

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 Mat lab 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 oft.

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.

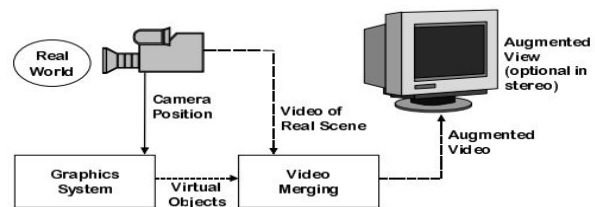


Figure 2: Augmented Reality Technology Display[4]

Short characteristics of an AR environment:

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

Manuscript received July 24, 2016

Bhupinder Singh, M .tech student Deptt of ECE; Chandigarh Group of Colleges Technical Campus, Jhanjeri

Dr. Rajneesh Talwar, Principal, Chandigarh Group of Colleges Technical Campus, Jhanjeri

III. FLOW CHART OF ALGORITHM USED TO DESIGN AR APPLICATION

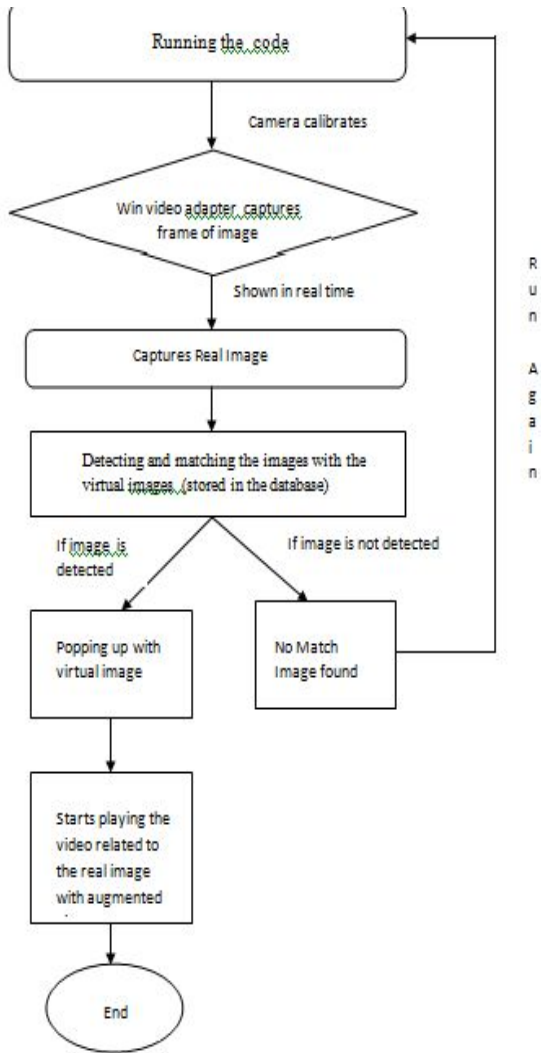


Figure 3: Flow chart of Algorithm used to design the application

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.



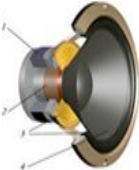
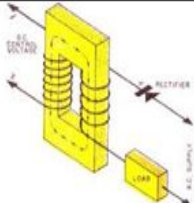

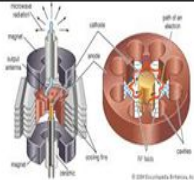
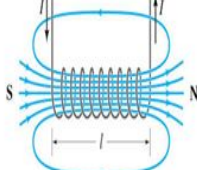


In this, AR application markers can be detected by their natural features and calculates the comparative pose of the camera by matching features to the original reference image.[6]





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

Reference Image No.	Device Name	Markers
1	Actuator	
2	DC generator	
3	Alternator	
4	Cathode ray tube	
5	Dash port	

6	Air compressor control	
7	Dynamometer	
8	Loudspeaker	
9	Magnetic amplifier	
10	Generator	
11	Magnetrons	
12	Solenoid	
13	Sparkplugs	
14	Stepper motor	

15	Temperature sensor	
16	Utility transformer	
17	Induction motor	
18	Gearbox	

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

```
points = detectSURFFeatures(I)
points = detectSURFFeatures(I,Name,Value)
```

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 conjointly 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 σ , 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]=matchFeatures(features1, features2)
 [indexPairs, matchmetric]=matchFeatures(features1, features2, Name, Value)

VII. PRACTICAL RESULTS

we used the MATLAB SIMULINK 2014a for the purpose to implement augmented reality application on electronic and electrical 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. The results obtained after executing the application are shown below: As we use 18 image markers. some of them results are shown using images.

