

LIBRARY 4.0: Application of Augmented Reality in Agricultural Libraries

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Abstract

The Industrial Revolution 4.0 has paved the way for the emergence of Web 4.0, Education 4.0, and Library 4.0. The Cyber-Physical Spaces interaction is the new coinage term used to integrate technology leading for immersive or experiential, oriented service in different sectors. The Internet of Things (IoT), Virtual Reality and Augmented Reality, Big Data, Robotics, and 3D print environment are the popular term now in usage which are altogether called Artificial Intelligence where the reality is mixed with technology to provide more knowledge and economy. The education sector at the elementary level already uses augmented reality for gaming, reading other learning activities; the library being part of the learning system is no exception. The developed countries have successfully implanted this technology for innovative information services. India has to take more steps in this direction. This paper examines the AR usage in different sectors like entertainment, business, medicine, archives, museums, military, science, services, education, including the culture sector, and further how it can be implemented in the academic libraries of agricultural education.

Keywords: Augmented Reality, Virtual Reality, Agricultural, Library, Innovation, Farming

Introduction

Augmented Reality is technology-based, where the natural objects or environment are superimposed digitally in a computing environment that

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provides an interactive experience that includes sensory, visual, and auditory orientation. According to Investopedia, 2020, augmented reality (AR) is an enhanced version of the real physical world that is achieved through digital visual elements, sound, or other sensory stimuli delivered via technology. It is a growing trend among companies involved in mobile computing and business applications. The Pokemon GO 2016 has paved the way for developing gamification using AR has further resulted in using this interactive technology for a different purpose which has helped for more knowledge growth. Augmented reality (AR) technology has been blooming in the past few years, with a growing number of low-cost AR devices becoming available to the general public. AR techniques have demonstrated the capacity to optimize task efficiency in various industries and provide engaging entertainment and education experiences.

Augmented Reality in Agriculture

Agriculture is an area where advanced technology is constantly introduced with a delay. Currently, it appears that new techniques and technologies appear in it very quickly.

Augment reality will probably soon become popular, especially since there are many areas in which its implementation might be advisable. However, the condition is a reduction in the cost of this technology, so its use would be cost-effective.

According to the Food and Agriculture Organization of the United Nations, one of the priorities by 2030 is the following:

- Creation of mechanisms and institutions for the elaboration and expansion of international norms, standards, and data for partnership between countries;
- To increase the exclusivity and stability of production to external influences;

- The development of small farms and the diversification of the workforce, which moves to cities;
- Creating a systems approach: ecosystem and proper education;

Virtual technologies used to develop agricultural science and technology advancement will allow farmers to understand better and master the advanced methods of agricultural land management. Making the learning process more and more intuitive, vivid image, which significantly increases the effectiveness of training and increases their educational interest.

In addition to virtual reality, there are already practical cases of companies with augmented reality. So, the Swedish agricultural machinery brand Väderstad offers one of its applications. The AR in the agriculture market is segmented based on applications and solutions. The applications include outdoor and indoor farming, including hardware, software, and services. The outdoor farming segment of the AR in the agriculture market is further categorized into precision and smart farming, livestock monitoring, simulated training, and weather tracking and forecasting.

The AR in the agriculture market by application is majorly driven by indoor applications, such as vertical farming, hydroponics, aquaponics, and cannabis farming. However, outdoor farming applications have more significant potential, generating more revenue than indoor farming.

Livestock monitoring applications lead the outdoor farming application segment. It is currently one of the most lucrative applications and the most promising segments. This is followed by the precision and smart farming application segment, which is expected to have the second-highest growth rate.

Scientists at the Danforth Plant Science Center in St. Louis Missouri, US has taken the project in 2019 to build AVR Learning Laboratory. It uses sophisticated imaging technologies including X-ray microscopy and CT scanning, combined with data-driven machine learning to improve innovative ways of analysis and visualization of plants in ways that are

important to sustainable agriculture and crop improvements. The data generated can be built into engaging 3D and even 4D immersive scientific stories and experiences for students, adults, and life-long learners. This project will collaboratively engage teachers and scientists in establishing a community-accessible, one-of-a-kind Plants and Agriculture AVR Learning Laboratory at the Danforth Center that can be used for teacher professional development and student exploration.

