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PUBLIC ENGAGEMENT IN SCIENCE – EDUCATION THROUGH THE USE OF 3D TECHNOLOGY APPLIED IN TOMOGRAPHY

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This paper summarizes one of the knowledge transfer scheme under DENIDIA Framework XI funded project at the Computer Engineering Department in the field of public engagement and 3D stereoscopic projection system. It will provide insight of how public engagement is important in terms of inspiring young students into science and engineering, particular computer scientist area. With the use exciting technology such as 3D stereoscopic projection system, it will make public engagement activities far more interesting than just ordinary 2D PowerPoint presentations.

1. INTRODUCTION

Public engagement is a mean to achieve a goal with the share of understanding and articulation in science to the public audience. It is necessary not only to enable the great trust of science and scientists by the public, but also to enable both of good understanding of science and enhanced citizenship by all involved.

It is become apparent that higher education, in losing its purpose of educating and produce greater scientist of all, but ended up to the production of both: scientists who lack the capacity to engage effectively the public; and public who lack the capacity to effectively engage with science.

It is imperative that we agreed on both scientists and the public only ever have partial knowledge. While the benefits of these two knowledge-systems working together are well documented, scientific culture remains largely aloof and distant from the public. The changing the culture of science to include the public in their process of creating knowledge would be close to revolutionary, cutting close to the heart of modernization [1].

Universities have not always been so separated from public society. Apparently, the modern research university to pursue the goal of knowledge for their own sake in the 19th century, this concept has furthered apart the distance of interest in getting the public to involve in understanding the research work. Not until recently, the research council in UK had been attempted to re-constitute the goal of higher education to enhance the knowledge of citizenship within the university. Higher Educations are locked into the larger scientific culture which they helped to create. It is quite a challenging task if one want to change one part of this larger system (be that higher education or industry) without changing other parts as well. There are still some significance evidences to emphasise the difficulty of the challenge, and the importance of building alliances within the organization and between different high educations, as well as reaching out to other public social sectors.

2. SCIENTISTS' VIEWS ABOUT PUBLIC ENGAGEMENT

There has been considerably less finding on what the scientists' views of the public than on the public's views of scientists. In general it seems that scientists are supportive of greater dialogue, however, the main concerns of the scientists are lack of competence among each other to communicate and the lack of recognition or reward for this activity to engage with the public, compared to research itself. The perceived barriers are skill, not attitude, as well as lack of validation of the activity by employers and peers. The Royal Society in UK is currently exploring what scientists perceive to be the barriers to communication [1].

There is a logistical challenge about how such public engagement experience can be made widely available to the science community. However there is not yet a great deal of research on how scientists approach the 'dialogue' process, further that there seems a big gap between the routine acceptance and the uncertainty of the message that schoolchildren seem to get from the higher education, in terms of what a great deal of science subject can be. Research on the underlying model that the majority of scientists have of science seems a necessary prerequisite to appreciating the problems of dialogue.

The importance of science is demonstrated by its inclusion as a statutory subject in the core of the National Curriculum for all 5-16 year olds in English maintained schools. However, there are concerns over student's apparent lack of interest in the sciences and criticisms of a curriculum which many feel is too 'content heavy' and 'not really engaging'. There is also widespread concern about the proportion of students choosing science courses at university level, particularly in physical sciences. This trend continues into science careers.

Informal science education is also developing, with numerous projects taking place around the country. These are aimed at both young people and adults, to engage people with science, often encouraging dialogue about contemporary issues rather than sticking only to traditional methods of science education. Different way of informal science education had been suggested and one particularly way that found particularly effective in many years of experience through exhibition is the clever use of technology such 3D movie technology. In assent, this can be a powerful interest in getting the message of science subject across to the public if the right materials is being shown.

3. PRINCIPLES BEHIND 3D TECHNOLOGY

While most exhibitions would just show some exciting walkthrough movies in 2D, it is much engaging if one can see something in 3D stereo. When one walk past an exhibition stall observing another visitor wearing a pair of 3D glasses, the curiosity will grow and stop by to pick up a pair of 3D to watch as well. This happens particularly to younger generation of visitors in the exhibition show.

In general, it can be quite a challenge to get the public interest into your research subject particularly in computer science. Majority of computer scientists would have told you that "Powerpoint" would be the solutions in promoting research to public during university's open day or public exhibition. While 2D PowerPoint presentation can be exciting as it seems to be few years ago, it is quite rarely able to attract youngsters these days to pay attentions to the presentations, as they have been exploited by some many exciting animation from games, website and TV.

