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Proiect de cercetare:
”Facilitarea accesului la educație prin realitatea augmentată şi stimularea învățării dinamice în afaceri prin microlearning”

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Conținutul acestui document prezintă sub forma unui raport intermediar rezultatele cercetărilor pe tema proiectului cu titlul *”Facilitarea accesului la educație prin realitatea augmentată și stimularea învățării dinamice în afaceri prin microlearning”* pe durata lunilor 4, 5, 6 ale proiectului postdoctoral sub egida Academiei Oamenilor de Știință, din România, Filiala București.

Raportul intermediar (2) conţine detalii despre rezultatele proiectului de cercetare:

(A) O lucrare de cercetare ce explorează potențialul tehnologiei Realității Augmentate (AR) pentru îmbunătățirea experiențelor de navigare în campusul universitar, cu un accent deosebit pe satisfacerea nevoilor studenților cu tulburări de spectru autist (ASD), ceea ce face obiectul prezentului contract, împreună cu dovada publicării în programul şi volumul conferinței;

TOMA, M.V. & BEJINARU, R. (2023). **Embracing diversity: Augmented Reality application for inclusive university campus navigation**, ***Strategica International Conference***, 11th edition, 26-27.10.2023.

(B) Participarea fizică şi prezentarea rezultatelor cercetării - la Sesiunea Ştiinţifică AOSR tineri cercetători - Etapa 2, 27 Noiembrie 2023, sediul Academiei Oamenilor de Știință din România, din strada Ilfov, nr. 3, sector 5, București, în Sala de Consiliu, parter;

TOMA, M.V. & BEJINARU, R. (2023). **Îmbrățișarea diversității: aplicație de realitate augmentată pentru navigarea incluzivă în campusul universitar**, ***Sesiunea Ştiinţifică AOSR tineri cercetători - Etapa 2, 27 Noiembrie 2023.***

(C) Participare şi prezentare online la Conferinţa Internaţională - VI International Scientific Congress - Society of Ambient Intelligence 20-25 Noiembrie 2023; Panel Discussion “Regional business ecosystem involvement to digitalization and green transition and university’s role” - Titlul Prezentării: *Augmenting the university campus: digital approach, Vlad Toma, Bejinaru Ruxandra.*

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(A)

STRATEGICA INTERNATIONAL CONFERENCE
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EMBRACING DIVERSITY: AUGMENTED REALITY APPLICATION FOR INCLUSIVE UNIVERSITY CAMPUS NAVIGATION

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Abstract. *This academic paper explores the potential of Augmented Reality (AR) technology in enhancing university campus navigation experiences, with a particular focus on catering to the needs of students with autism spectrum disorder (ASD). We address the limitations of traditional campus navigation methods and introduce AR as a promising solution. We consider that the mission of a future-oriented university is to enable and facilitate access to higher education and advanced research opportunities focusing on becoming more inclusive. Throughout the literature review, we delve into the interactive nature of AR, its multisensory capabilities, and the importance of spatial registration. We also highlight the complexity of AR system architecture, emphasizing the role of hardware and software components, rendering engines, and tracking algorithms. The paper then explores the utility of AR in campus navigation, emphasizing its potential in improving spatial awareness and enriching educational experiences. The methodology section outlines the objectives of the research, including understanding the adoption of AR in universities for orientation, exploring AR technologies and platforms, and defining key characteristics of an AR application. Within the results and discussion section we present findings related to the use of AR applications in future-oriented universities for campus navigation. While specific university-based implementations are limited, pioneers like MIT, Stanford, and Harvard are to be watched for their potential adoption of AR technology as core stream of their long-term academic leadership strategy. We focused on exploring technologies and platforms for developing AR applications, encompassing modeling and computer vision, geospatial technologies, sensor technologies, machine learning, cloud computing, network technologies, and frameworks in order to argue their positive impact.*
Within the section dedicated to developing AR applications for students with ASD we emphasize stakeholder engagement, technological selection, application development, user feedback, and continuous improvement. The paper concludes by proposing a sequence diagram illustrating the interaction between parties involved in developing and using an AR campus navigation application.

Keywords: *academic leadership strategy; application; Augmented Reality (AR); autism spectrum disorder (ASD); campus navigation; future-oriented university; students.*

Introduction

Due to the global evolution, universities are compelled to adjust to emerging technologies and incorporate them into their educational and research methodologies (Bejinaru & Prelipcean, 2017). Navigating through expansive university campuses can be a challenging experience, particularly for newcomers, international students, or those with accessibility needs. Traditional methods of campus navigation—like static maps, signages, and GPS-based mobile applications—often fall short in offering a comprehensive, interactive, and inclusive navigation solution (Liao et al., 2015).

