] je odprtokodni format datoteke, ki uporablja človeško berljivo besedilo za prenos podatkovnih objektov, sestavljenih iz parov atributnih vrednosti in podatkovnih tipov matrike (ali katerekoli druge serijsko spremenljive vrednosti). To je zelo pogosta oblika podatkov, ki se uporablja za asinhronsko komunikacijo brskalnika / strežnika.



Slika 6: Delovanje JSON formata datoteke

Turistične znamenitosti so bile zapisane kot objekti, kateri so vsebovali trinajst atributov: ime atrakcije, povezava na spletno stran, naslov atrakcije, telefonska številka, spletna stran, oznake, tip atrakcije, opis, fotografija, ime regije, ime občine, gpsX in gpsY.
Znamenitosti je bilo sprva potrebno prebrati, jih filtrirati in grupirati po regijah. V drugem koraku smo podatke shranili v podatkovno strukturo in naprej v obstoječo podatkovno bazo sistema Turist **(slika 7)**.



Slika 7: Potek vnosa novih znamenitosti v obstoječo podatkovno bazo

API funkcija za branje novih turističnih znamenitosti iz strežnika pošlje podatke o turistični znamenitosti v JSON obliki v obdelavo modulu za vnos novih znamenitosti.
Funkcija za filtriranje vstopnih podatkov omogoča kasnejšo lažjo obdelavo. Ker vsi atributni niso potrebni za vnos v obstoječo podatkovno bazo Sistema Turist, je najprej potrebno pobrisati nerelevantne attribute. Po tem sledi filtriranje znamenitosti, katere ne vsebujejo atributa občina. Na podlagi atributa naslov, je na to potrebno istancam določiti občino kateri pripadajo, tako da lahko kasneje instance grupiramo po regijah.
Funkcija za grupiranje po regijah nam omogoča natančen zapis v obstoječo podatkovno bazo, tako da lahko dodamo nove znamenitosti v že obstoječe regije, pravtako pa regije katere še niso zapisane v podatkovni bazi vpišemo na novo. Začetnim trem regijam Slovenska Istra, South Holland in Srce Slovenije smo dodali še enajst novih: Gorenjska, Goriška - Smaragdna pot, Jugovzhodna Slovenija, Koroška, Notranjsko – kraška, Obalno – kraška, Osrednjeslovenska, Podravska, Pomurska, Savinjska, in Zasavska.
Funkcija za zapis novih znamenitosti, se sprehodi po vseh prebranih turističnih znamentostih, katere smo predhodno obdelali (filtriranje, grupiranje, vpis novih regij) in jih sproti zapisuje v

obstoječo podatkovno bazo. Med obdelavo so instance shranjene v pomnilniku računalnika. Po končanem zapisovanju lahko s pomočjo administrativnih spletnih strain opisanih v razdelku 2.3 preverimo pravilnost in smiselnost podatkov, da med samim zapisovanjem ni prišlo do kakšnih napak.
S pomočjo API-ja za vnos novih turističnih znamenitosti smo tako število turističnih znamenitosti iz 300 povečali na skoraj 3000.

4. ZAKLJUČEK

V članku smo predstavili obstoječi sistem za načrtovanje izletov Turist in povezavo sistema z novim sistemom za pomoč turistom pri načrtovanju njihovih čezmejnih obiskov AS-IT-IC. Podrobneje je predstavljeno delovanje Sistema Turist, v nadeljevanju pa potrebne nadgradnje. Opisan je tudi API za vnos novih turističnih znamenitosti v obstoječo podatkovno bazo.

Zaradi velikega števila novih neobdelanih turističnih znamenitosti in morebitne kasnejše uporabe tudi v drugih sistemih je bilo nujno potrebno razviti API vmesnik za vnos novih turističnih znamenitosti.

Vmesnik nam omogoča vnos novih turističnih znamenitosti preko HTTP zahtevkov. Programerju tako ni potrebno podrobno poznati delovanja API-ja. Tako lahko API uporabimo v bodoče tudi za morebitne druge naloge.

V prihodnje je potrebno zaradi povezave sistemov razviti še API kateri bo nudil funkcije za priporočanje znamenitosti, in gradnjo načrta poti. API bo preko HTTP zahtevkov klican iz strain sistema AS-IT-IC.

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Open Questions of Technology Usage in the Field of Tourism*

Bernhard Peischl
Institute for Software Technology
Graz University of Technology
b.peischl@ist.tugraz.at

Oliver A. Tazl
Institute for Software Technology
Graz University of Technology
oliver.tazl@ist.tugraz.at

Franz Wotawa
Institute for Software Technology
Graz University of Technology
wotawa@ist.tugraz.at

ABSTRACT

The focus of this paper is to identify and discuss requirements necessary for a tourism recommender that is capable to interact with customers naturally in order to identify their wishes and needs in order to plan for the best journey. For this purpose, we introduce a case study comprising a typical conversation between a customer planning a trip and the system. We further on use this case study when discussing available solutions in order to identify shortcomings. We summarize the findings and come up with open research questions to be tackled in order to provide methods and techniques needed when developing a recommendation system for tourists.

Keywords

intelligent recommendation systems; trip planning; requirements for tourist applications

1. INTRODUCTION

In the last years a lot of booking portals and other tourism applications have been arising, which people use regularly. Most of these applications provide specialized services and functionality but do hardly really cover interactions occurring for example in a travel agency when customers plan for their vacation. Hence, more sophisticated tourism applications are required that allow interactions with customers to identify needs and wishes for recommending traveling plans considering requirements like the available budget, the customer's interests, routes, and available dates. Such tourism systems need to provide and integrate chat functionality, booking systems, travel planning, and recommendation technology to identify the best match between the customer's requirements and available offers.

In order to come up with a general tourism application, we need to identify potential use case scenarios from which we identify the most general system requirements. In addition, we need to know potential competing systems and their shortcomings in fulfilling the obtained requirements. From the requirements, we also are able to extract new challenges that serve as foundation for research in order to come up with methods and techniques that allow to develop the indented general tourism application. One example of such an open issue necessary to be closed, corresponds to the question of how to deal with inconsistencies that naturally arise during a conversation when searching for the best customer solution. There might be wishes like always staying overnight in a five star hotel, which might be in contradiction with the available budget or the chosen route in cases of unavailability of requested hotels. Therefore, systems have to adapt constantly during a conversation which requires solving inconsistencies and also obtaining knowledge to further enhance future recommendation interactions with the same customer.