However, before we get into the process of making 3D movies, it is important to understand what principles are at work in the creation of a 3D image. Most humans see in 3D, due to the fact that each eye sees the world at a slightly different perspective than the other. Our brain fuses the two perspectives together to give us the dimension of depth or distance. Closer objects bounce light to our eyes in a different way than objects further away. The closer the object the more curved the reflected light is, and our eyes refocus to compensate for this. Human stereoscopic depth perception is part physiological and psychological. Physiologically, we perceive depth only in objects that are between 20cm - 550cm away. Beyond those boundaries we utilize other cues to determine depth [2].

Before we decide how to show the 3D video, it is imperative to determine the type of 3D technology to be used, as this step determines the type of equipment needed for a successful 3D viewing experience. There are several different viewing technologies that allow captured images to be seen in 3D, through the mean of use of special glasses, filters. Some techniques are considered "passive" while others are "active." Historically, passive 3D has been by far the most widely utilized and cost effective, but active technology is catching up.

While there are many passive 3D technology are available in children’s comic book with the commonly used two colours-based glasses, another more effective type of passive 3D techniques is called Polarization 3D. This type of passive 3D presents much better colour in the 3D image, because it does not utilise colour filters and lenses to present the 3D effect. In this scenario, a special projector (with two projection lenses stacked on top of one another, sends each different image, one from the left camera, and one from the right camera, through a polarized lens/material. The polarized filters can be either linear or circular. With linear polarization, one camera's image is filtered through a polarizing lens that orients the light waves in a vertical pattern, while the other camera's image is filtered through a polarizing lens that orients the light waves in a horizontal pattern [3].

These images are bounced off of a special silver passive screen that preserves the polarization of the light waves, and are seen by the viewer through special polarized glasses in which one lens sees the vertically-polarized image and the other sees the horizontally-polarized image. With this polarization technique, however, the viewer must always be looking at the screen at a 45-degree angle. If they tilt or move their head, the 3D effect will be lost. Circular polarization fixes this issue by filtering the light in a clockwise pattern for one eye and a counter-clockwise pattern for the other. This technology is a bit more expensive, but in future improvement to the preservation of the 3D image when the viewer moves from the 45-degree plane may be worthwhile for many.

With active 3D technology, there is a different, more expensive pair of glasses the viewer must wear, in order to see the 3D image on the screen. Similar to passive technology, two images, one "right eye" and one "left eye" are filmed. However, the similarities end there. The two images are combined or fused together (with the special formula to close and open) via either alternating lines of left-eye and right-eye video or alternating pixels in the image between right-eye and left-eye video. The former is called "interleaving" technology, where the right eye sees every other line in the video frame and the left eye sees the alternate lines. This method produces much choppier results than the alternating pixel method.

While the active technology provides an easy and full-colour 3D viewing experience, there are multiple downsides. The components needed are very expensive (3D TV or monitor, special active glasses that require a power source, and upkeep of equipment), the frame rate is cut in half, due to the fact that each eye is only seeing half of the frame rate of the video and the refresh rate of the monitor, and the active shuttering can cause headaches and nausea (particularly when the battery in the glasses is weaken) much more often than the passive, polarized.

Lastly, a glasses-free 3D viewing experience is also possible, with lenticular viewing. This technique has been around for many years as a way to view 3D images without the use of glasses, by manipulating the viewing screen in such a way that it bounces the left-eye camera's image to the viewer's left eye, and the right-eye camera image to the viewer's right eye. In the past, this has been done by creating accordion-style ridges in the screen, and projecting the left image on the ridges angled toward the left eye and the right-camera images onto the ridges angled toward the right eye. The downside to this has been that there was a limited viewing "sweet spot," where the viewer would have to sit still in order to get the full effect of the 3D image.

4. 3D STEREOSCOPIC PROJECTION SYSTEM AT TECHNICAL UNIVERSITY OF LODZ

Based on experience and varies of advantages specified above, polarised 3D passive stereo has been selected for the setup of the 3D stereoscopic system at Technical University of Lodz. This part of the whole DENIDIA project had taken the KIS department a huge leap of opportunity to acquire that can only be considered as one of the first 3D stereoscopic projection system within the universities in Lodz city, Poland.

With the use of lightweight aluminium profile means that this mobile setup can showcase the 3D content produced by the university in different exhibition or locations. However, at this early stage of development, it is in difficulty position to source a pull-up passive silver screen in Poland, therefore, it is decided that the system can only use within the meeting room at KIS department at this moment in time. While mobility (a non-fixed) is the main benefit of having this flexibility 3D setup, it is, however will take some time to align these two sets of projectors. The process of align can made simpler with certain amount practices.

