International Journal of Enhanced Research in Science Technology & Engineering, ISSN: 2319-7463
Vol. 3 Issue 3, March-2014, pp: (66-69), Impact Factor: 1.252, Available online at: www.erpublications.com

Computer Vision – A Review

Eshaan Gupta[1], Sukhwinder Singh[2]
Student[1], Mentor[2]
[12]Dept. of Electronics and Communication Engineering, PEC University of Technology, Chandigarh, India

Abstract: when a person gets lost, he uses all his senses to acquire his location and the way back to the last identified location. But what about the robots, how do they come to know their location, the source and destination. Here comes the concept of Computer Vision into the picture. The scope of this paper concerns both the developments in the field of computer vision and applications related to computer vision such as vision for the robots of the next century. It also describes the efforts of development teams to integrate some of these advanced ideas into coherent prototype development system.

Keywords: Artificial intelligence, Computer Vision, Graphics, Lost robot, Motion analysis, Navigation, Vision.

Introduction

Computer Vision is defined as the field that includes methods for acquiring, processing, analyzing, and understanding images and, in general, high-dimensional data from the real world in order to produce numerical or symbolic information. A theme in the development of this field has been to duplicate the abilities of human vision by electronically perceiving and understanding an image. This image understanding can be seen as the disentangling of symbolic information from image data using models constructed with the aid of geometry, physics, statistics, and learning theory. Computer vision has also been described as the enterprise of automating and integrating a wide range of processes and representations for vision perception.

Areas of artificial intelligence deal with autonomous planning or deliberation for robotical systems to navigate through an environment. A detailed understanding of these environments is required to navigate through them. Information about the environment could be provided by a computer vision system, acting as a vision sensor and providing high-level information about the environment and the robot.

Artificial intelligence and computer vision share other topics such as pattern recognition and learning techniques. Consequently, computer vision is sometimes seen as a part of the artificial intelligence field or the computer science field in general.

Therefore computer vision studies what world information vision systems can retrieve from visual sensory input, under what circumstances, and how.

Relationship between Graphics and Vision

It has often been said that computer vision and computer graphics are closely related, being inverses of the same problem. Computer graphics can be considered image synthesis in that it takes a mathematical description of a scene and produces a 2D array of numbers, which is an image. Computer vision can be considered a form of image analysis, taking a 2D image and converting it into a mathematical description. The mapping of the image processing and computer vision algorithms into computer graphics hardware explicitly and practically exposes the relationship between these operations. For instance, it has been shown that the process of image registration using an algebraic projective geometry is isomorphic to the process of projecting a texture mapped polygon under perspective projection in computer graphics. In the same fashion, modern graphics requires a number of operations to be performed on an incoming fragment generated from a mathematical representation of a desired scene. These are operations such as geometric transformations, lighting, reflection, texture mapping and so on which are done in order to generate a final output pixel value. Similarly, for computer vision, a low-level algorithm will perform a number of operations on an input pixel value.

After the processing is done, a final output is produced which characterizes the input image as a mathematical construct of some significance. Despite the inverse nature, these processes are both characterized by a high degree of local processing which must occur per pixel (or in a small region, achieved perhaps by filtering)[6].

Medical Image Processing

One of the most prominent application fields is medical computer vision or medical image processing. This area is characterized by the extraction of information from image data for the purpose of making a medical diagnosis of a patient. Generally, image data is in the form of microscopy images, X-ray images, angiography images, ultrasonic images and tomology images.

Fig.1: Anmol Pednekar, loannis A. Kakadiaris, Uday Kurkure, Adaptive fuzzy connectedness-based medical image segmentation.

Computer Vision in Industries

A second application area in computer vision is in industry, sometimes called machine vision, where information is extracted for the purpose of supporting a manufacturing process[3]. One example is quality control where details or final products are being automatically inspected in order to find defects. Another example is measurement of position and orientation of details to be picked up by a robot arm. Machine vision is also heavily used in agricultural process to remove undesirable food stuff from bulk material, a process called optical sorting [8].

Fig.2: Artist's Concept of Rover on Mars, an example of an unmanned land-based vehicle. Notice the stereo cameras mounted on top of the Rover.

Computer Vision in Military

Military applications are probably one of the largest areas for computer vision. The obvious examples are detection of enemy soldiers or vehicles and missile guidance. More advanced systems for missile guidance send the missile to an area rather than a specific target, and target selection is made when the missile reaches the area based on locally acquired image data. Modern military concepts, such as "battlefield awareness", imply that various sensors, including image sensors, provide a rich set of information about a combat scene which can be used to support strategic decisions. In this case, automatic processing of the data is used to reduce complexity and to fuse information from multiple sensors to increase reliability[9].

Fig.3: Cost pressures and consumer handheld technology increasingly drive rugged wearable computer designs for war fighter application.

Lost Robot Problem

Computer vision also has important implications in robotics. The robot is placed randomly in an environment and, when started up, has to determine where it is. A new method is presented that employs a SOM to provide a shortlist of candidate locations for the robot. A quick and dirty localization method sits on top of the SOM and disambiguates its output by moving the robot a small distance away from the initial position and accumulating evidence[1].