In this paper, we start describing a general use case for a tourism recommendation system that interacts with customers in the context of the AS-IT-IC project[1]. This use case is further on used for identify shortcomings in available tourism systems considering planing a whole journey. In particular, we discuss TripAdvisor[2] and Google Trips[3] in detail. Afterwards, we summarize the findings and identify research questions to be tackled in order to really come up with a general tourism recommendation system that is able to naturally interact with users in order to find the best traveling solution based on availability of resources and the customer's needs and wishes.

2. USE CASE

In the following use case, we discuss a typical scenario occurring during a recommendation session with a tourism application we have in mind. In this use case, we mainly focus on the interaction between an intelligent tourism recommender and ignore other means like human interventions into the process. The purpose of this use case is to identify requirements and needs for a tourism recommendation system to be developed.

*Authors are listed in alphabetical order.

[1]See `https://as-it-ic.ijs.si/`
[2]See `https://www.tripadvisor.com`
[3]See `https://get.google.com/trips/`

Use case 'Trip to Europe'. John is an American businessman who is interested in modern architecture and art, natural heritage, and ethnic culinary. For his next trip, he and his family would like to visit the central European region, specifically Graz. He wants a truly customized package of experiences, not a standard tourist package which he would be offered to him in a local tourist office. He can also use the internet search to obtain the information on his own. But John neither wants to a standard package nor search on his own. So he decided to use again an application which provides recommendations, based on his interests and previous visits, human-like, but fully automated, communication via a chat interface and an easy to use interface via his mobile devices.

Therefore he visits the application and chooses to log-in since he can use one of his many identification providers such as Google or Facebook. After log-in, he checks his previously specified preferences and the basic information about himself, like his age, gender, and his interests. Next, he clicks on a button to launch a new tourist session. Immediately, he is greeted by a virtual assistant, which asks him which places John would like to visit. The assistant takes into account the provided answer and John's interests and recommends him some natural and the cultural sights in the Slovenian-Austrian cross-border area.

The virtual assistant first asks John about the basic trip dates, like start date, duration, the number of travelers, travel radius and cause of the stay. After answering these questions, the assistant offers him several interesting sights in Graz like the Kunsthaus, the Eggenberg palace, and the Schlossberg. All these recommendations are based on his profile, which he defined, and his past trips. By accepting several sights, the system tries to find other fitting sights as well. Although John's travel radius is too small for some interesting sights in Ljubljana, the assistant offers him some of these because of his strong preferences to this sort of sight. The assistant included an offer of a car-rent as well for the travel from Graz to Ljubljana. John accepts this offering because he really likes the pictures and information, that the assistant provides to him. After selecting the sights, he wants to visit, the assistant starts to show him some possibilities to eat lunch and dinner during his visit. In his past travels, John prefers quite expensive restaurants, because on business trips he does not really care. The assistant shows him that kind of restaurants in Graz and Ljubljana, but he denies them because of the estimated costs. The system adapts to the new situation and shows him lower priced restaurants. John browses through the provided information of the restaurants and selects his preferred places. The last step is the selection of the hotel. The system knows that the hotel has to be family friendly and needs to be located next to the sights he wants to visit, because of the answers before. The system lowers also the price range of the hotels.

The assistant now finishes the session with calculating the optimal path for his travel and offers him the possibility to book all necessary hotels, attractions, transportation and sights in a convenient way. The travel information is now provided within the application and could be easily accessed from every device John uses.

3. REQUIREMENTS

The use case shows many features and requirements to an application which is important for a user experience we propose.

3.1 Natural Language Interface & Chat bot

A natural language interface is a great way to interact with a user in a more natural and interactive way. Therefore it is necessary to ensure that the system can process many kinds of information via a natural language interface. Talking to a virtual assistant enhances the user experience and allows new ways of helping the customer to achieve his goals. The technological challenges lie in the problem that a conversation could involve many topics and domains which is not easy to cover (see also [1], [2], [3]). This level of complexitiy drops to some extent by narrowing the domain to the touristic sphere. Nevertheless stays the complexitiy on a very high level.

3.2 Recommendation

The task to recommend hotels, sights, etc. to customers is a very important task, because the time they want to invest in their trip planning seems decreases. There are also several stakeholders in this process of recommendation. Hotels want to sell their product, attractions want visitors, customers want a perfect vacation experience. Here it is necessary to find a balance between each of these interests.

The recommending strategies of the available platforms and applications did not consider the user's interests in the first place. There is no profile and not enough information available to ensure qualitative recommendations. The user could choose from several packages or has to plan the days on his own. There is no really customized and intuitive way to plan such trips. The process of trip planning has to become more humanized.

The approach, shown in the use case, by using the profile and past trips to recommend the customer also shows that this could lead to problems when the parameters for the trip are different to everything before. There the system has to adapt itself to the new situation and should be able to learn from this new kind of information. Maybe the change in behaviour is triggered by the weather, the fellow travelers, the purpose of the travel or other external factors. The system should detect this kind of changes, adapt for the specific session and ask the customer where the change of behaviour come from.

3.3 Trip & route optimization

The trip and route optimization is the next and last step in a trip planing procedure. The distribution of places should be evenly throughout the stay addressing the duration every sights need to consume. The route should be short, but scenic. The tourist needs enough time to visit the sight and should not feel like in a hurry.

4. AVAILABLE APPLICATIONS AND PLATFORMS

In the following section we discuss the main and established contendors in trip planning as well as new and arising platforms.

4.1 TripAdvisor

TripAdvisor is a platform, owned by the identically named American company, which provides information and recommendations of sights and hotels, as well as hotel booking features and more. It offers customers to share their experiences and opinions with a large user audience. Originally founded as an aggregator of professional reviews, found in newspapers, guidebooks, and magazines, it evolved into a user-generated content platform.

