MAJOR PROJECT RESEARCH

Merge Cube as a New Teaching Tool for Augmented Reality

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Merge_Cube_as_a_New_Teaching_Tool_for_Augmented_Reality.pdf

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Amazon Merge Cube - Augmented & Virtual Reality Science & STEM Toy - Educational Tool - Hands-on Digital Teaching Aids - Science Simulations - Home School, Remote & in Classroom Learning - iOS & Android

- educational app process since 2017
- solar system, world monuments, and marine animals, and two entertainment parts
- Unity 3D environment for mobile operating system Android
- intended for hospitalized children
- we can modify the content - it is open source
- Teaching through mobile devices is called m-learning or mobile learning
- In 2013, Volkswagen’s car company introduced the Marta (Mobile Augmented Reality Technical Assistance) application. The application contained service manuals for car repairs and, through augmented reality, instructed the user on how to perform individual service tasks

- head-mounted displays for surgeon’s, based on projected augmented reality
- merge cube software can turn the cube into a hologram.
- By synchronizing the cube with the application and then rotating the physical cube, we see a virtual representation of 3D objects through the screen of the device
- disadvantage of these applications is that they provide only part of their functionality for free and then you have to pay for a license
- **Explorer-offers the largest database of comprehensive educational materials in the form of animated scenes; shows a sample of educational materials from the Explorer application - the development of the solar system.**

- **Principles of Augmented Reality**

1. 2D Image tracking - tracking and detection of image elements obtained from the camera image, which are compared with the target images stored in the device database.
2. 3D Object tracking - detection and tracking of 3D objects, which are created by scanning a physical object from all sides.
3. Face tracking - identifying the facial area and creating a 3D network (drawing elements that correspond to the contours of a human face).
4. Body tracking - tracking and recognition of the human body, its position (we obtain an outline that we can overlap with graphic elements or insert into the image of avatars).
5. Plane detection - detection of the plane (table, floor, etc.) on which we place 3D models.
6. Point clouds - a map consisting of millions of points containing unique data that defines their location in 3D space.
7. Cloud recognition - an online image recognition service that can recognize and track as many as millions of image (more info is describe [30]).

- **Object Viewer-**The database consists of hundreds of objects that can be viewed in detail, arbitrarily enlarged, and reduced; (for example dinosaurs, ancient artefacts -

history, animals, anatomy of human parts - biology, computer parts - computer science, etc.)

Hologlobe - application that allows you to examine satellite images of the planet Earth in detail; views containing scientific data, such as information on precipitation, clouds, ocean and land temperatures, the occurrence of glaciers, fires, etc.

CoSpaces is a web-based application7 that allows users to build virtual worlds or to create object which can be located in augmented realit

several tools or web pages to create own applications for the Merge cube

- Merge Edu - A simple online tool [30] to create AR
- CoSpaces - a more advanced online editor in which the Merge cube is directly integrated
- Unity - a game engine to create 2D and 3D games.
- Unreal Engine - a game engine to create 2D and 3D games. Very similar software as Unity.
- currently working on another educational app for Merge Cube with new educational functionality focusing on other areas such as physics, mathematics and other natural sciences

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Enhancing Biomedical Education with Real-Time Object Identification through Augmented Reality

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- mobile augmented reality (AR) platform aimed at training first and second-year STEM majors in college, specifically focusing on the identification and usage of laboratory instruments
- utilizes computer vision and AR technologies
- features such as a knowledge test, guided navigation using Google Map API, and the ability to build a library of laboratory instruments through augmented reality
- Tools - Unity 3D Game engine and ARkit-XR plugin
- Future research will focus on expanding the platform to include chemistry and physics labs while incorporating additional functionalities to deepen students' understanding of laboratory instruments and improve the overall learning environment.

Fighting Pandemics With Augmented Reality and Smart Sensing-Based Social Distancing

Fighting_Pandemics_With_Augmented_Reality_and_Smart_Sensing-Based_Social_Distancing.pdf

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- DistAR, an android-based application for social distancing leveraging AR and smart sensing using on-device analysis of optical images and environment crowdedness from smart campus data.

- combine AR and smart sensing technologies to create a real-time social distancing application
- hardware to access AR augmentations, i.e., ubiquitous smartphones and specialized head-mounted displays (HMDs), such as the Microsoft HoloLens.
- smartphone-based AR applications, the device renders virtual augmentations on top of the video feed from the world-facing camera.
- HMD-based AR directly displayed in front of users' eyes
- example - citywide user navigation and displaying virtual nutritional information for food items in a supermarket.
- AR applications, such as Sodar[2] and ARAroundME,[3] are developed to overlay social distancing guidelines in real-world environments
- DistAR helps users to make safe choices when navigating environments by displaying distance visualizations
- estimation of the distances around the user requires using the depth API from ARCore, which is currently only supported on android.

- collect various measurements, including CO2, light levels, noise, etc
- The real-time sensor data are sent to a storage server over LoRaWAN using the university 5G test network.
- The centralized data are accessed in real time using a RESTful API.
- Several benefits arise from using WebXR, for example, accessing applications without needing to install from a traditional "app" store.
- **Future Directions/ Scope - Cross-Platform AR Applications** as many devices as possible, such as Apple's iPhone; This cross-platform access would be significantly easier with development using the aforementioned WebXR API. However, there is still a lack of general support for the API on iOS.

- AR is not limited to smartphones; HMDs are important devices for immersive AR experiences, for example, Microsoft’s HoloLens 2.
- Using HMD-based applications would allow users to free up their hands instead of holding up a smartphone to analyze their surroundings constantly.
- **QoE and User Acceptance -** Ensuring a good user experience is essential for any AR application, regardless of the use case.

Development and Evaluation of Augmented Reality Learning Content for Pneumatic Flow: Case Study on Brake Operating Unit of Railway Vehicle

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Development_and_Evaluation_of_Augmented_Reality_Learning_Content_for_Pneumatic_Flow_Case_Study_on_Brake_Operating_Unit_of_Railway_Vehicle.pdf





In this study, AR content was designed for maintenance staff to effectively train pneumatic flow of railway vehicle BOU. This content displays the pneumatic flow as streamlines matched to each other in a 2D circuit diagram and a 3D model by using SLMVC and CEPC algorithms. To verify the usability of the developed content, an experiment was conducted by dividing into group A using the existing booklet-type manual and group B using AR content. The conclusions obtained through the study are as follows:

1. The pneumatic flow was simultaneously displayed in a 2D pneumatic circuit diagram and a 3D model using the SLMVC algorithm. As a result, it was possible to match the two pneumatic flows with each other and it showed a 62% reduction in the performance part score of NASA-TLX.
2. Dot-shaped particles are continuously emitted and could display pneumatic flow as streamlines by using the CEPC algorithm. As a result, it was possible to intuitively learn the pneumatic flow, which was difficult to identify with the naked eye and it showed a 64% reduction in the frustration part score of NASA-TLX.
3. As a result of the experiment for the NASA-TLX survey, the difference in mean completion time was insignificant. However, the mean number of correct answers increased by 68% in group B, and the perceived workload decreased by 28% in group B.
4. Except for these, because AR content was designed based on MAR in consideration of the environment of railway vehicle maintenance work, it is convenient to utilize and not limited by time and space.

In conclusion, The developed content in this study is a practical system that could overcome the shortcomings of the existing education method and increase the efficiency of job training. If railway operating organizations use AR content as educational materials for new employees or job transitioners, it will revolutionize maintenance education.