"For example, when you come up out of the subway, you might be standing at an intersection," he says. "A GPS can tell you which intersection, but only approximately. So you take a photo and use it to know where you're standing in the world, without needing any other information. What we have right now is just a stepping stone to the ultimate goal, which is to scale up this solution to unknown, large environments, but the results suggest this approach could scale up quite well."

Fig.4: Robot in a wooden maze

Future Possibilities

Involving the other senses

The field of virtual reality has driven much progress in immersive computing experiences, but a whole field of inspiration comes from the area of interface gadgets beyond the monitor, keyboard, and mouse. Science fiction has long dreamed of the ultimate computer interface that will "wet-wire" directly to our brains. What might the new generation of users develop to improve upon head-mounted displays and power gloves?

Smart environments

The concept of the environment as the interface follows our interest in cognition and sensory perception. Desktops and file systems draw from our experience, but researchers have begun to explore new paradigms that take the computing space off the CRT monitor. An example appears in the work "Emancipated Pixels: RealWorld Graphics in the Luminous Room" which implements smart work spaces using the IO Bulb, a two-way optical transducer (projector and camera) that interprets physical inputs from and projects graphics onto arbitrary surfaces[5]. An especially interesting application of this work examines wind flow around buildings in the tabletop planning of a business park. In this example, a simple architectural figure is placed on a table with a wind indicator, from which the system computes the wind field and displays it around the object. You can easily see how this application ties into current work7, 8 to stabilize and interactively compute physics-based models for fluid-like behavior.

Networked graphics

The ubiquity of access to the Internet and the World Wide Web has opened new doors of communication and exchange, even as it has demonstrated the need to re-examine and evolve our current methods. From new designs for transfer protocols to real-time algorithms and data compression, researchers are responding to the challenges presented by user expectations for instant access. New areas of application will need to overcome latency issues and enable the transfer of simple data models from which complexity can be reconstructed at the receiving end. For example, the receiver's system might construct a holographic 3D human figure texture-mapped with the sender's image. A camera at the sender's end might capture motion and expression, cull the data, and transmit updates in real time.

Conclusion

Computer graphics and computer vision are truly complementary disciplines quickly approaching convergence. As noted, the broad study of computer-based imagery extends beyond these two fields to include the areas of HCI, visualization, and image processing. Where does it go from here? As stated so eloquently by Sir Isaac Newton, "Standing on the shoulders of others, we see farther." Ongoing research and development will continue to forge this bond, and we'll begin to see real-world products emerge from these efforts. Then we will see the fruits of this convergence.

References

[1]. R. DERICHE, "Using Canny's Criterion to Derive a Recursively Implemented Optimal Edge Detector", International Journal of Computer Vision, pp. 167-187, 1987.
[2]. A Yuille, P Hallinan, D Cohen. Feature extraction from faces using deformable templates. International Journal of Computer Vision, 1992, 8(2): 99-111.
[3]. T. F. Cootes, C. J. Taylor, D. H. Cooper, et al. Active shape models–their training and application. Computer Vision and Image Understanding, 1995, 61(1): 38-59.
[4]. P. Viola, M. Jones Rapid objects detection using a boosted cascade of simple features. In: Proceedings of IEEE Computer Society Conference on Computer Vision and Pattern Recognition. Hawaii, USA, 2001: 511-518.
[5]. G. Linda Shapiro and C. George Stockman (2001). Computer Vision Prentice Hall.
[6]. R. J. Campbell and P. J. Flynn, "A survey of free-form object representation and recognition techniques," Computer Vision and Image Understanding, vol. 81, no. 2, pp. 166–211, 2001.
[7]. Shingo Kagami, Takashi Komuro, Idaku Ishii, and Masatoshi Ishikawa, "A real–time visual processing system using a general purpose vision chip," in Proceedings of the 2002 IEEE International Conference on Robotics and Automation, Washington, DC, USA, May 2002, pp. 1229–1234.
[8]. A. Darabiha, J.R. Rose, and W.J. MacLean, "Video rate stereo depth measurement on programmable hardware," in IEEE Conference on Computer Vision & Pattern Recognition, June 2003, pp. 203–210.
[9]. D. Scharstein and R. Szeliski, "A taxonomy and evaluation of dense two-frame stereo correspondence algorithms," International Journal of Computer Vision, vol. 47, pp. 7–42, 2004.
[10]. T. Boult. Pico: Privacy through invertible cryptographic obscuration. IEEE/NSF Workshop on Computer Vision for Interactive and Intelligent Environments, 2005.
[11]. S. M. Aminzade. Interactive visual prototyping of computer vision applications, PhD Thesis, Stanford, 2008.
[12]. Z. H., F. J.E., and G. S.A., "Image segmentation evaluation: A survey of unsupervised methods," Computer Vision and Image Understanding, vol. 110, no. 2, pp. 260–280, 2008.