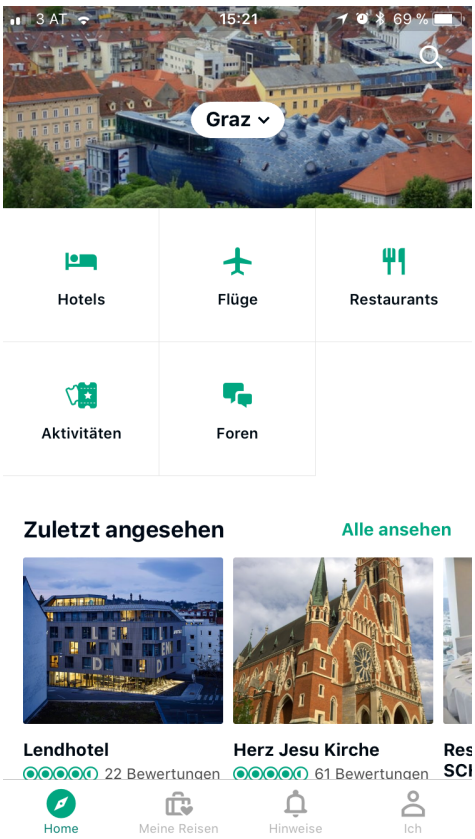

Figure 1: A trip view in TripAdvisor

The platform aggregates now all kind of information, like pictures, texts, ratings or tagging. It includes recommendation features to provide advices for traveling to a specific city.

It provides a feature to plan specific trips and book hotels and visits from the platform. After selecting a name for the trip, the destination and the date of the trip, the platform enables the user to select several sights and attractions. These places could be planned on days. A map of and routes between them is also provided.

The integrations to book hotels or reserve tables in restaurants exist but do not submit every needed information to the other portal which implies more hassle for the booking tourist.

4.2 Google Trips

Trips is a service by Google which provides similar features than TripAdvisor. It allows marking sights which should be visited during the trip. It also provides several predefined sights packages, which could be visited in a day or more. The ways between are already calculated and time approximated. Another way is to define your own custom day sightseeing. There you could select some sights and pin them to your route. After that, the application could add sights on the way to complete a full day. After saving the package it is available in the trip view.

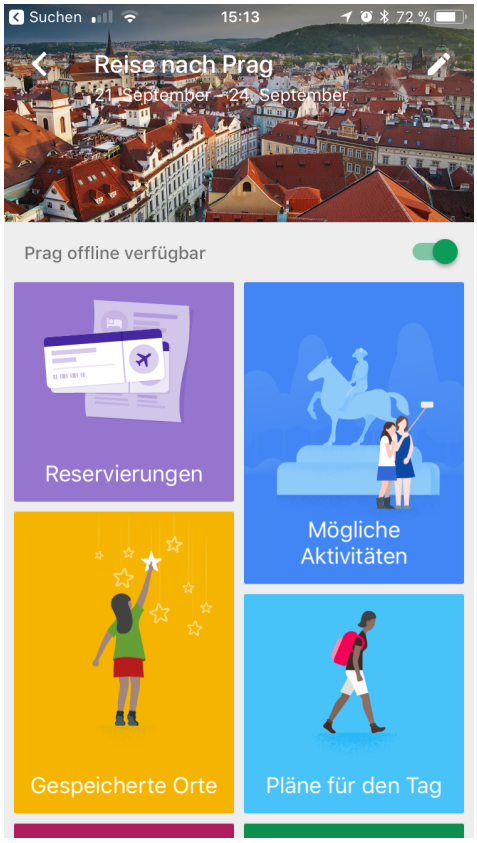

Figure 2: A trip view in Google Trips

It works tightly together with the product Google Maps (see [4]) . The ratings, top comments, and some pictures are shown in the Trips app, along with phone number and website. There is no possibility to comment or rate there. If you want to comment or rate the sight, it is necessary to switch to the Maps App to do so.

The app works well with Gmail. Tickets and Reservations are extracted from Mails and put into a section of the trip view. There they could be easily accessed in one place during the actual trip. This integration improves the user experience, but shows the high level of data analysis and interconnection within the Google services.[4]

[4]See `http://inbox.google.com`

4.3 AS-IT-IC

The project AS-IT-IC will provide an application, which allows user to interact with human and virtual assistants to plan trips to Austria and Slovenia. The usage of chat bots enhances the possibilities of tourist centric applications in a great way. It allows a 24/7 coverage of user requests. The capabilities of chat bots are a bit restricted today but the field is subject to a rapid development. The recommendations will come from members of tourist offices and other involved people as well as virtual assistants. Aside from recommendations, the platform will support booking hotels and restaurants in a convenient and easy way.

The knowledge base of the platform stores hotels, sights and other points of interest. Aside of the typical information about a place, it stores also information about the estimated duration to visit it.

The trip is planned during a normal chat conversation. This planning could be done with a member of a tourist office or with the virtual assistant as conversation partner. After determining some basic information the platform shows several recommendations and possibilities to visit. After selecting the desired sights, hotels and eating spots the platform automatically calculates a convenient way through the points of interest.

	Trip Advisor	**Google Trips**	**AS-IT-IC**
Recommendations	+	+	+
Reviews	+	+	+
Rating	+	+	+
Manual planning	+	+	+
Auto planning	-	+	+
Preplanned packages	-	+	+
NLP & chat bots	-	-	+
Chat interface	-	-	+

Table 1: Comparison of the platforms

5. DISCUSSION AND CONCUSION

The compared platforms show many possibilities and features which are useful for a good user experience. The following table (see Table 1) shows a quick overview of the supported functionalities of every platform.

Ratings, reviews and recommendations in any way are broadly used in this applications. There are differences between the level of integration and automation of these functionalities. Planning features are also differently implemented in the reviewed platforms. Trip Advisor lacks fully automatic planning.

As part of our research effort, natural language processing, chat bots and chat interfaces will be supported by the platform AS-IT-IC. It brings this technology in a new way to the field of tourism. That makes it unique to some extent throughout the reviewed products. However, in order to support the prototyping of such a product, several research challenges need to be addressed within the project. First, the fact that AS-IT-IC deals with local cross-boarder content, there is the risk of inconsistencies among the various data sources. Data is retrieved from local tourism offices, in at least two languages and these data sources are possibly enriched with timely information (local tourism events etc.). Considering the high granularity and large diversity of the collected data and the fact that NLP and chatbots introduce additional inconsistencies in terms of data obtained from interaction with the user, it is of uttermost importance to address these issues. That is, one of the crucial questions is to provide recommendation systems [5] that can handle such inconsistencies such that the user is seamlessly guided when planning his trips.

In this article we motivated the AS-IT-IC project and illustrated a use case in the field of tourism. Afterwards we briefly discussed the requirements wrt. natural language interfaces and chat bots. We listed the central features of two well-known products in this field and focused on the challenges in designing the features for natural language processing, chat bots and the chat interface. One of the major issues is the handling of inconsistent information. These kind of information arises due to the multi-language interface, the granularity of cross-boarder relevant data and the interaction with the user.

