Taking Television Viewing To A New Dimension

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Soon will Free-Viewpoint TV let you watch a football match in all the details you can think of and in three-dimensions. This is because the new technique, being developed at KTH in Stockholm allows you to interactively select directions and angles to watch the telecast scene. Even those views that were not recorded for the scene can be displayed.

Imagine you are passionate about football matches and watching a match of your favorite team on television. Suddenly, a goal scored in the match. However, your television broadcaster did not telecast that goal from your desired direction. Recently introduced three-dimensional television broadcasting offers depth impression of a natural scene but has the same limitation.

This is because television shows us the same scene even if we change our position in front of the television display. It is quite different from what we experience in the real world. In television, users get only a single view of a three-dimensional world. The view is determined not by users but by a camera placed in the three-dimensional world. Although many important technologies have been developed, this aspect of television has never changed.

Free-Viewpoint TV is an emerging visual media application that expands the user experience beyond what is offered by traditional media. However, when compared to the existing virtual reality, Free-Viewpoint TV is not artificial but is for real scene.

Cheap cameras behind the technique

This has been facilitated by new research advances in electronic display technologies and advanced signal processing systems which permit viewing from a range of perspectives and perhaps for many viewers simultaneously. Furthermore, thanks to the wide availability of low-cost digital cameras, they enable us to record multimedia contains, the multiview video, for the Free-Viewpoint TV. Multiview video is a set of videos recorded from a natural scene. This set of videos was recorded by using many cameras to capture the natural scene from many angles and directions simultaneously. Thus, an enormous amount of recorded video data needs to be stored or transmitted for this emerging media application.

The biggest proponent of Free-Viewpoint TV, and the person who coined the expression, is Masayuki Tanimoto, professor at the Graduate School of Engineering, Nagoya University, Japan. His research group developed a ray-space based system for Free-Viewpoint TV. The ray-space is a virtual space but is directly connected to the real space. One ray in the real space is represented by one point in the ray space. The ray space is generated by using multi-view videos.

The system consists of recording, processing, and display of the multiview video. This system also allows generating new views at any arbitrary position without any geometry information. The created views are photo-realistic.

Hard to get the right picture

Due to the vast amount of multiview video, we need to compress these videos before storage or transmission. Still, commercialization Free-Viewpoint TV will also increase the demands of high-capacity television networks in future. Multiview video compression must be such that users can later create any new views from any desired position. The new view is created using many recorded neighboring views and their corresponding depth information. With depth information gives we get the distance between the camera and objects in the natural scene from a particular position. The visual quality of the new views highly depends on the reliability of the depth information. Usually, the depth information for each specific position in the natural scene is estimated independently using nearby views only. But the resulting depth information at many positions has low reliability which in turn lowers the visual quality of the new views.

Thus we still have many challenges to overcome in order to enable the use of Free-Viewpoint TV in real-world applications. It is not easy to build a system that can record and store a large number of videos in real time. Multiview data compression and broadcasting over television network are challenging tasks. Reliability of the depth information also imposes a difficult problem for creating new views accurately.

However, these challenges provide ample new research opportunities. At ACCESS Linnaeus Centre, KTH-Royal Institute of Technology, Stockholm, we have developed technique to improve the reliability of depth information. We exploited the depth information from many angles and directions to improve the depth reliability at a desired location. To reduce compression requirements, we also introduce the concept of structured depth information, based on our reliable depth information. This information comprises reliable depth information from a desired position and additional supporting information. The additional information is about the depth and appearance of points not visible from the desired position but possibly visible from adjacent positions. This supporting information will be used for the generation of new views at these adjacent positions. Furthermore, we used this depth reliability based structured information more efficiently in our new view generation technique. Experiments show that our technique offers better new views. At present, we are working toward the realization of our dream of real-time Free-Viewpoint TV by exploring efficient ways to compress multiview videos and empowering future television networks for Free-Viewpoint TV.

Not only for entertainment

Free-Viewpoint TV will not only take television viewing to new dimensions, there are also many other applications. There will be significant changes in the advertising world as one can view a product from many different directions and angles in three dimensions. Free-Viewpoint TV will take interactive computer gaming to the next level of enjoyment by giving gamers a more natural and realistic way to experience the game. If surveillance images from a thousand different angles can be produced in real-time, it becomes much harder to break into, sabotage, steal or violate security rules. This leads to new discussions regarding

an individual's privacy. But, you can enjoy holidays in your home by recreating an existing distant location at your home -Virtual Tourism. In medical science and technology, one can use Free-Viewpoint TV-like technology to improve diagnosing and equipment, for instance for keyhole surgery. Free-Viewpoint TV emergence will also significantly improve many existing applications of television such as remote education, coordination in air-traffic control, object tracking and recognition, environmental surveillance, and industrial inspection.

While it may be cool to be able to choose one's own position in television viewing, developments in Free-Viewpoint TV may not only be positive. Critics believe that with the emergence of Free-Viewpoint TV, movies as an art form will be devalued. Movie directors will no longer able to decide how a scene in a movie presented to viewer, since that decision now is up to the viewer. This can make excitement and suspense disappear, and the movie losing its charm. Still Free-Viewpoint TV will obviously take TV viewing to new dimensions.

Additional Information

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