Augmented Reality (AR)-based campus navigation systems have the potential to fill this gap by providing interactive, context-sensitive, and real-time orientation assistance. By superimposing directions, annotations, and other relevant information directly over the physical world, AR applications can create a more intuitive and engaging navigation experience. Furthermore, these systems can be customized to cater to diverse user needs, offering features like voice guidance for visually impaired users or sign language avatars for those who are hearing-impaired.

Augmented Reality is an interactive paradigm where digital elements are superimposed onto the real world, thereby augmenting the user's perception and interaction with their environment (Milgram & Kishino, 1994). AR differs from Virtual Reality (VR) in that it does not create an entirely simulated environment but integrates digital information with the existing environment in real-time (Billinghurst & Kato, 2002). Using a variety of technologies, including computer vision algorithms, machine learning and sensor data, AR applications have been developed for diverse domains like healthcare, industrial maintenance, education, business administration and other fields (Bejinaru, 2019). From a technical perspective, AR systems often consist of multiple components: a camera for capturing the real-world environment, a display mechanism (which can range from smartphone screens to AR glasses), tracking systems for spatial and object recognition, and a computational backend for data processing (Carmigniani et al., 2011; Wagner & Schmalstieg, 2007). These systems may use various tracking technologies such as marker-based, marker-less, and simultaneous localization and mapping (SLAM) for the precise placement of virtual objects in the real world.

Literature review

The essence of Augmented Reality lies in its real-time interaction capabilities, allowing a seamless blend of computer-generated information with the physical world. This dynamism in the interaction is not just a technological marvel but also a fundamental shift in how we perceive and interact with digital data (Azuma et al., 2001). It challenges the passivity of traditional interfaces by engaging users directly with contextual information. Unlike many other digital technologies that isolate the user from the physical environment, AR thrives on context-awareness. The system actively uses sensorial data—captured through accelerometers, gyroscopes, and GPS—to adapt and provide relevant information, making each AR experience highly personalized (Kretzenbacher et al., 2020). Besides the major benefits, future-oriented universities must carefully plan and invest in the technology, considering both its short-term benefits and long-term viability to ensure its sustainability (Neamtu et al., 2020).

While most people attribute AR to visual overlays, it's worth noting that it is not restricted to the visual modality. AR can offer a multisensory experience that can also include audio and haptic feedback (Steinicke et al., 2010). This multi-modal approach opens up numerous opportunities for more immersive and engaging interactions. The concept of spatial registration is another cornerstone in AR systems. This involves the accurate alignment of virtual and physical elements, which ensures that the digital overlays are correctly positioned relative to real-world objects (Klein & Murray, 2009).

On the technical side, the system architecture of AR can be quite complex. Hardware and software components work together to create this immersive experience. The hardware often comprises of various sensors for tracking movement and orientation, display devices that range from smartphones to specialized AR glasses, and cameras for capturing real-world data (Carmigniani et al., 2011; Lee & Tuceryan, 2004). From a software perspective, the rendering engine plays a crucial role in creating the virtual elements. Frameworks and platforms such as ARCore, ARKit, Unity3D and Unreal Engine are widely used for developing AR applications. Additionally, sophisticated tracking algorithms, such as Simultaneous Localization and Mapping (SLAM), are employed for real-time location and orientation tracking (Klein & Murray, 2009).

Using augmented reality for campus navigation

The utility of augmented reality in navigating new spaces, particularly in the context of university campuses, represents an innovative intersection of spatial cognition, human-computer interaction, and educational technology. One of the most significant advantages of employing AR in university campus navigation is the augmentation of spatial awareness. AR can facilitate the internalization of spatial relationships by overlaying digital information, such as directional arrows or point-of-interest markers, directly onto the real world. This real-time augmentation alleviates the cognitive load involved in spatial reasoning (Sweller, 2011), thus aiding the user in quickly becoming familiar with unfamiliar spaces. Beyond navigation, the AR system can serve educational goals by contextualizing information relevant to specific campus locations. For instance, when a user approaches a science building, the application could display historical facts, ongoing research projects, and other educational material (Dunleavy et al., 2009). This enhanced engagement not only enriches the user’s experience but also contributes to a deeper learning outcome, incorporating elements of situated learning theory (Lave & Wenger, 1991).