Acknowledgement

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Testing of Artificial Intelligence Applications *

A State of the Art Survey

Bernhard Peischl
Institute for Software Technology
Graz University of Technology
bpeischl@ist.tugraz.at

Oliver A. Tazl
Institute for Software Technology
Graz University of Technology
oliver.tazl@ist.tugraz.at

Franz Wotawa
Institute for Software Technology
Graz University of Technology
wotawa@ist.tugraz.at

ABSTRACT

Verification and validation are procedures that are used together for checking that a product, service, or system meets requirements and specifications and that it fulfills its intended purpose. With the advent of artificial intelligence-enabled applications, there is an increased pressure to test such systems. In this article we present a survey on the state of the art in testing artificial intelligence applications. We present the general publication population in this area and discuss the open challenges and issues when it comes to verification and validation of artificial intelligence software.

Keywords

test, software test, verification, validation, adaptive systems, software evolution

1. INTRODUCTION

Verification and validation is one of the most important activities carried out during system development to assure system quality. The purpose of verification is to assure that a system fulfills its specification, whereas validation deals with assuring that the system implements the functionality users are expecting. Hence, verification answers the question whether someone has built the system right, whereas validation deals with the question: "Have I developed the right system?". Testing (see e.g. Myers [6]) is one activity that can be used for both validation but also verification. Quoting Edsger W. Dijkstra "*Testing shows the presence, not the absence of bugs*" it is obvious that the purpose of testing is to find faults in the system but there is no guarantee to find all of them before deployment. Nevertheless, testing is inevitable for quality assurance, which cannot be superseded by formal proofs as said by Donald Knuth: "*Beware of bugs in the above code; I have only proved it correct, not tried it.*".

Unfortunately, testing as a necessary activity within the software engineering process has gained only little attention in Artificial Intelligence (AI). It is often assumed that an implementation of an algorithm works as expected because of available correctness, termination, and completeness proofs. However, often systems fail because of underlying boundaries like memory limitations, or the used data structure, causing a system to crash. Unfortunately, such bugs are hardly considered during formal verification based on mathematical proofs. The necessity to deal with testing is further supported considering a most recent example. In Tom Simonite's Wired article, *Even Artificial Neural Networks Can Have Exploitable 'Backdoors'*[1], the author mentioned the case where a neural network can be trained to behave differently in identifying a traffic sign in cases with or without attaching a post-it note. Such behavior can have severe consequences in real life and thus testing AI systems is required.

In this paper, we focus on the current state of the art in testing AI applications. In particular, we are interested in finding out whether there are already testing approaches used in the context of AI applications and also to discuss future research directions and open challenges. The goal behind is to prepare for testing an application in the area of tourism recommendation systems where we are interested in finding the right testing technique to be applied before deployment in order to capture the most important bugs during development. This paper is organized as follows: First, we discuss the research design behind the survey including the tackled research questions, the analysis procedure and the study results. We further on discuss the obtained results and come up with open research questions. Finally, we conclude the paper.

2. RESEARCH DESIGN

Our objective is to capture the field of testing wrt. applications that exhibit intelligent behavior, i.e., a software that perceives its environment and takes actions to maximize its chance to achieve a specific goal. In this context, the software mimics cognitive functions such as learning or problem solving. By analyzing the exiting pool of publications, we provide a snapshot that further will be used to analyze trends or to identify gaps. Therefore, we identify the research questions first.

*Authors are listed in alphabetical order.

[1]See `https://www.wired.com/story/machine-learning-backdoors/`

Table 1: Criteria for selecting relevant articles.

Criteria
title, keyword list and abstract suggest that the paper is related to testing and artificial intelligence
paper presents test and AI-related topics, e.g., testing methods or tools, evolution of software systems
article is written in English language
paper belongs to the body of literature in the field of computer science or software engineering
full text of the paper is available

`Research questions:`

- RQ 1: What is the general publication population when it comes to testing AI-enabled applications? This research question aims to structure the publication pool on and around testing AI-enabled applications. In particular we are interested in the research type facets in this evolving field of research.
- RQ 2: What types of research contributions are in place regarding software testing of AI-enabled applications? This question deals with the addressed topics and major contributions (e.g., models, theories, frameworks, guidelines, etc.).
- RQ 3: Can we observe trends respectively are there significant open challenges and issues? The last question will investigate the focus point and strive to identify gaps in order to sketch possible future research on testing of AI-enabled applications.

In this study we collected data from two sources. First we carried out a query via Scopus[2] document search. Second we considered articles published in workshop series specifically dealing with realizing artificial intelligence synergies in software engineering [5, 4, 10, 9, 1].

`Query construction:` In a worksop we defined the keywords that we are interested in. Since we are interested in articles that investigate functional testing of of AI software we looked for the keywords 'test' or 'testing' and the keywords 'functional' or 'regression' or 'acceptance' and the keywords 'AI' or 'artificial intelligence' in the title or abstract. We performed an automated search that required us to filter the result. For example, we found a number of publications that are not in software engineering or computer science. We therefore cleaned the initial result by removing these publications and we removed duplicates.
`Selection process:` We classified the obtained papers as relevant or irrelevant to build the final set of publications for further investigation. We applied the criteria listed in Table 1.

2.1 Analysis and classification

On the final set of publications we carried out the analysis and classification. The classification has been carried out in two dimensions. We classified every selected publications according to the research type as proposed by Wieringa et al. [13]. Table 2 illustrates the proposed research types. In order to characterize how a specific research type contributes to the body of knowledge regarding the testing of AI-enabled applications we used contribution type facets as proposed by Shaw [8]. Table 3 lists the criteria for these specific facets.

[2]see www.scopus.com

Table 2: Research type facets for our survey (Wieringa et al. [13]).

research type	description
evaluation research	an implementation has been carried out, evaluation of implementation has been conducted, requires more than just one demonstrating case study
solution proposal	a solution of the problem is proposed, benefits/applicability is demonstrated by example, this includes proposals complemented by a demonstrating case study, however, no dissemination plan is obvious
philosophical paper	paper comes up with a new way of thinking or structuring a specific field, e.g., in the form of a taxonomy of conceptual framework, secondary studies like systematic literature reviews or systematic mapping studies
opinion paper	captures a personal opinion, the work however, is not grounded in related work or research methodology
experience paper	captures personal experiences and describes how things are done in practice

3. STUDY RESULTS

In this section, we present and discuss the results of our study. In particular we address the research questions raised in the previous section.