ALTERNATOR as Image marker using reference image 3 from Table 1

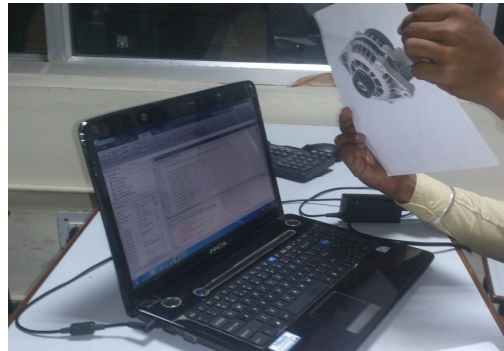


Figure 3a)

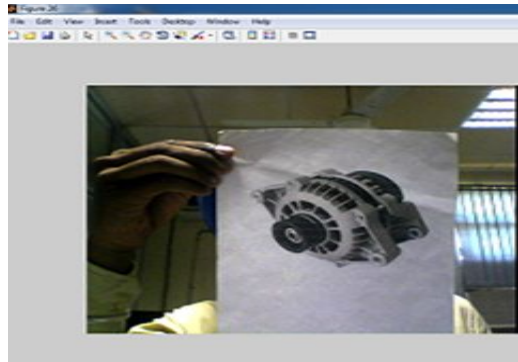


Figure 3 b)

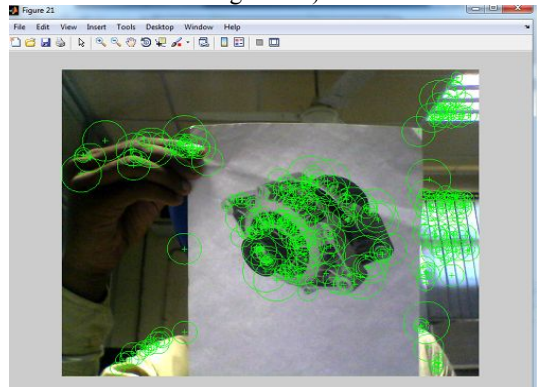


Figure 3 c)

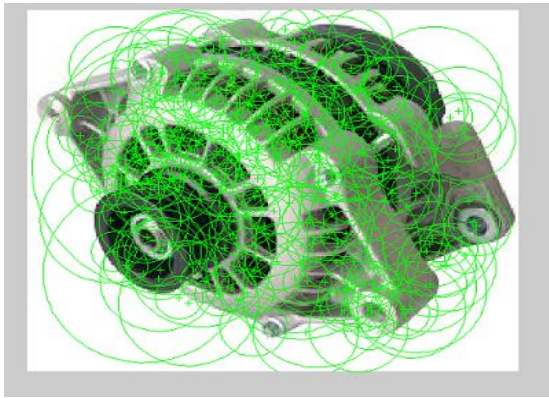


Figure 3 d)

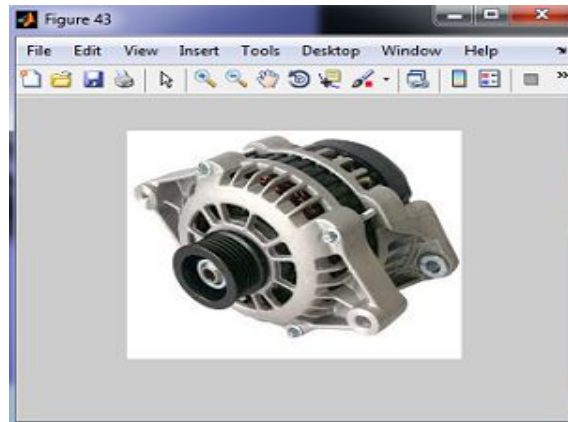


Figure 3 h)

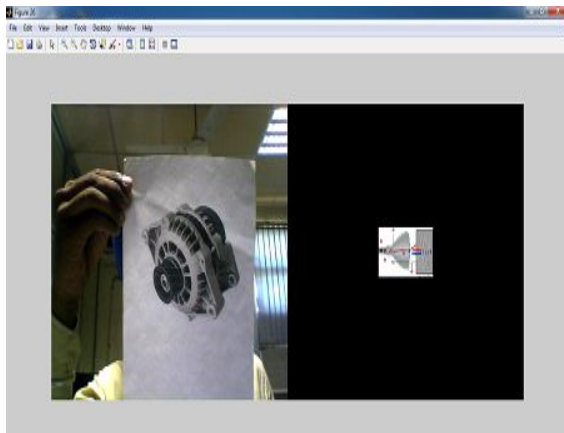


Figure 3 e)

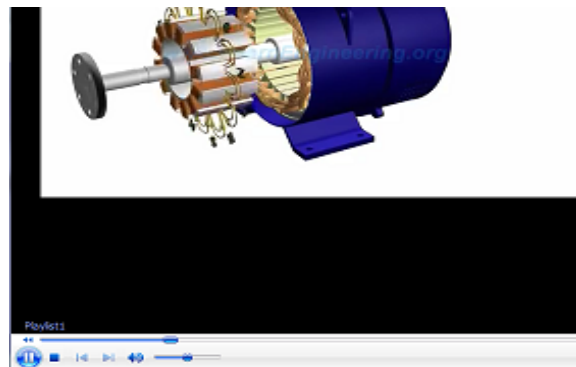


Figure 3 i)