Review of Literature on AR in Libraries

During the last decade, several research articles related to the implementation of VR/AR and mixed reality in the library and information science domain have come up. Research related to models, apps, surveys, and implementation is done, and a few are discussed below.

The Bavarian State Library experimented with Augmented Reality applications. In the App Ludwig II, the library provided multimedia content on the famous Swan King as an interactive Augmented Reality application, georeferenced at prominent places of the king's life such as Neuschwanstein Castle (Ceynowa, 2011). A model was suggested (Noh, 2015) related to future libraries 4.0 which included intelligence-based, massive data, augmented reality, context-aware, cutting-edge displays, and infinite creative space, intelligence-based agents, connected web, ubiquitous web, intelligence connections, and intelligence-based web.

Augmented reality has been effectively used in the health sector; a study (Chalin & Chan 2018) on applied dietary monitoring related to the self-participatory aspect of AR showed that most of the students achieved learning objectives and were positive with exploring with AR. The study suggested (Huang & et.al, 2016) showed that though the library in the public system has provided the orientation of learning path through signage and location but providing a digital interactive innovative service integrating with virtual technology solve the problems of spatial unawareness and domain awareness in learning in libraries. Karambakhsh et. al, (2019) in

their study on deep gesture interaction for augmented anatomy said that augmented reality is helpful in studying anatomy where the students face body organs in the classroom further they suggested that neural networks can be combined with augmented reality as a rising field, and the great potential of augmented reality and neural networks to be employed for medical learning and education systems.

The research done by Shen (2019) investigated the strategic development of a large-scale transdisciplinary area, named intelligent infrastructure for human-centered communities at Virginia Tech. The findings reveal the emerging scenarios around complex adaptive systems, intelligent data infrastructure, and future digital libraries all in the context of building infrastructure for human-centered communities.

The subject Smart Libraries emerging innovation habitat was discussed by Gul & Bano (2019) showed that smart libraries are becoming smarter with the emerging smart technologies, like the Internet of Things, Artificial Intelligence, Blockchain Technology, Augmented Reality which enhances their working capabilities and satisfies the users associated with them. Implementing smart technologies in the libraries has bridged the gap between the services offered by the libraries and the rapidly changing and competing needs of humans.

Effects of an Augmented Reality Library Orientation on Anxiety and Self-Efficacy: An Exploratory Study (Kannegiser, 2021) indicates that academic libraries use scavenger hunt library orientations to engage students and teach them about the library. Libraries are also starting to use augmented reality (AR) technology in orientations, instruction, and programming. The study used both traditional and AR-based orientation for first-year students. The outcome was that both orientations positively impacted students' perceptions of the library; the AR orientation had a significant impact on students' perceptions of librarians' desire to help them. The study made by Saleh et al., (2021) on augmented reality technology in the libraries of universities of medical sciences: a model consisted of strengthening

education, promoting users' information literacy, finding resources, user guidance, gamification, educational justice, helping management, enriching resources, providing new services and economic savings. The advantages were library services, sociocultural excellence, educational level, software potential, and helping the librarian. The challenges were technical, economic, and cultural barriers.

Case Studies on Augmented Reality in Libraries

myLibrARy

In 2014 the University of Applied Sciences Potsdam started myLibrARy, a project to evaluate and explore the fields and scope of the application of AR in public libraries (Freyberg & Wolf, 2016). The main goal was the development of a user-oriented app for libraries with significant features related to augmented reality.

Some of these features are related to AR; some are classic features of library apps that could already be found elsewhere. The prototype was developed by Metaio and was a channel in the Junaio app of Metaio (Tonnis, 2010). Media were identified by optical tracking and image recognition of the book cover. The second prototype was implemented as an independent app where media were identified by scanning the ISBN code. The main idea of myLibrARy was the development of Smart Libraries where smart technologies are an integrated part of the user experience. AR might be a critical element that enables new knowledge due to the semantic and visual contextualization of information.

