Augmented Reality Using Image Markers for Electromechanical Devices: A Research

Bhupinder Singh, Dr. Rajneesh Talwar

Abstract—Augmented Reality (AR) employs computer vision, image processing and computer graphics techniques to merge digital content into the real world. This research describes marker based Augmented Reality (AR) which combines the real image and virtual image together to show the 3D view of electromechanical devices while popping up the matched image like alternators, DC generators, stepper motors, actuators, dash ports and many more devices. The Matlab simulink 2014a is used for the purpose to implement augmented reality application on electromechanical devices for innovative study. This can be designed by installing OS generic video interface and using SURF features to locate and recognize objects and pops up the virtual image. The video related to the particular reference image being started just after the matching of virtual image with the real image. This proposal describes augmented Reality (AR), that is applies to education that clear the ideas of scholars still as lecturers in learning and also the possible impact on the long run of education.

Index Terms—Computer, Markers, Real, Virtual, SURF, win video

I. INTRODUCTION

This paper focuses primarily on learning with augmented reality technology, a vital feature of computer-based technology, and attainable advantage if used suitably is that, it permits the presentation of multimedia system educational messages [4] that's, educational messages consisting of words (spoken or printed) and photos (such as animation, video or 3D illustrations). Computer-based technology conjointly permits levels of interactivity and graphic rendering [3]. one among main benefits of using this technology is that the student’s adhesion that permits the institution of contact whereas finding out tasks. Learning processes accustomed be long, involving plenty of boring didactical material resulting in students throwing in the towel of subjects. AR technology permits interaction, motivation and it will even be used at home. It’s true that adhesion to any technology disappears overtime if used off.

This kind of technology can target the precise content of the topic avoiding the study turning into a routine once students are not any longer curious about it.[1] during this paper the advantages of teaching and learning are analyzed moreover because the use of didactical material with extra data provided by augmented reality against the use of ancient class notes. This AR primarily based application facilitate them to be told the electromechanical devices with interest. These markers used are common in electronics and communication engineering.[1] Students ought to master these fundamental subjects for eminent professional performance.

II. AUGMENTED REALITY ENVIRONMENTS

Augmented reality (AR) merges 3D virtual objects into a real environment and then in real time displays this augmented image to the user. Unlike virtual reality which seeks to immerse the user in a synthetic environment, AR supplements the real world with synthetic information. This makes AR the perfect tool to aid and even enhance human perception and interaction.

Figure 1. Example of a simple augmented reality system setup.

However, an augmented reality atmosphere permits the user to visualize the real world with virtual computer-generated objects superimposed or merged with real surrounding. A basic theme of an augmented reality system consists of a camera that captures snapshots of the real world connecting to a computer that produces necessary calculations for merging virtual objects into the real scene. The result is a picture shown to the user through a graphic interface.

Figure 2: Augmented Reality Technology Display[4]

Short characteristics of an AR environment:

- Combines real and virtual environments
- Is real-time interactive
- Is registered in three dimensions

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III. FLOW CHART OF ALGORITHM USED TO DESIGN AR APPLICATION

Figure 3: Flow chart of Algorithm used to design the application

IV. IMAGE MARKERS

We are using image markers in this application as they have variety of advantages.

- Image markers can use ordinary (color) images as markers.
- To help detection and pose calculation Image markers usually have a border or other landmarks, but these are optional.
- Image markers are mostly recognized by using feature matching which is resourceful process[6]
- Detecting images without frames comprise an advantage of operating AR applications in an existing environment without changing to the environment itself. For example, an AR application may convey supplementary value to a book by not changing the book itself. The images on hand book could be use in AR application to explode out extra 3D visualization, animation, etc.

In this, AR application markers can be detected by their natural features and calculates the comparative pose of the camera by matching features to the original reference image.[6]

A. Markers used in Application

As this research describes marker based Augmented Reality (AR) using image markers, that how it applies to education and learning and helps the students in both technical and non technical fields and the potential impact on the future of education. Basically, this work shows the 3D view of electromechanical devices video like alternators, DC generators, stepper motors, actuators, dash ports and many more devices which students often cannot understand. It shows the complete knowledge of devices in a better way. So these electromechanical device’s images can be used as reference images. These are markers used in real time shown below.