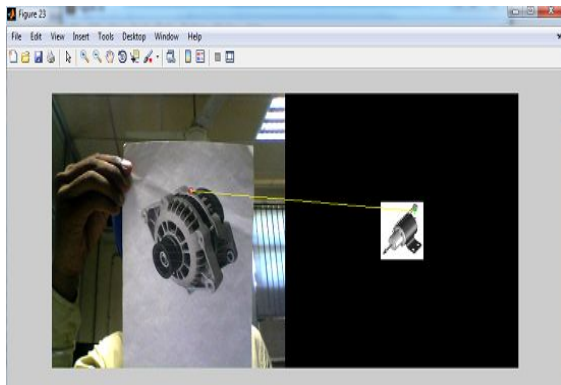


Figure 3 f)

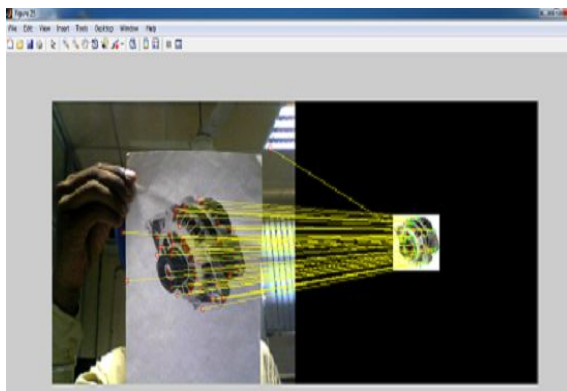


Figure 3 g)

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)

S.No	Marker/ reference image Name	Frame Value	Frame Features value	Frame points value	Reference features value	Reference image 'value	Reference pts value	Highest matching Index pairs value Min/ Max
1	Alternator	1024x1280x3 uint8	214x64 single	214x1 SURF Points	214x64 single	204x247x3 uint8	214x1 SURF Points	43x2 uint32 1,211

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

S.No	Marker/ reference image Name	Frame Value	Frame Features value	Frame points value	Reference features value	Reference image 'value	Reference pts value	Highest matching Index pairs value Min/ Max
1	Actuators	1024x1280x3 uint8	88x64 single	88x1 SURF pts	101x64 single	217x233x3 uint8	101x1 SURF Points	18x2 uint32 1,81
2	Air Compressor	1024x1280x3 uint8	77x64 single	77x1 SURF Points	84x64 single	225x225x3 uint8	84x1 SURF Points	12x2 uint32 1,54
3	Alternator	1024x1280x3 uint8	214x64 single	214x1 SURF Points	214x64 single	204x247x3 uint8	214x1 SURF Points	43x2 uint32 1,211
4	CRT	1024x1280x3 uint8	134x64 single	134x64 single	115x64 single	171x295x3 uint8	115x1 SURF Points	{33,5,82,2 2,89,22,1 01,22} 5,101
5	Dash ports	1024x1280x3 uint8	217x64 single	217x1 SURF Points	570x64 single	800x665x3 uint8	570x1 SURF Points	40x2 uint32 2,499

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 MAT LAB 2014a which uses a image acquisition

REFERENCES

- [1] Jorge Martín-Gutiérrez “Proposal of Methodology for Learning of Standard Mechanical Elements Using Augmented Reality” 978-1-61284-469-5/11/\$26.00 ©2011 IEEE October 12 - 15, 2011, Rapid City, SD 41st ASEE/IEEE Frontiers in Education Conference T1J-1
- [2] [Matt Dunleavy, Chris Dede “Augmented Reality Teaching and Learning” In J.M. Spector, M.D Merrill, J. Elen, & M.J. Bishop (Eds.), The Handbook of Research for Educational Communications and Technology (4th ed.). New York: Springer.
- [3] Mayer, R.E. (2010) Learning with Technology. In Hanna Dumont, David Istance and Francisco Benavides (Eds). The nature of learning. Using research to inspire practice. Centre for educational research and innovation, pp. 179-198, OECD Publishing.
- [4] Mayer, R.E. (2009). Multimedia Learning. Cambridge University Press-2nd edition, New York.
- [5] Azuma, R. (1997). A Survey of Augmented Reality, Presence: Teleoperators and Virtual Environments. 6 (4), 355-385.
- [6] Sanni Siltanen “Theory and applications of marker-based augmented reality” ISBN 978-951-38-745 6 (URL: <http://www.vtt.fi/publications/index.jsp>) ISSN 2242-1203 (URL: <http://www.vtt.fi/publications/index.jsp>) Copyright © VTT 2012
- [7] P M Panchal, S R Panchal, S K Shah (2013) “A Comparison of SIFT and SURF” International Journal of Innovative Research in Computer and Communication Engineering Vol. 1, Issue 2, April 2013
- [8] Herbert Bay, Tinne Tuytelaars and Luc Van Gool “SURF: Speeded Up Robust Features Katholieke Universiteit Leuven.
- [9] Seok-Wun Ha, Yong-Ho Moon, “Multiple Object Tracking Using SIFT Features and Location Matching” ,International Journal of Smart Home Vol. 5, No. 4, pp. 17-26, October 2011.