LibrARi

LibrARi is an image-based AR app for mobile devices and AR glasses that supports users in finding their way to the desired book in the bookshelf (Siddappa, 2014). Since the AR app shows the direct way to the book on the display, the library can be explored interactively and users do not have to bother with classification systems anymore. LibrARi offers to search, locate,

and navigate physical space using a digital interface on a mobile device (Siddappa, 2014). The University of Illinois Library developed a mobile recommender app with augmented reality features called Topic Space. By embedding optical character recognition software, the augmented reality app can recognize the signature on a book in the library and suggest relevant items that are shelved nearby. Additionally, the app shows users media that are generally shelved at the location, but that is currently checked out. (Hahn & Ryckman, 2015)

ShelvAR

The Miami University in Oxford, Ohio developed an ARbased app called ShelvAR intended to support librarians to identify books located in the wrong place in the bookshelf (Wolf & Buttner, 2015). Using the prototype librarians could aim the mobile device (e.g., smartphone or tablet) at the shelf, and books in the wrong place will be marked accordingly. Unfortunately, due to a patent dispute the project was discontinued.

The Bavarian State Library Munich developed the AR app "Ludwig II" that presents location-based services of cultural assets (e.g., unique locations, buildings, monuments) related to King Ludwig II. (Ceynova, 2012). The multimedia content is either displayed on top of a map view or integrated into the live camera video.

DiscoverRoux

Florida Southern College, Roux Library open house event also consists of library orientation that covers students coming to the library, meeting librarians, getting awareness of library resources, and enjoying some pizza. In 2016, the physical event was cut due to some administrative reasons. This left the staff on their terms to get students to the library, reach as many students as possible, and reduce the anxiety of students coming to the library. The Pokemon Go 2016 game inspired incorporating augmented reality in this welcome event using Aurasma AR and Google Card Board for Virtual reality app. With proper advertisement name as "DiscoverRoux"

The Library services, sources related were added. Trigger areas for students were identified, and VR station was set up for the students to use the app; the event become successful with the participation of two-thirds of the strength of the students and their positive feedback, along with offering pizza as food for motivation.

Mysillman AR

Silliman University uses AR for instruction function to enhance the services. The AR has been kept to use through the Mysilliman portal where students have to register through the portal and get access to the resources and services. The tool was used as an aid to reduce anxiety among the students.

Wayfinding and Metadata

Mandal Public Library and Oslo Science Library funded by the Norwegian National Library uses a practical application for Augmented Reality (AR). The two functionalities of this was to develop a prototype app which will have Wayfinding (locating books) and Extra information on books(metadata). The books were located using coded AR lighthouse which is scanned through the mobile and further related to books are guided by enhanced locating guides and further extra information related to the books.

AR in Agricultural Libraries

The artificial intelligence has already been applied in the agriculture sector and is the supporting system and library with its cost-effective plan can implement the AR in the following areas in agricultural libraries, which help meet the vision of digital or virtual library in the future.

Areas for AR implementation in Agricultural Libraries.

- Locating reference books related to agriculture and providing additional print and digital information using 3D and animation. AR can be used to link different types of library holdings and show all media since not everything can be presented in the catalog of the library.

- Providing orientation or information literacy related to agricultural resources and services.
- Enhancing the image of the library with a user-friendly and immersing experience. With the help of AR, the libraries can offer better, and demand actuated service.
- Users are motivated to use the library by providing a personal experience in curiosity, games, puzzles, which improves the discovery of the knowledge.
- Library building navigation, providing additional information on the location of Agri-related cultural and archival collections.
- Creation of additional content and same be incorporated in the AR app for historical agricultural manuals and physical objects related to the agriculture revolution.

Conclusion

The University of Agricultural Sciences GKVK, Bengaluru Library provides one of the e-resources services called Krishichitralaya. The functionality of this video library cum virtual classroom is to provide unique & dynamic real-time online multimedia service to user fraternity. One of the initiatives shows that the library staff can plan innovative services without attracting much cost expenditure and provide value-added services. The same can be incorporated into the AR app medium to become more effective oriented and reach masses through remote access facilities. The IIT Kharagpur Library being the leader in the Digital Library of India, has taken the initiative to provide AR services called a WebAR Based Information Delivery System which consists of an available Web marker that can be scanned through mobile using QR code and it further leads for the Web portal. These are the live examples already been done in India. The AR will be used in all the activities in the future where the next generation is fascinated to it and the agricultural information centers cannot ignore this innovative service and lag behind.

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