Campus navigation applications for students with autism spectrum disorders (ASD)

Autism spectrum disorder (ASD) is a complex neurodevelopmental disorder characterized by deficits in social communication and interaction, alongside restricted, repetitive patterns of behavior, interests, or activities (American Psychiatric Association, 2013). The term "spectrum" is used to denote the wide range of symptoms and individual differences in severity and functioning that can occur in individuals with ASD (Baio et al., 2018). While ASD is characterized by significant challenges, it is noteworthy that individuals with ASD may also exhibit remarkable strengths such as enhanced perceptual skills and attention to detail (Mottron, Dawson, & Soulières, 2009).
Augmented Reality has a significant potential for creating more inclusive educational environments, especially for students with autism spectrum disorder. Campus navigation is a critical stage of university life that can be overwhelming for many students, and even more so for those with ASD, who may face challenges with social interaction, spatial navigation and coping with new routines (Kasari et al., 2019). Integrating AR technology into campus orientation activities for ASD students could create a tailored experience that better suits their individual needs (Escobedo et al., 2012).

One of the critical elements in AR applications for ASD students is the adaptability of the user interface. It is crucial for these applications to be highly customizable, allowing for adjustments such as the simplification of visual elements or modification of audio prompts. This conforms with the principles of Universal Design for Learning (UDL) and can accommodate the sensory sensitivities often associated with ASD (Rose et al., 2006). Students with ASD can also benefit significantly from immediate feedback that AR applications deliver. Real-time tracking and feedback mechanisms are integrated within the applications to adjust the orientation process dynamically according to the students' immediate needs (Zhou et al., 2018). When triggered, AR delivers clues that can range from simple, unimodal cues such as visual markers indicating directions, to more complex multi-modal cues incorporating sound and haptic feedback. Based on the tenets of Applied Behavioral Analysis (ABA), AR can deliver conditioned stimuli at regular intervals to elicit desired behavioral responses, such as maintaining a certain walking pace or staying within demarcated safe zones on the campus. While campus navigation is the primary goal, these AR applications can also promote the development of other cognitive skills such as spatial awareness and problem-solving. Cognitive load theory suggests that these additional skills can be incrementally integrated without overwhelming the user (Sweller, 2011).

Methodology

In order to be able to future develop an augmented reality application for navigation in new spaces by students with autism but also by those with normal development, we proposed the following objectives:

O1. To have an overall understanding of the level of adoption of augmented reality by future-oriented universities for navigation in new spaces and how the problem of students with autism is approached.

O2. To study the main technologies and platforms available for the development of an augmented reality application.

O3. To establish the key characteristics that the application must have.

Considering the fact that each university has certain peculiarities regarding the location of buildings, access roads and other campus objectives, the following research questions were formulated to fulfill the mentioned objectives:

RQ1. How do universities implement campus navigation solutions based on augmented reality?

RQ2. What technologies and platforms are available to develop augmented reality applications for campus navigation?

RQ3. What should be taken into account for the development of an augmented reality application for campus navigation for students with autism spectrum disorder?

Results and discussion

Objective 1: The use of augmented reality applications by universities for campus navigation

Going through the scientific literature, it can be stated that there has been a proliferation of AR applications for the broader student demographic, but information on specific universities using such applications is quite scant. However, various universities have been at the forefront of incorporating AR technology to foster a more inclusive educational environment. Universities such as MIT, Stanford, and Harvard have been pioneers in adopting AR and VR technologies in education and it wouldn't be far-fetched to anticipate the inclusion of features accommodating the needs of students with ASD in their AR-oriented initiatives in the near future, given their history of innovation and inclusivity (Papagiannis, 2017). Moreover, there has been a broader interest in the potential applications of AR technology for individuals with autism. For instance, researchers have been exploring how AR can be used to assist individuals with ASD in learning new skills and achieving greater independence (Kuriakose & Lahiri, 2015). In their research, the authors scrutinized how AR can be an enabler in enhancing the learning experiences and fostering greater autonomy for individuals with ASD. Their pioneering work paves the way for universities globally to conceptualize and implement AR applications that are addressing the unique needs of individuals with autism.