The 3D projection system at the Lodz Technical University

Nonetheless, having to build up and set up this 3D stereoscopic technology is nothing without the appropriate training to generate good 3D contents to show to public. Lodz Technical University has been well-known to its expertise in ECT tomography's research, therefore, it is crucial that the computer scientists in KIS department have the opportunity to be trained and shown the correct techniques to make their own 3D stereoscopic movies for their presentations. This part of the project also had the opportunity to convince other researchers that 3D stereoscopic system is not an entertainment equipment, but a 3D system that has a research purpose to allow viewer travel through some exciting journey through an ECT pipeline. While a virtual 3D journey through ECT pipeline may not seem to be as exciting in the sound of it, but the experience of the viewer to travel through the virtual journey using 3D stereoscopic system can certainly provide the viewer the experience to remember by for some times.

5. WORKSHOP TRAINING DAY AND 3D MOVIES DAY

It is also a rather challenging to convince and encourage the colleague at Lodz Technical University to take on new technology and to understand the needs of using 3D stereoscopic technology. This is particularly tricky if one hadn't really seen the effects of 3D stereoscopic movies before. Therefore, It is crucial that we can showcase the 'wow' factor from the past public engagement experience from other project in another university. A one-hour presentation showcased a variety of successful public engagement activities during the KIS departmental meeting on the 7th July 2010 in front of approximately 70 colleagues.

It is also important to have good 3D contents to go along with the 3D stereoscopic projection system, which this is the skill that KIS colleague is lacking of at current stage. A 'one whole-day' training workshops had been set-up for the colleague in KIS who are interested in such knowledge. Two days of the workshop (16th and 23rd September 2010) had been set-up in order to allow maximum attentions to a smaller number of attendances during each of workshop trainings. The response for the training workshop had been positive, which 17 colleague from within KIS department attended the training workshops.

Rather than just to train up the setting up of the hardware for the 3D stereoscopic projection systems, the activities from the training workshops are range from basic introductions to hands-on experience to create their own 3D movies, which include the following activities:

- ✓ The introduction of 3D stereoscopic system
- ✓ Generate real 3D movie
- ✓ Generate virtual 3D movie
- ✓ Compose both real + virtual together
- ✓ The set-up for the 3D stereoscopic system.

It is rather important to allow the colleague to have the chance to try out their own 3D movie, hands-on experience and let them to see for themselves what they have produced. A KIS 3D movies day had been organised on the 27th September 2010 that allow the colleague at KIS to see for themselves the effects of 3D stereoscopic of their own 3D movie from their own research. During this 3D movies day, a virtual journey through 3D ECT sensors had been generated by one of KIS member of staffs (dr inż. Robert Banasiak), which allow the KIS colleagues "virtually" experience the effects of 3D stereoscopic system within the 3D ECT sensors.

6. CONCLUSION

As mentioned, this project had taken Technical University of Lodz a huge leap to set-up this exciting yet still unknown purpose serving technology. However, this would be a start for the department to have an opportunity to further produce their own 3D movies for public viewing purpose. By having some nice science-related 3D stereo movies developed by KIS, and shown to the local invited school children, this should greatly make public engagement in computer science more interesting and attract more pupils into computer science subject in their future.

7. ACKNOWLEDGEMENT

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REFERENCES

[1] **Sara Wolcott and Anasuya Sengupta**, Learning for Change in Public, Educational and other Science Organisations: Embedding greater public engagement, British Science Association 2010.

[2] **Kellie Welborn, Chauncey Eugene Frend and Edgar Huang:** Searching for an Online 3D Video Streaming Technology, School of Informatics, Indiana University–Purdue University Indianapolis, 2010.

[3] **Blanchard, Jim and Reiko Tsuneto (Fall 1993**): Stereoscopic Viewing, December 3, 2009.

SPOŁECZNA EDUKACJA TECHNICZNA POPRZEZ TECHNOLOGIE 3D STOSOWANE W TOMOGRAFII

Streszczenie

Artykuł jest podsumowaniem projektu dotyczącego transferu wiedzy w ramach grantu DENIDIA (ang. Development of Excellence in Non Invasive Diagnostic System for Industrial and Scientific Application) w dziedzinie promocji nauki w społeczeństwie z wykorzystaniem nowoczesnych technik stereoskopowej wizualizacji 3D. Grant realizowany jest w Katedrze Informatyki Stosowanej Politechniki Łódzkiej. Autorzy podkreślają jak ważna jest promocja nauki w celu inspiracji i zainteresowania studentów inżynierią a w szczególności inżynierią komputerową. Nowoczesne technologie, popularne wśród młodzieży jak stereoskopowa wizualizacja 3D pobudzają wyobraźnię i otwierają nowe możliwości w dziedzinie promocji nauki.

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