

Implementation of Image processing using augmented reality

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Abstract - Augmented reality is the new paradigm shift in this world of ever changing technological marvels. Augmented reality is the integration of virtual elements in real world environment. It is a new perspective of looking at information in conjunction with the real world. In this paper, we proposed to develop a simple mobile educational application using augmented reality resources. The proposed system will use different image processing like text recognition, marker based, marker less, cloud based, model tracking.

elements. Virtual Reality enables the user to fully immersed in the three-dimensional virtual environment while augmented reality aims to combine the elements of virtual and real elements.

Key Words: Augmented Reality, Educational system, Image Processing, MAR (Mobile Augmented Reality)

1. INTRODUCTION

The new age of technological development is further changing the education environment from the traditional classroom scene with blackboard and chalk to smart education appliances such as projectors, teaching aids, tablets, e-book reader offering vast opportunities of information and various challenges to the student and the teacher. Following along this, researches are conducted to introduce a new way of teaching and learning experiences. Among these is the possibilities of bringing augmented reality to pedagogical applications, providing user with visualization, interaction and experimentation of the educational objects.

Through Augmented reality, it is possible to further enhance the learning experiences by creating a more enhanced level of user engagement through the visualization of the 3D objects interposed to real ones.

As augmented reality is recognized in the educational aspect, researcher are finding new strategies to improve the learning experience. Considering this, Nincarean et al proposed that augmented reality efficiency be improved by combining with other technologies like the mobile device hence incorporating a lot of useful features such as portability, social connection, connectivity and individuality thus a new concept is formed called Mobile Augmented Reality(MAR).

2. Augmented Reality

Augmented reality is the integration of the virtual world and the real world in which the virtual element is present along with the real world. To achieve a more deeper understanding of the contrast between augmented reality and virtual reality. Milgram and kishino implemented a continuum called the Milgram Virtual Continuum. They defined it as the real world "augmented" by means of virtual

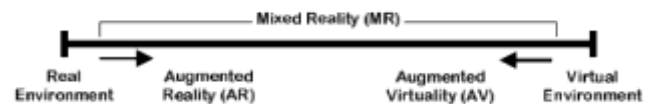


Fig 2.1: Milgram's Virtual Continuum

As computer increases in processing and its size becomes smaller, mobile devices or wearables becomes increasingly feasible and people are able to access the online world at any place at any time. This new flexibility of the mobile devices allows a new breed of applications that can change the paradigm of technology. Augmented reality application added on the mobile devices provides portability, social connectivity, individuality as additional features.

2.1. Image Processing

Various types of image processing is used in augmented reality for a lot of different input sources. According to the input sources various output can be generated.

2.1.1. Text Recognition

Text Recognition otherwise referred to as OCR(Optical Character Reader). It involves a system capable of translating an image of text into machine editable text or into standard encoding scheme representing each one of them. Its real application is in bank, offices, post office, etc where image of documents needs to be converted into an editable document.

The Steps are:

1. **Preprocessing:** It is the first step in processing of the scanned image. The scanned image is then checked for noise, skew and slant. After that the scanned image is converted into grayscale and then turn into binary.
2. **Segmentation:** After preprocessing, the noise free image is passed to the segmentation phase, where the image is decomposed into individual characters. The binarized image is checked for inter line spaces. If the inter line spaces are detected then the images is segmented into sets of paragraphs across the interline gap. The lines in the paragraph are then scanned for horizontal space intersection with respect to the background. Histogram is used to detect the width of the horizontal lines then it is

scanned vertically for vertical intersection, it is also used to detect the words. Then the words are decomposed into characters using character with computation.

3. **Feature Extraction:** After segmentation, feature extraction follows it. Here individual image glyphs is considered for image extraction.
4. **Classification:** Classification follows after feature extraction as it is done after comparing each character glyph with its own corresponding glyphs. These features are then analysed using set of rules and labelled as belonging to another class. This classification is generalized so that it only works for a single font.

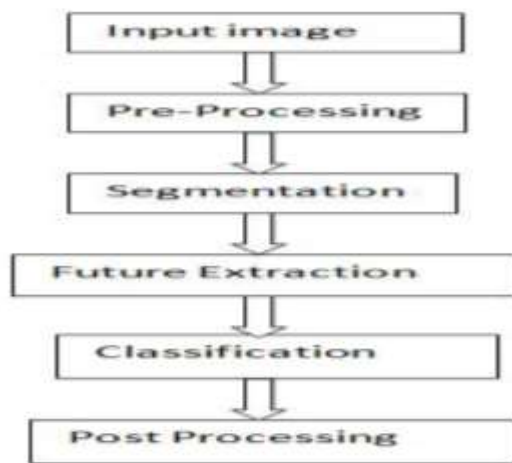


Fig 2.2: Flowchart of Text Recognition

2.1.2. Marker Recognition

Marker is an image (it could be anything) that can be uniquely identified and not be confused with other image as it will be the gateway through which virtual elements can be brought into the real world. The application is programmed to recognize the marker in an arbitrary scene and give details of its locations and orientation.