Future-oriented universities have a tradition in applying strategic university governance and took upon themselves the development of customized AR applications specifically tailored for their campuses (Lupan & Bejinaru, 2019). These applications generally offer features such as AR guided tours, interactive campus maps, and information pop-ups about different facilities on the campus. Although it is possible that some information is not publicly available and the applications are not entirely dedicated to orientation in new spaces, we found that some examples of notable universities and institutions where AR has been used or piloted for campus navigation or related applications are:

University of Arizona – Developed an AR application that offers a 3D map visualization of the campus, information pop-ups about different facilities, and real-time event information.

Harvard University – While not a fully-fledged AR campus tour, Harvard has utilized AR in various exhibitions and set-ups across the campus to offer enriched experiences.

MIT (Massachusetts Institute of Technology) – Used AR in multiple projects including campus tours that include AR-enhanced experiences of the facilities.

Stanford University – Though it predominantly uses AR for research and academic purposes, there have been instances of AR being used for campus navigations and tours, predominantly during exhibitions and special events.

University of Cambridge – Has leveraged AR technology in public engagements and outreach programs, including interactive AR-enhanced maps of certain facilities.

Yale University – Yale has employed AR in various exhibitions and public engagements, though detailed AR campus tours are yet to be instituted.

University of British Columbia – Engaged in the development of AR initiatives, including the pilot testing of AR-enhanced campus tours to facilitate better campus navigation and information dissemination.

University of Tokyo – Involved in AR research projects and has employed AR in public engagements and tours, offering a glimpse into the campus's facilities through AR lenses.

ETH Zurich – The university has employed AR in various projects, including offering AR-enhanced experiences during campus tours, particularly focused on architecture and facility demonstrations.

Though not exclusively for campus navigation, there are applications developed to assist individuals with ASD in navigation and understanding space:

Autism2Ability: This platform offers applications with visual support and AR technology to help students with ASD in various capacities including understanding new environments which can be harnessed for navigating throughout the campus.

Wayfinding Project: A specific endeavor undertaken by the University of Minnesota to assist individuals with ASD in navigation through spaces using AR technology.

The landscape of AR applications specifically tailored for campus navigation, including the needs of students with ASD, is still developing. Many of the existing solutions are general-purpose AR platforms that require substantial customization to meet the specific requirements of college campuses and the diverse needs of their students. This suggests that this field of research has significant potential for innovation and exploration. Given the trajectory of advancements in AR technology, it is plausible to anticipate a surge in universities incorporating AR applications in their campuses that are tailored to the needs of students with ASD, presenting an optimistic future.

Objective 2: Technologies and platforms for developing augmented reality applications for campus navigation

Developing an augmented reality (AR) application for campus navigation involves the use of a variety of technologies and platforms, including AR development frameworks, cloud computing platforms for backend support, and tools for creating 3D models and assets (Bejinaru & Balan, 2020). In the following section we break down the prominent technologies and platforms that can be leveraged to build a comprehensive AR application.

Technologies: Augmented reality platforms are usually used alongside a suite of advanced technologies that redefine the interaction between the digital and physical worlds. At the forefront are modeling and computer vision technologies like 3D reconstruction, which uses methods such as LiDAR (Light Detection and Ranging) and photogrammetry, and SLAM (Simultaneous Localization and Mapping) which facilitates the precise overlay of digital objects over the physical spaces. Geospatial technologies with GIS (Geographic Information Systems) integration providing enhanced navigation experiences on campuses are complemented by GPS and Beacon technology for precise localization, especially indoors. The dynamism of AR is represented by a multitude of sensor technologies, including accelerometers, gyroscopes, and magnetometers, which are essential in detecting device movements and orientation, thus facilitating a more immersive AR experience. Machine and deep learning technologies amplify AR's capabilities in identifying and interpreting real-world objects and contexts. The scalability and performance of AR applications is based on cloud computing's ability to handle voluminous datasets and intricate computations. Network technologies, especially 5G and edge computing, are ensuring real-time AR interaction by guaranteeing faster data transmission and low latency. Collectively, these technologies stand as the basis for ensuring AR's seamless, immersive, and responsive experiences.

Platforms and software development kit (SDKs): Table 1 provides a summary of the most popular frameworks and SDK's for developing augmented reality applications. These platforms are at the forefront of AR development, offering a broad array of tools and functionalities to develop state-of-the-art AR applications for campus navigation. Leveraging these platforms can significantly enhance the campus orientation experience, offering students an engaging, tailored and immersive introduction to the campus environment.