3.1 RQ1: General publication population

To get an overview of the selected publications, we performed a categorization and defined the research type and the contribution type. Table 4 provides an integrated picture

Table 3: Contribution types for our survey ([8])

contribution type	description
model	representation of observed reality by concepts, representation after conceptualization
theory	construction of a cause-effect relationship
framework	framework of method related to testing of AI-enabled systems
guideline	list of advices
lessons learned	number of outcomes from obtained results
tool	a tool supporting testing of AI-enabled systems

Table 4: Integrated picture: type of research in the obtained result set (numbers in percent)

evaluation research	solution proposal	philosophical paper	opinion paper	experience paper
11	50	31	4	4

Table 5: Integrated picture: type of research in the obtained result set (numbers in percent)

model	theo.	fw./ meth.	guidel.	less. lear.	adv.	tool
11	4	60	0	8	3	15

that shows the papers in the different categories. Regarding the research type facet, our analysis reveals that the majority of the contributions deal with solution proposals (50 percent) and philosophical papers (31 percent). Taking into account the fact, that most of the publications appeared in the last couple of years, the classification according to research types indicates a evolving research field. Only a minority (11 percent) of the research papers are classified as evaluation research.

Table 5 aggregates the contribution type facet and shows a similar tendency. From the 53 papers in the result set, almost 60 percent contribute frameworks or methods, followed by models (11 percent) and tools (15 percent).

3.2 RQ2: Research contributions

From the analysis using the basic classification schemas, we see a clear trend towards solution proposals and the majority of the proposed solutions considers frameworks or methods. A second trend is the appearance of philosophical papers. Regarding the solution proposals, approx. 19 percent (10 out of 53 papers) are classified as framework/methods, i.e., solution proposals without any evaluations beyond a demonstrating case study. In summary this indicates an emerging research field that is developing new approaches but the field yet lacks evaluated models and /or sound theories. Figure 1 illustrates a systematic map over research- and contribution types.

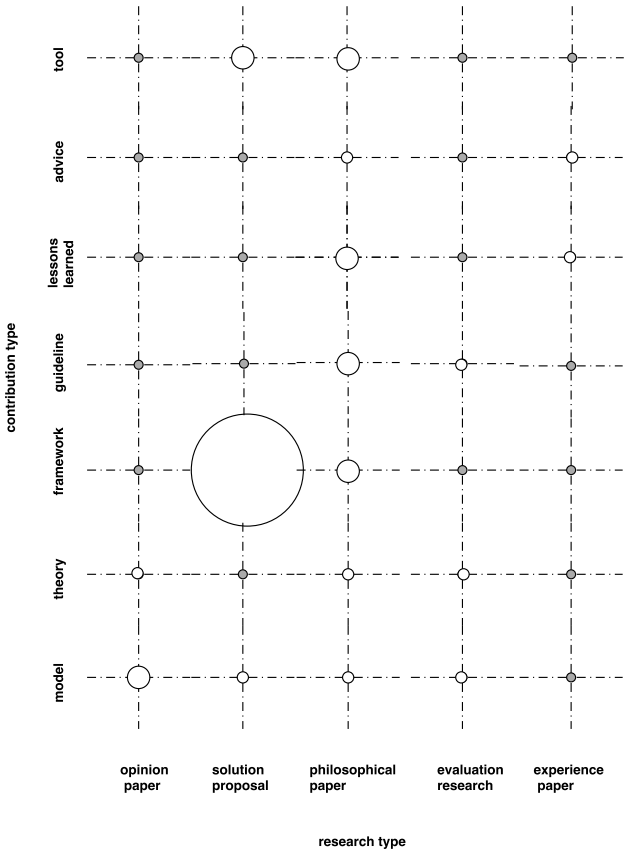

Figure 1: Systematic map over research- and contribution types.

3.3 RQ3: Trends and open challenges

As outlined previously, the majority of the contributions address testing of AI-enabled software in terms of a framework or method at the level of a solution proposal. The first publications date back to 1991 and deal with testing of expert systems in the field of flight software [2] followed by the testing of AI-applications for satellite command and control [7] in 1996. In the recent past, the number of publications dealing with verification and validation of AI-application has risen. In [3] the authors present an analysis of the problems and lessons learned from the deployment of an artificial intelligence based financial application that was developed and commercialized later. Regarding the research to development interface, the authors state the difference between an experimental AI, with its quirks and oddities; and a development tool that must be a reliable and testable product. During this transition the authors encountered the problem of being able to confirm that the software, after optimizations and modifications, was functionally equivalent to the original software. They necessitated the development of repeatable 'intelligence tests' that could be automated to confirm that no functional changes occurred. Most notably, this article reports on lessons learned to smooth the transitions along the path from a research project to a commercially deployed artificial intelligence application. In [11] the authors describe their early experiences of using agile techniques while developing a solution to a specific, multi-objective real world problem called the United States Navy Sailors' Assignment Problem. Because the investigators are working in a research environment where the results produced at intermediate stages cause the requirements to continually change, an agile software development methodology was deemed most appropriate. Although the research team applied several agile practices, the paper emphasizes their experiences when performing test-first or test-driven development. Whereas the latter contribution focuses on testing within an agile process when developing an AI-research prototype, at the other end of the spectrum, publications deal with automated learning of the behavior of evolving functionality. For example, the authors of [12] show that model-based testing allows the creation of test cases from a model of the system under test. Often, such models are difficult to obtain, or even not available. Automata learning helps in inferring the model of a system by observing its behavior. Under some assumptions, for dealing with nonde-

terminism, input-enabledness and equivalence checking, the authors prove that the algorithm produces a model whose behavior is equivalent to the one under learning. To what extent this method is applicable to learn the behavior of AI-enabled applications is an open issue.

4. THREATS TO VALIDITY

As a literature study in an emerging research field, this study may suffer from potential incompleteness of the obtained results. Also the study may exhibit a general publication bias, i.e, positive results are more likely published than failed approaches. For example, to our best knowledge, the result set does not contain papers that report on failed attempts to testing of AI-enabled applications. We counteract this risk by providing the result set to other researchers[3] and encourage them to continue this line of research. Among the major threats is also the threat regarding internal validity. Internal validity of the study could be biased by personal ratings of the authors. To counteract this risk we used supporting tools in cleaning, study selection and classification and in particular carried out this work in a peer setting.