To recognize a marker, the following steps are followed:

1. **Input:** The image is captured using the onboard camera or the camera connected to the system. It can be either captured as live still image or as a video, preferably a video is used and the input is then send for processing further down the steps.

2. **Grayscale Conversion:** The input frame is done in the intensity plane and then converted to the grayscale. Input of an android phone is given in RGB format and so it is converted into grayscale.

3. **Thresholding:** After this the image is converted into binary image so that a binary image component analysis can be performed. Two types of threshold is used for the conversion:

Adaptive Threshold and Global Threshold.

4. **Blob Analysis:** we move on from the image plane to a group of connected components with geometrical properties of each one.

2.1.3. Markerless Recognition

This image processing is different from the other recognition as it uses no predefined marker but it uses a marker created from the images captured through the camera. The proposed methods has two steps:

1. **Preprocessing:** A 3d model of the environment is reconstructed using SfM methods using images taken from multiple viewpoint. The position and orientation of all the viewpoint is then stored in a database. After that the coordinates of the augmented 3d component is defined in according to the real viewpoint and then store in the database. Here, SURF (Speeded up Robust Features) is used instead of SIFT(Scale Invariant Feature Transform) for interest point detection.
2. **Real time Processing:** First the files stored in the database is imported in this process and using SURF the feature point is extracted from the live stream. After that the 3d components are rendered using the orientation and position of the real world coordinate taken from the captured image.

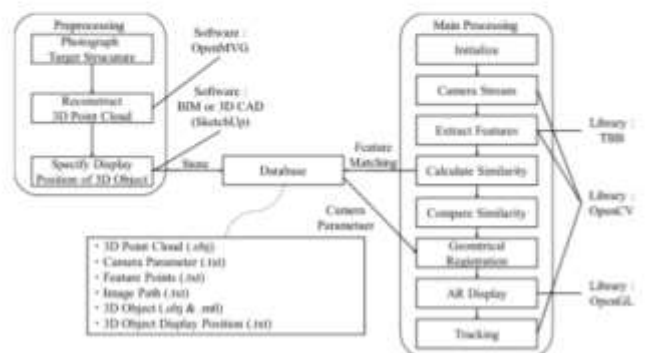


Fig 2.3: Markerless Recognition

3.Framework Used:

3.1. Vuforia (QCAR):

Vuforia is a product of Qualcomm Connected Experiences. It is a software platform that enables the use of best and most creative experiences of augmented reality. Vuforia uses

superior image recognition algorithm and with the support of multiple platforms such as Android, iOS, Unity, Web based browser. It is much more better than the other toolkits which only offer a single platform.

3.2. Unity 3D:

Unity3D is an IDE platform for developing games. It can also developed complex application. It features a huge 3D creation features and is able to support Vuforia so that it can implement augmented reality application much easier and faster. It is processed in two languages C# and javascript and the frontend designed using xaml.

4. SYSTEM ARCHITECTURE

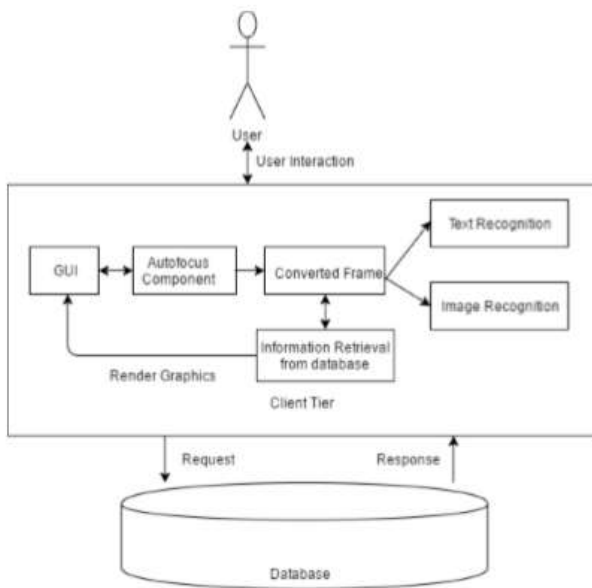


Fig 4.1: Proposed architecture

The proposed architecture is given above. The above architecture is comprised of multiple modules. Let us see their roles in the architecture.

GUI: Graphical User Interface, it act as the basic interface between the user and the programs.

Autofocus programs: It is the component used to focus the image so that the marker is easily recognized.

Information retrieval from database: Information is retrieved from the database in according to the marker recognized.

Converted frame: The Input frame and the output frame is integrated into a single frame thus making the real world be augmented by the virtual world.

5. IMPLEMENTATION

Implementations of each role of the component of the system. The implementation is done in unity and Vuforia.