Table 1. AR Development Platforms and SDKs (Source: authors' own contribution)

Platform	Description
Google ARCore	Enables developers to create AR applications for Android devices.
Apple ARKit	Enables developers to create AR applications for iOS devices
Vuforia Engine	A platform that provides an SDK for creating AR applications that use image recognition and tracking. It supports Android, iOS, Windows, Unity, and Unreal Engine.
Hololink	A web-based platform that enables creation of AR through a visual no-code solution.
Unity	Cross-platform game engine for developing 2D and 3D games, simulations, and interactive experiences. It supports various platforms.
Unreal Engine	Game engine for developing high-quality games, simulations, and interactive experiences. It supports various platforms.
Wikitude	A platform that provides an SDK for creating AR applications that use image recognition and tracking. It supports various platforms, such as Android, iOS, Windows, Unity, and Unreal Engine.
8th Wall	A web-based platform that enables creation of AR through a visual no-code solution. AR created in 8th Wall is served directly in the mobile browser without the use of an app.

Objective 3: Developing AR applications for campus navigation for students with ASD

Developing an augmented reality application for campus navigation customized for students with autism spectrum disorder requires a multidisciplinary approach that intertwines knowledge from computer science, psychology, education, and design. It is crucial to adopt evidence-based practices to create an AR application that is effective and beneficial for students with ASD. Following the research, a number of 9 steps necessary to develop such an application were identified. Here we outline some pivotal considerations and methodologies:

Identifying the goals and objectives: The initial phase begins with a nuanced understanding of the goals and objectives that the AR application aspires to achieve. At this point, it becomes essential to envision an app that can act as an inclusive tool, facilitating easy navigation and decipherable information about various campus facilities for students with ASD. A strong focus on sensory preferences and cognitive styles of these studies can influence the development of user-centric features.

Stakeholder engagement: As we move forward, stakeholder engagement emerges as a critical endeavor, where the collaboration with students, including those with autism, faculty, and administrative personnel translates into valuable insights. Here, emphasis should be placed on creating a support system that encourages feedback and suggestions from autistic students, ensuring their unique perspectives are integrated into the app, a strategy that promotes inclusivity and user-centered design (Bower et al., 2014).

Technological selection: The technological substrate forms the next layer, where choices made in selecting platforms and tools resonate with the aspirations of inclusivity. Leveraging platforms such as Unity for the overarching development and integrating AR functionalities through ARKit or ARCore stand as viable strategies. A focus here should be on technologies that enable the creation of features like simplified navigation and intuitive interfaces which would cater specifically to students with ASD, facilitating their comfortable interaction with the app (Craig, 2013).

Content development: In the center of this developmental blueprint lies content creation and crafting of media elements and graphical overlays tailored to foster an enriching experience for all users, including those with ASD. The development team must infuse the content with an understanding of the cognitive and sensory preferences of autistic students, orchestrating an environment within the app that is both supportive and understanding of their needs (Wojciechowski & Cellary, 2013).

Application development: During the application development phase, the technical blueprints emerge into a tangible entity. Here, the developers use the power of programming languages and AR technologies to architect an app with rich features, responsive designs, and user-friendly interfaces. Essential in this stage is the integration of ASD-friendly features, which could encompass simplified layouts, calming color schemes, and the provision of clear instructions to guide the students efficaciously. Furthermore, the integration of the AR application with the existing campus infrastructure stands as a critical determinant in the successful implementation and operational fluidity of the system.

Testing: As the structure receives its substantial form, a rigorous testing phase initiates to identify potential glitches. It is in this phase where the app undergoes several tests, potentially including usability testing with a diverse group of students, encompassing those with ASD. Tailored testing protocols for autistic students could be utilized to ensure that the app caters to their unique needs effectively and sensitively (Dunleavy, Dede, & Mitchell, 2009).

User feedback and iterations: Post the initial deployment in a controlled environment, it is prudent to foster a feedback-rich ecosystem where users, including those with ASD, can articulate their experiences and pinpoint areas necessitating refinement. The feedback should be meticulously analyzed to derive actionable insights, promoting a cyclical process of refinement through various iterations.

Deployment: Following the iterative refinements based on holistic feedback, the deployment phase marks the inaugural launch of the application to the wider public. It would be pivotal to establish a support system, perhaps a helpline or a digital manual, to aid all students, including those with ASD, in seamlessly adapting to the new technological improvement. Engaging the university community in a comprehensive understanding about the app's functionalities would be a strategic move, ensuring smooth integration into the daily routines of all students (Bower et al., 2014).