5. DISCUSSION AND FUTURE WORK

In this article we analyzed the publication flora in the emerging field of testing AI-enabled applications and structured the general publication population in this field. We analyzed 53 contributions and conclude that the majority of the papers are solution proposals, i.e, proposed methods of frameworks that are illustrated in terms of a single case study. There is lack of evaluation results and to our best knowledge we cannot report on an article proposing a sound theory of testing AI-enabled applications. Although numerous applications appeared in the recent past, we lack papers that in particular deal with systematic testing of such applications. Most of the investigated articles address testing in a broader sense (namely verification and validation). Testing is about finding critical faults within the implemented software, such as mentioned in the introduction (memory limitations, data structures and configuration issues). In deploying AI-enabled applications, testing will become a necessity for professional software engineering of AI-applications. Research in this direction, in particular contributions dealing with conceptual and formal models, and sound theories alongside with evaluation research is thus highly desirable in setting up future research.

Acknowledgement

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Virtual Assistants for the Austrian-Slovenian Intelligent Tourist-Information Center

Jernej Zupančič
"Jožef Stefan" Institute and
Jožef Stefan International
Postgraduate School
Jamova cesta 39
Ljubljana, Slovenia
jernej.zupancic@ijs.com

Gregor Grasselli
"Jožef Stefan" Institute and
Jožef Stefan International
Postgraduate School
Jamova cesta 39
Ljubljana, Slovenia
gregor.grasselli@ijs.si

Aleš Tavčar
"Jožef Stefan" Institute
Jamova cesta 39
Ljubljana, Slovenia
ales.tavcar@ijs.si

Matjaž Gams
"Jožef Stefan" Institute
Jamova cesta 39
Ljubljana, Slovenia
matjaz.gams@ijs.si

ABSTRACT

We present a virtual assistant for the Austrian-Slovenian Intelligent Tourist-Information Center (AS-IT-IC - project within the Cooperation Programme Interreg V-A Slovenia-Austria, period 2014-2020) that can answer questions and hold a conversation on the topic of natural and cultural heritage sights. The prototype is currently integrated into the AS-IT-IC communication platform prototype and Slack application and communicates in Slovene language. During the AS-IT-IC project the virtual assistant will be expanded to other languages (English and German) and other communication platforms.

Keywords

virtual assistants; chatbots; chat platforms; tourism; natural language understanding; AS-IT-IC project

1. INTRODUCTION

Virtual assistants (VAs) or chatbots are software programs that can interact with the user through a vocal, textual or graphical user interface (or a combination of them) usually mimicking the way humans converse. Continuous advances in artificial intelligence technologies, particularly text processing and natural language understanding, have greatly increased the performance of VA systems. Easily accessible tools for creating such systems (examples are API.ai[1], Wit.ai[2], and Microsoft's bot framework[3]) together with the widespread adoption of chatting platforms and mobile electronic devices, have caused the number of VAs available to a user to increase significantly in the past few years.

1.1 Virtual Travel Assistants

Tourism is one of the industries where VAs can provide a significant added value as is evident by the increasing number of tourism or travel chatbots. Travel chatbots usually aim to enable:

1. Quicker and smarter booking.
2. Quicker and more entertaining travel options and destinations searching process.
3. Personalized city tour guides.
4. At least partial automation of call centers and information offices.

Existing travel bots usually specialize in one aspect of travel and can be sorted into one of the following categories:

1. *Customer service/info bots.* Usually very limited assistants that offer information about a certain business where the user talks to the VA instead of consulting complicated FAQ pages. Examples include Ana[4] and Julie[5].
2. *Travel options searching and booking bots.* These assistants allow one to search and book a flight, hotel, drive or restaurant through a conversation. This is usually more time-consuming than using a graphical user interface (GUI) with well-known and established web forms. However, some search domains are easier to navigate using natural language, therefore with the advance of natural language understanding tools and their easier integration into conversation platforms the options for innovation will increase. Examples of such assistants are the Expedia Facebook Messenger Bot (hotel search) and the Skyscanner Facebook Messenger Bot (flight search).
3. *Human assisted bots.* Despite the advancements in natural language understanding research and the rising popularity of fully automated VAs the chatbot-only response is rarely of good quality. Until enough usage data is gathered and several conversational corner

[1]https://api.ai
[2]https://wit.ai
[3]https://dev.botframework.com
[4]https://connectmiles.copaair.com/en/web/guest/ask-ana
[5]https://www.amtrak.com/about-julie-amtrak-virtual-travel-assistant

cases are addressed, the human-in-the-loop approach seems to be the most effective assistance. The user may communicate through a familiar chat interface with a VA and when the VA is not sure about the answer it forwards the question and the conversation history to a human operator, who continues the conversation with the user. Examples include Tradeshift Go, Pana[6], Lola[7], and Mezi[8].

1.2 AS-IT-IC Project

Austrian-Slovenian Intelligent Tourist-Information Center (AS-IT-IC) project was accepted in the cross-border Cooperation Programme Interreg V-A Slovenia-Austria in the programme period 2014-2020.

Currently the only way to obtain relevant information about cultural and natural heritage sights is through user-unfriendly web search, less known information sites (usually managed on the government or local authority levels), and then plan the trip using itinerary planners such as Google Maps[9] or more advanced tour planners such as e-Turist[10] [1] and TripHobo[11]. ICT tools will be built within the scope of the project that will enable integration of several solutions: tourism information search, tour itinerary planning, sight and tour recommendations, and live-chat with the tourist information providers (service providers and tourist offices, municipalities, tourists and citizens) in one place - the AS-IT-IC Platform.

2. AS-IT-IC PLATFORM

The goal of the AS-IT-IC project is to integrate and upgrade the existing tools to enable smart tourism. The existing components that will be integrated into the AS-IT-IC ecosystem include (Figure 1): Rocket.Chat - a chat platform, e-Turist - a tour planner, Asistent - a rule based question-answering and natural language understanding toolkit. The existing components will be upgraded with application programming interface (API) implementations that will enable the use of their functionalities through third party applications and will be customized for the AS-IT-IC project.