5.1. Setting up Vuforia

To get started, Vuforia’s Developer Portal is set up, and an account is created. Once logged in, a developer page is available. A license key works as an ID to create an application in Unity using Vuforia. This license key is created in the developer page with the help of a “License Manager”. Next, the “Target Manager” is used to add Image Target in Unity. This is done by adding an Image Target database and filling in the details. Images are added to the newly made database. Vuforia supports various kinds of targets like a single flat image, cylindrical, cuboidal, 3D image, etc. Lastly, this Image target database is downloaded for importing into Unity. This is done with the help of the “Download Dataset”.

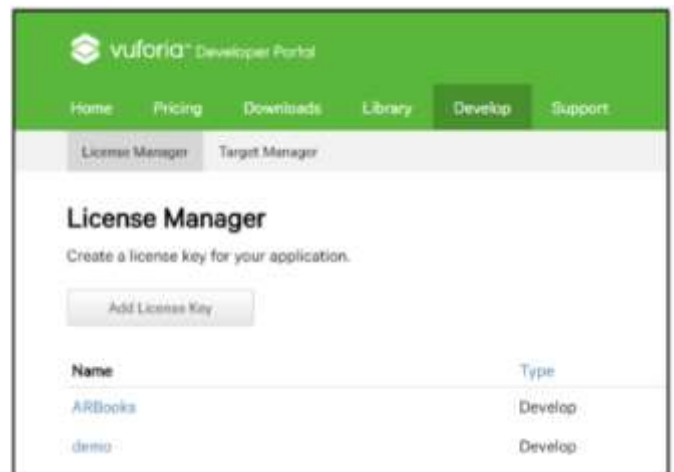


Fig 5.1: Vuforia Developer Portal

Fig.5.1 shows the Vuforia Developer Portal where the license keys can be managed and the targets can be uploaded.

5.2. Integrating with Unity

Unity is a cross-platform application engine developed by Unity Technologies which provides a framework for designing game or app scenes for 2D and 3D. “ARCamera” is an Augmented Reality camera prefab from Vuforia. Image Target is added to the scene which is be found in the “Prefabs” folder. Fig. 5.2 shows the Image Target that is added into Unity which is obtained by importing the dataset downloaded from Vuforia.

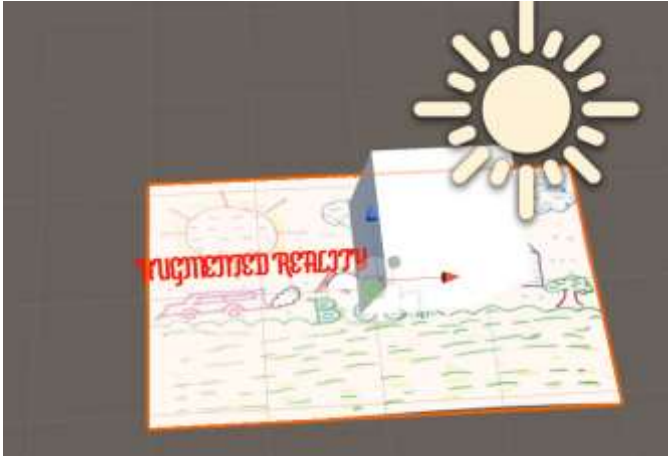


Fig 5.2: Image Target

5.3. Recognition

Text recognition, marker recognition or markerless recognition are all recognized in this phase. Text recognition will recognize the text from the words and augment it. Similarly both marker and markerless are recognized and augmented over the marker.

5.4. Model Augmentation



Fig 5.3: Augmented Model

After the system is ready with all the recognition processes, then the models are augmented on top of the markers. It is found under "Model" folder in Assets. For the model to appear over Image Target, it is made a child of Image Target. This is simply done by dragging the model prefab in the Hierarchy panel. Whenever the Image Target is detected by a mobile device's camera, all the children of the target also appear together.

5.5. Deploying the System

After developing the system, the most important step is to deploy it on platforms which make it usable for users. Unity provides the advantage of deploying the system on multiple platforms such as Android, iOS, etc.. The company name and the Bundle identifier are changed in the build settings for the

system to be deployed. Fig.5.4 shows these changes where the Bundle identifier and company name are added to the system deployment build settings.



Fig 5.4: Changing Build Settings

5.6. Running the Application

After deploying the application, a package is made available for installation. After installing the package, the system will start, and the camera module will begin. Then, the user has to only hover the camera over the provided text or image, and the corresponding graphics will be rendered.

6. CONCLUSION

The system "Implementation of real time image processing in augmented reality" is implemented where a user can hover a camera over a page and obtain augmented information such as 3D Model, video or an explanation about that page. It is a system where no typing or searching is required for getting information. The application provides a helping hand to the children by facilitating them to learn new concepts using graphical aid. Since the application can be deployed on any smartphone, a student can use it as per his/her convenience. Also, there is no need of any extra maintenance for this application thus making it an economical solution. The interactivity aspect of this application like showing the 3D model allows the user to understand the concept from every angle. The application can be expanded further and used for various age groups for not only learning but also helping the users to visualize and grasp things faster. It provides a unique and interesting way of learning and understanding of unknown concepts.

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