Continuous improvement: After the deployment, the application enters a phase of dynamic evolution characterized by continuous improvements. Here, a sustained engagement with the user base, paying attention to the feedback received from the ASD community can guide the trajectory of further developments. The constant concern on technological advancements and user preferences would need periodic updates, guaranteeing that the app remains a reliable, inclusive, and innovative tool in the educational landscape. Considering the data gathered for answering the research questions, we proposed a sequence diagram that illustrates the functioning and interaction between the parties involved in developing and using an augmented reality campus navigation application (Figure 1).

Conclusions

The major scope was that throughout this paper to explore the potential of Augmented Reality (AR) technology in improving campus orientation experiences, with a particular emphasis on catering to the needs of students with autism spectrum disorder (ASD). We approached various aspects related to AR technology, its applications in campus navigation, and its relevance for students with ASD and we reiterate the key findings: -Augmented Reality has significant potential in enhancing campus navigation experiences; -We documented the complexity of AR system architecture, including hardware components like cameras and displays, as well as software components like rendering engines and tracking algorithms; -AR is not limited to visual overlays and can offer a multisensory experience, including audio and haptic feedback particularly relevant for students with ASD; -Proper spatial registration ensures that digital overlays are correctly positioned relative to real-world objects.

We highlight the potential of AR technology in addressing the unique challenges faced by students with ASD during campus navigation. We emphasize the need for highly customizable interfaces, immediate feedback mechanisms, and features that accommodate sensory sensitivities. As part of our research, we outline a comprehensive methodology for developing AR applications for campus navigation. It includes steps such as stakeholder engagement, technological selection, content development, testing, user feedback, deployment, and continuous improvement. We conclude that the field of AR applications for campus navigation, particularly for students with ASD, is still evolving. Many existing solutions are general-purpose and require customization for specific campuses. We stress the importance of user-centered design, adaptability, and continuous improvement in the development of AR applications for this purpose and suggest that universities and institutions are increasingly recognizing the value of AR technology in education and campus navigation.

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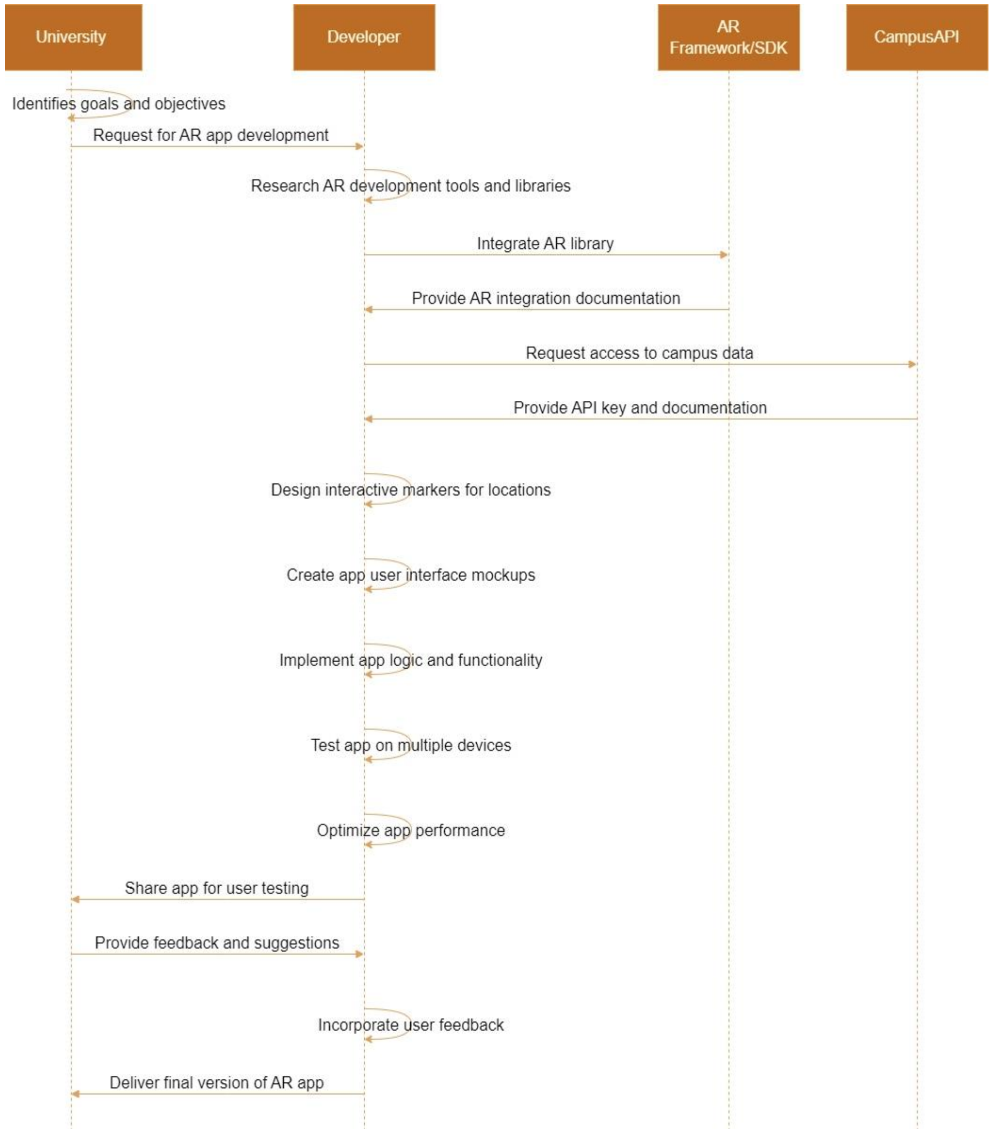