Table 1: Marker used

<table>
<thead>
<tr>
<th>Reference Image No.</th>
<th>Device Name</th>
<th>Markers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Actuator</td>
<td><img src="image1.png" alt="Actuator" /></td>
</tr>
<tr>
<td>2</td>
<td>DC generator</td>
<td><img src="image2.png" alt="DC generator" /></td>
</tr>
<tr>
<td>3</td>
<td>Alternator</td>
<td><img src="image3.png" alt="Alternator" /></td>
</tr>
<tr>
<td>4</td>
<td>Cathode ray tube</td>
<td><img src="image4.png" alt="Cathode ray tube" /></td>
</tr>
<tr>
<td>5</td>
<td>Dash port</td>
<td><img src="image5.png" alt="Dash port" /></td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Image</td>
</tr>
<tr>
<td>---</td>
<td>------------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>6</td>
<td>Air compressor control</td>
<td><img src="image1.jpg" alt="Image" /></td>
</tr>
<tr>
<td>7</td>
<td>Dynamometer</td>
<td><img src="image2.jpg" alt="Image" /></td>
</tr>
<tr>
<td>8</td>
<td>Loudspeaker</td>
<td><img src="image3.jpg" alt="Image" /></td>
</tr>
<tr>
<td>9</td>
<td>Magnetic amplifier</td>
<td><img src="image4.jpg" alt="Image" /></td>
</tr>
<tr>
<td>10</td>
<td>Generator</td>
<td><img src="image5.jpg" alt="Image" /></td>
</tr>
<tr>
<td>11</td>
<td>Magnetron</td>
<td><img src="image6.jpg" alt="Image" /></td>
</tr>
<tr>
<td>12</td>
<td>Solenoid</td>
<td><img src="image7.jpg" alt="Image" /></td>
</tr>
<tr>
<td>13</td>
<td>Sparkplug</td>
<td><img src="image8.jpg" alt="Image" /></td>
</tr>
<tr>
<td>14</td>
<td>Stepper motor</td>
<td><img src="image9.jpg" alt="Image" /></td>
</tr>
<tr>
<td>15</td>
<td>Temperature sensor</td>
<td><img src="image10.jpg" alt="Image" /></td>
</tr>
<tr>
<td>16</td>
<td>Utility transformer</td>
<td><img src="image11.jpg" alt="Image" /></td>
</tr>
<tr>
<td>17</td>
<td>Induction motor</td>
<td><img src="image12.jpg" alt="Image" /></td>
</tr>
<tr>
<td>18</td>
<td>Gearbox</td>
<td><img src="image13.jpg" alt="Image" /></td>
</tr>
</tbody>
</table>

V. SURF FEATURES

In laptop vision, speeded up robust features (SURF) could be a native feature detector and descriptor which is able to be used for tasks like seeing or 3D reconstruction. It's partially impressed by the scale-invariant feature transform (SIFT) descriptor, the standard version of SURF is persistently faster than SIFT and claimed by its authors to be lots of strong against whole completely different image transformations than SIFT. [8]

To understand interest points, SURF uses associate number approximation of the determinant of hessian blob detector, which can be computed with three number operations employing a pre computed integral image. Its feature descriptor is predicated on the total of the Haar ripple response round the purpose of interest. These may also be computed with the help of the integral image.

SURF descriptors will be used to find and acknowledge objects, individuals or faces, to form 3D scenes, to trace objects and to extract points of interest. [8]

**Syntax**

```python
points = detectSURFFeatures(I)
points = detectSURFFeatures(I,Name,Value)
```
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A. Algorithm
The SURF algorithmic program is predicated on identical principles and steps as SIFT however details in every step are totally different. The algorithmic program has 3 main parts: interest purpose detection, native neighborhood description and matching.[8]
The SIFT approach uses cascaded filters to sight scale-invariant characteristic points, wherever the distinction of Gaussians (DoG) is calculated on rescaled pictures more and more. In SURF, square-shaped filters are used as associate approximation of mathematician smoothing. Filtering the image with a square is far quicker if the integral image is employed, that is outlined as:

\[ S(x, y) = \sum_{i=0}^{x} \sum_{j=0}^{y} I(i, j) \]