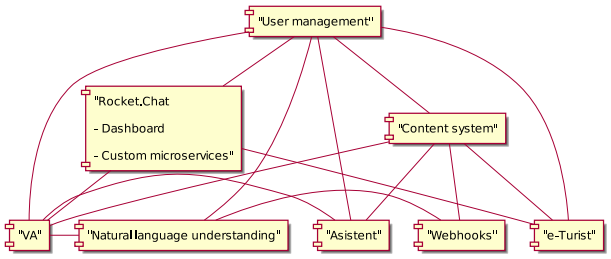

Figure 1: AS-IT-IC ecosystem components

Additionally, services that will enable the integration of existing components will be developed: integrations that can use the Asistent and e-Turist as a service, conversational logic and webhooks that will use a natural language understanding toolkit on the backend, and several microservices that will extend the functionality of Rocket.Chat for the purpose of the AS-IT-IC project. Dashboards that will enable access and modifications of the existing knowledge base will have to be added, together with an ecosystem-wide user-management service that will allow for a seamless transition between applications, and a content system that will enable the ground truth knowledge base (multilingual tourist information data) to be used by the various components.

3. AS-IT-IC VIRTUAL ASSISTANTS

The AS-IT-IC VA will provide the integration of several services and tools: Hubot - bot infrastructure for Rocket.Chat, Asistent, natural language understanding toolkit, content system and third party services that will be integrated through the specialized bots (Figure 2).

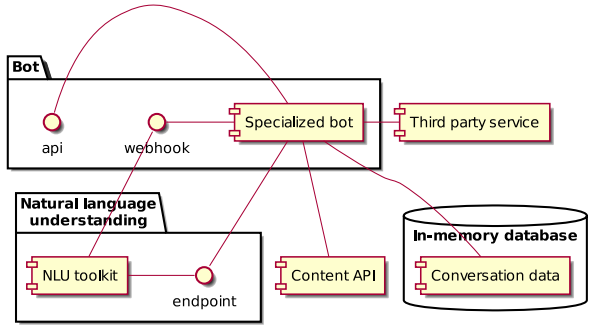

Figure 2: Example architecture for the AS-IT-IC specialized bot

3.1 AS-IT-IC VA Components

3.1.1 Hubot

Hubot[12] is an open source chatbot framework that has built in support for the Rocket.Chat client. It provides a standardized way to create chatbots on several conversational platforms by matching patterns from user input and producing a response by calling custom JavaScript code that in most instances calls an external api. For the AS-IT-IC project, Hubot provides a way to call APIs exposed by the AS-IT-IC Virtual assistant and correctly displaying the results in the Rocket.Chat client.

3.1.2 Asistent

Asistent[13] - slovenian for assistant ([2]) is a rule-based virtual assistant framework developed at the Jožef Stefan Institute, Department of Intelligent Systems. It enables the embedding of a floating window on a website, within which questions can be asked and the reply is presented, additionally the background web-page is changed to a page relevant to the answer.

Asistent provides a rudimentary API for posting questions and receiving answers, which will be upgraded during the project. The API exposes the endpoint `/ask` which takes the question as a URL parameter and responds with a json

[6]https://pana.com
[7]https://www.lola.com/welcome
[8]https://mezi.com
[9]https://www.google.si/maps
[10]http://e-turist.si
[11]https://www.triphobo.com
[12]https://hubot.github.com/
[13]http://projekt-asistent.si/info/

document that contains the answer and, optionally, the url of a web-page with relevant information to be displayed in the background. An example query to ask who is the mayor of Ljubljana with the question in Slovenian being "Kdo je župan?" is (after url encoding the question) `http://projekt-asistent.si/ljubljana/ask?question=Kdo%20je%20%C5%BEupan%3F`. The JSON response from the asistent service is:

```
{
  "answer": "Župan Mestne občine Ljubljana je
              Zoran Janković.<span><br>
             Oglejte si tudi podatke o
             <a href=\"http://www.ljubljana.si/
                       si/ljubljana/zupani/\">
             dosedanjih ljubljanskih županih</a>.
             </span><br>",
  "url": "http://www.ljubljana.si/si/mol/zupan/",
  "id": 5495
}
```

Additionally, Asistent enables the information providers to enter a custom knowledge base for the Asistent in the form of a triple: (question, answer, web-page), where the question is presented in the form of a rule using keyword stems and logical operators.

3.1.3 Natural Language Understanding Toolkit

Natural language understanding (NLU) toolkit enables the parsing of entities, parameters and intents from a natural language text. In a way NLU transforms non-structured text into a structured text that can then be used by other programs and services to provide functionalities for the user. Currently available NLU toolkits include API.ai, Wit.ai, Microsoft bot framework, and Rasa NLU[14]. The AS-IT-IC VA solutions will be designed in such a way that they will be as much toolkit-agnostic as possible. This will enable higher sustainability of the project results and lower the damage in cases of unavailable external toolkit services.

3.1.4 Content System

AS-IT-IC project partners have access to multiple databases with information about sights in the cross-border area. However, each database is in its own format with its own special fields. In order to provide a unified data interface for all systems integrated into the AS-IT-IC ecosystem, a separate Content system will be developed.

The goal of the Content system will be the integration of various information sources about sights into a database that will be easily updateable from the information sources and enriched with the data from third party content providers from the Internet such as TripAdvisor, Google Places and relevant tourist information websites. The content system will therefore facilitate machine-human cooperation, where some of the information may be pulled from third party websites automatically and a human may be able to view, edit or add sight entries. The REST API based microservice layer will be responsible for providing all the relevant information about a sight. Since a microservice approach to implementation will be used, the Content system will be accessible by several AS-IT-IC ecosystem components. At the moment the integration modules are developed for obtaining the information about sights from the web and transforming the data into a database schema used by the e-Turist.

[14]https://rasa.ai/products/rasa-nlu/

3.1.5 Third Party Services

The biggest advantage of a VA is the possibility to integrate some third party applications into the chat platform. This greatly extends the functionality of the chat platform, brings all the interaction into one place and enables a user-friendly natural text based conversation interface for controlling applications. Several third party services will be integrated into the AS-IT-IC VA, most notably: internal solutions (such as Asistent, e-Turist, full-text sights search) and outside services (such as Google places, Google maps, TripAdvisor, restaurant bookings, hotel bookings, event ticket purchase). Some of these services already provide an API that will facilitate access for the VA, for others, however, wrapper methods will be implemented, which will then be used by the AS-IT-IC VA.