***Figure 1*. Augmented reality sequence diagram**
Source: (authors' own contribution)

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VI INTERNATIONAL SCIENTIFIC CONGRESS
SOCIETY OF AMBIENT INTELLIGENCE
NOVEMBER 20-25, 2023

PROGRAM ISC SAI 2023 –
PANEL DISCUSSION “REGIONAL BUSINESS ECOSYSTEM INVOLVEMENT TO DIGITALIZATION AND GREEN TRANSITION AND UNIVERSITY’S ROLE”

November 23 (Thursday)

10:00 – 14:00	Panel Discussion “Regional business ecosystem involvement to digitalization and green transition and university’s role” (ISCSAI_2023_ID.15) *Moderators:* *Carmen NASTASE, Prof. PhD, Stefan cel Mare University of Suceava (Romania)*

Join Zoom Meeting
https://us02web.zoom.us/j/88640343007?pwd=aXltS05lazRKcDZaaGJSMzZhQ2RXQT09
Meeting ID: 886 4034 3007
Passcode: 879616

09.45 – 10.00 **Registration**

10.00 - 10.20 **Opening and presentation**

Chair: Carmen Chasovschi, Stefan cel Mare University of Suceava, Romania

10.20 - 10.40 – **Innovation Laboratories for Climate Actions - Project presentation**, Consortium from Finland, Lithuania, Bulgaria, Romania, Ukraine
10.40 - 11.00 - **Lithuanian Innovation Laboratory for Climate Actions as facilitator of ecosystem actors' involvement**, Ana Aleknavičiené, Vilnius College of Technologies and Design, Lithuania 11.00 - 11.40 - **The perception of tourism businesses in Romania regarding the European Green Agend**a, Carmen Chasovschi, Mihaela State, Ștefan cel Mare University of Suceava, Romania
11.40 - 12.00 - **Ukraine`s path to climate neutrality according to EU framework**, Irina Maksymova, State University of Economics and Technology Ukraine

12.00 - 12.20 - Coffee break

Chair: Ruxandra Bejinaru Stefan cel Mare University of Suceava, Romania

12.20 - 12.40 - **The university role in developing components of the green economy**, Ruxandra Bejinaru, Ștefan cel Mare University of Suceava, Romania
12.40 - 13.00 - **Chernivtsi Business System**, Viktoria Kyfyak, Olena Vinnychuk, Yevhen Tkach, Yuriy Fedkovych Chernivtsi National University, Ukraine
13.00 - 13.20 - **Augmenting the university campus: digital approach**, Vlad Toma, Ștefan cel Mare University of Suceava, Romania
13.30 - 13.40 - **University keyrole in fostering the green entrepreneurial mindset**, Otilia Bordeianu, Lucia Moroșan Dănila, Ștefan cel Mare University of Suceava, Romania
13.40 - 14.00 – **Aspects regarding the role of tourism in sustainable socio-economic development**, Adrian Liviu Scutariu, Ștefan cel Mare University of Suceava, Romania

Final conclusions and closing

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