The total of the first image at intervals a parallelogram will be evaluated quickly exploitation the integral image, requiring four evaluations at the corners of the parallelogram.[8]
SURF uses a blob detector supported the hessian matrix to search out points of interest. The determinant of the hessian matrix is employed as a live of native modification round the purpose and points are chosen wherever this determinant is outside. In distinction to the Hessian-Laplacian detector by Mikolajczyk and Schmid, SURF jointly uses the determinant of the boot for choosing the dimensions, because it is finished by Lindeberg. Given some extent \( p = (x, y) \) in a picture \( I \), the boot matrix \( H(p, \sigma) \) at purpose and scale \( \sigma \), is outlined as follows:

\[ H(p, \sigma) = \begin{pmatrix} L_{xx}(p, \sigma) & L_{xy}(p, \sigma) \\ L_{xy}(p, \sigma) & L_{yy}(p, \sigma) \end{pmatrix} \]

where \( L_{xx}(p, \sigma) \) etc. are the second-order derivatives of the grayscale image.
The box filter of size 9×9 is associate approximation of a Gaussian with \( \sigma=1.2 \) and represents rock bottom level (highest spatial resolution) for blob-response maps.[7][8]

VI. MATCHING
By comparing the descriptors obtained from different images, matching pairs can be found.[9]

Syntax
Index Pairs=match Features(features1,features2)
example[indexPairs,matchmetric]=match Features(features1,features2)
[indexPairs,matchmetric]=match Features(features1,features2,Name,Value)
Description of images - Figure 3: 3a) - Showing alternator marker in front of Web cam. 3b) - win video preview captures the frame 3c) - Detecting SURF features of real image. 3d) - Detecting SURF features of virtual or reference image. 3e), 3f), 3g) - Shows the matching of real image with reference image. Real image is matched with all the reference images, some of them are shown above(53 e), 3f). The matched with the image contains highest index pairs as in 3 g). 3h) Matched reference image pops up. 3 i) video started related to matched image.

VIII. MATCHING RESULTS OF ALTERNATOR MARKER HAVING HIGHEST INDEX PAIRS

A conclusion section is not required. Although a conclusion may review the main points of the paper, do not replicate the abstract as the conclusion. A conclusion might elaborate on the importance of the work or suggest applications and extensions.

Table 2: Different feature values of alternator markers resulting highest index pairs while displaying in front of camera ie (Min 1; Max 211)
toolbox which uses a hardware and support packages that includes OS generic video interface. Furthermore, we uses SURF features which used an integer approximation of the determinant of Hessian blob detector. When index pairs are high while matching, then video corresponding to the particular image started playing in 3D using matlab. Thus, research describes marker based Augmented Reality (AR) using image markers, which applies to education to help the students in both technical and non technical fields. This work depicted the 3D view of electromechanical devices video like alternators, DC generators, stepper motors, actuators, dash ports, motors and many more devices which students often cannot understand. It shows the complete knowledge of devices in a better way.

IX. MATCHING RESULTS OF OTHER MARKERS HAVING HIGHEST INDEX PAIRS

Table 3: Different values of markers with highest index pairs while displaying in front of camera

<table>
<thead>
<tr>
<th>SNo</th>
<th>Marker Name</th>
<th>Frame Value</th>
<th>Frame Features value</th>
<th>Frame Points value</th>
<th>Reference Name</th>
<th>Reference Features value</th>
<th>Reference Points value</th>
<th>Highest Matching Index Pairs Value Min/Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Alternator</td>
<td>1024x1200x3</td>
<td>216x64</td>
<td>single</td>
<td>SURF Points</td>
<td>48x2</td>
<td>1,218</td>
<td></td>
</tr>
</tbody>
</table>

REFERENCES


CONCLUSION

The results of the application of Augmented Reality using image markers for electromechanical devices are obtained. Earlier, AR tool kit was used to design the mechanical elements which has limitations but we design a application of AR using MATLAB 2014a which uses a image acquisition