3.2 VA Prototype

In order to test the AS-IT-IC VA concept, we have implemented a tourist VA that the tourist can use to ask questions about a specific sight, a group of sights in a specific area, a specific group of sights, and to hold a conversation about a sight (preserving context and taking into account the conversation history). Currently, the prototype is implemented for Slovenian language, since the used service for full-text search is indexed only over the Slovenian content.

The prototype architecture is very similar to the example architecture for the AS-IT-IC specialized bot (Figure 2). For the NLU toolkit we have chosen Api.ai, another third party service that we integrated into the prototype was full-text search over the sights, instead of the Content API we have accessed the sights database directly through the ORM (object relational mapping) layer, conversation data was managed by the Api.ai chatbot framework, as well as the bot API. Additionally, we have provided rich message templates for bot integration into the Slack communication platform and custom Hubot scripts for integrating into the Rocket.Chat client, which will form the basis for the AS-IT-IC platform. Rich messages are only partially supported by the Rocket.Chat platform for now. To overcome this shortcoming we will implement custom frontend modifications and API calls for Rocket.Chat, which will provide the required functionalities. Rich messages are already supported by Slack, which was the reason we provided such integration. We will strive to provide services in a chat platform-agnostic way, which will allow us to easily transfer the bots to other messaging platforms such as Facebook Messenger, Microsoft Cortana, Google Assistant, WeChat, Viber and others.

3.2.1 VA Modeling and Integration

The VA intelligence comprises NLU and a webhook part.

NLU part comprises model training, entity definitions, and context specifications. In order to train the model to adapt it to the tourism domain we had to come up with several possible inputs from the user, when he/she communicates with

the VA. Each input was classified into one of the following categories: *welcome*, *general sights query*, *sight query near specific place*, *sight query in the specific region*, *similar sight query near specific place*, *similar sight query in the specific region*, *adding the sight to "must see list"*, *obtaining the path to sight*, *sight recommendation*. Additionally we have added a few small talk categories, allowing for the VA to answer questions about itself - what does it do, who developed it, how old it is etc.

Entities enable the VA to label a word or a set of consequent words and categorize it. We have added the following entities: *attraction name*, *attraction type*, *place*, and *region*. When enough training examples are given the NLU is able to infer the category on its own.

The webhook integrates the logic of the VA transforming the intents and entities provided by the NLU toolkit to commands and method calls. Additionally, the webhook may use original input text from the user to call third party APIs. In the case of the VA prototype, we have devised different methods that correspond to the intent, determined by the NLU toolkit. The original input text is transformed to a query that was tested to yield better results and the transformed query is then sent to the sight description full-text search service. The obtained response is then transformed to a rich message representation which is forwarded to Api.ai, which in turn responds to the client in its own format.

3.2.2 *VA Interaction*

The VA prototype supports the following types of questions by a user:

1. Show me some rivers in the Dolenjska region.
2. List the castles near Kranj.
3. (After asking about a sight in previous question) Recommend me nearby sights.
4. (After asking about a sight in previous question) How do I get there?

All the answers are provided in text form, with additional formatting when providing the description of a sight - url link to the detailed description, category and a location of a sight, quick description, interactive buttons for quicker interaction. An example is shown in Figure 3.

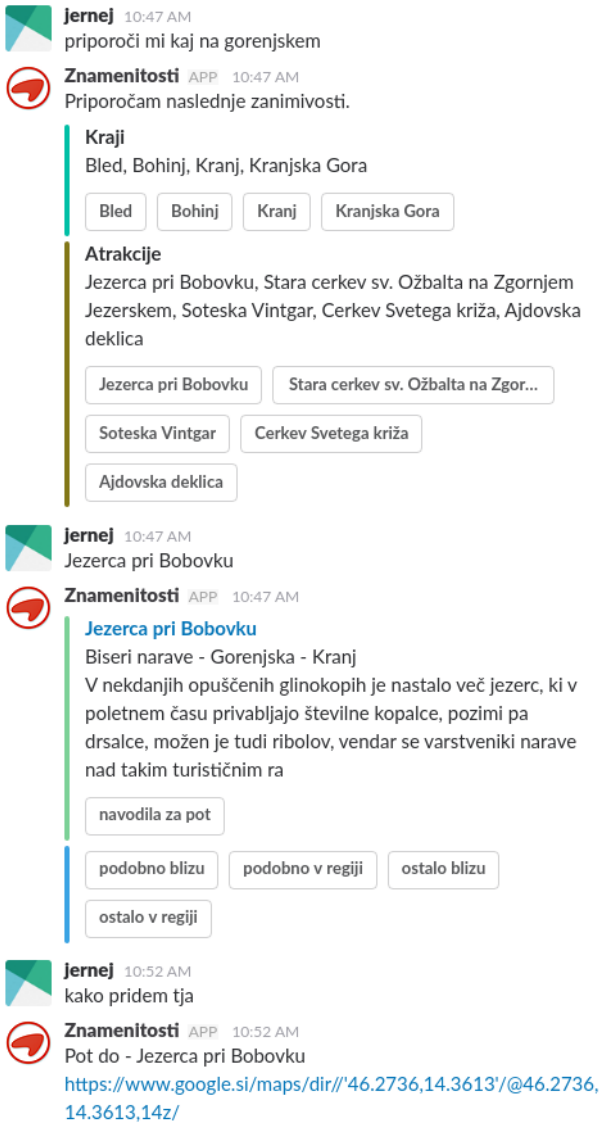

Figure 3: VA interface in the Slack client

All the answers are provided in text form, with additional formatting when providing the description of a sight - url link to the detailed description, category and a location of a sight, quick description, interactive buttons for quicker interaction. An example is shown in Figure 3.

4. CONCLUSION

The paper presents the architecture and functionalities of the virtual assistant for the AS-IT-IC platform and its integration into the AS-IT-IC ecosystem. Additionally, a prototype VA was presented, which has already been integrated into the AS-IT-IC conversational platform and enables the tourist to search a particular sight, a set of sights of particular type, or obtain relevant information about a sight.

Future work will include the addition of other languages, primarily English and German and more thorough integration with the Rocket.Chat platform. Additionally, several other specialized VAs will be added, the integration of which will be based on the presented prototype, and the AS-IT-IC VA will be implemented. It will provide a unique access point to all the specialized VAs. This will provide easy access to available bots and a seamless experience for tourists.

5. ACKNOWLEDGMENTS

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Matjaž Gams, Jernej Zupančič