DomePres - Live immersive presentations, from your laptop to the dome in real-time with any software.

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ABSTRACT
Producing presentations and simpler content for domes, beyond the display of a single presentation screen, comes with a steep learning curve and prohibitive work-time requirement with existing immersive content creation tools. These challenges have motivated the development of a simplistic yet powerful presentation software which can be used in any immersive environment, filling the immersive environment with content on multiple locations, yet allowing a presenter to control it from a laptop using any standard presentation tool. The presenter only needs to add markers (QR-codes) that the system will detect and decode to position and fill the display environment with content.

I. INTRODUCTION
Today, the use of a dome can be very diverse and one common usage beyond movie playback is live shows/presentations to further engage audiences through conferences and workshops in many different research, education and business areas. Most display systems require a sophisticated software to support placement of graphics, effects, playback and diverse content, often capable of running on a computer cluster. Beyond playback of prepared movies, a common use case is to create presentations that utilize the immersive display in a good way. While the use of flat presentation slides in an immersive environment, such as a dome, is still subpar to fulldome content there is still significant work for most visiting presenters to get their content onto a dome [4]. Presentation software that support immersive environments often support capturing of several video inputs through dedicated video capture cards. While this general functionality enables any person to present flat content onto a dome, or any other immersive display configuration, they do not utilize the capabilities of the display and both presenter and audience might leave with the impression that they should rather have been in a conventional lecture hall.

While it is key functionality to utilize much more space of the display surface, the presentation often needs to be prepared and altered in the sophisticated software that drives the movie playback and other aspects of the display system. A significant drawback of such softwares is that the presenter, most often, is not knowledgeable about how to prepare or modify the presentation, and that the time for content preparation is often short. The presenters may also be hesitant to handing over their material before the presentation, or at all, sometimes due to sensitivity of the material, but often because that minimizes their preparation time and flexibility to adapt with short notice. It is imperative to significantly lower the needed time and required skill level to use a dome theatre (or any other non-conventional display environment) as an immersive presentation surface. Our goal was a solution that should be non-intrusive and have a low learning threshold. It was also of importance that the presenters knowledge of the solution could be re-applied with minimal help from technical staff. The preparation time for a new immersive presentation could be achieved when coming back to the facility.

The basis of our solution is the incorporation of a marker system, QR-codes [1], in the form of standard images that are inserted into the presenters own presentation tool, such as Powerpoint of Keynote. The presentation system for the immersive display surface is then programmed to detect and decode these markers, and apply the requested operation, which in our most basic use case is placing the current slide in a specific location on the display surface. We have then moved the control of how the immersive space is used from the display software, as common in many other conventional multi-screen/space solution [2], to the actual presentation software and thus given the control to the presenter without the need to learn or work in a second piece of software.

In this work, we elaborate on our implementation, the functionality and features, the usage of this approach, and the experiences which we have gathered with its use in our own facility, where live presentations with standard presentation slides on presenters own devices are very common.
II. APPROACH

The fundamentals for this presentation tool is a software capable of rendering on the complete display surface, able to get input through a video capture card from any standard desktop/laptop computer and display that content on a plane rendered in 3D space. The attributes of the plane is not fixed, but standard parameters such that the plane can be translated, scaled or rotated is very useful, so that the presenter could position his/hers content in a location they prefer on the display.

As each frame for the input is captured and rendered, our new approach is based on that the some operations normally performed by a controller/presenter in the separate display software, for instance changing attributes of the plane, should be incorporated and controlled by the presenter in the actual presentation. There exists multiple ways of finding information inside images, but a straightforward and common approach is to have visible markers. We have chosen to use the common marker system of QR-codes [1], as there exists numerous open-source implementation of generators, detectors and decoders of these markers.

The presenter then drag-and-drops these markers (QR-codes) into their software of choice (for example Powerpoint or Keynote). Our system then captures the frames from the presenter’s device during the live presentation and in real-time checks for these markers and respond to their respective action. The only limitations of which action/operation can be controlled from the presenters own software, is based on how many features we can introduce that can be controlled by a QR-code. As we wanted the key benefits of this system to be a low learning curve and short preparation time, we decided to limit the amount of operations as much as possible, based on input from previous work [3], while still making the presentation utilize much more of the display surface.

The operations can obviously vary dependent on how to best use the display surface, but our minimalistic setup is based on that there are numerous amounts of pre-defined planes (position, size and rotation parameters controlled in the display software) where the input capture from the presenters computer can be displayed. Thus the presenters only responsibility is to decide on which plane each slide/content should appear, and place the marker for that plane into the corresponding slide/position. Noticeably, the live capture from the presenter is then practically moved around from one plane to another. Thus, as soon as the presenter has decided that the next content/slide should be placed on another plane, the image/texture of the current plane is locked/frozen (i.e. showing the last frame), until the presenters decides to move the live capture back to that specific plane. For convenience, we also introduced one single marker which would hide all planes, such that the presenter can start over and enable/show desired planes, one at a time, in preferred order, when the system recognize a new marker for a certain plane.

There are, however, some aspects to consider, one being how the display system should treat the markers when detected. One significant drawback about inserting visible markers into the presentation is that the audience will also see them, which would not be desired in most cases. To remove the marker from the image when detected, we would require a static colored background of the presentation, which would also take up precious space in the presentation. Our system addresses this concern about noticeable markers by freezing the image/texture on the plane when detecting a marker with a valid operation (such that QR-codes can be used in other purposes in a presentation). The valid operation is then applied when the display system does not recognize the QR-code anymore, i.e. when the presenter has changed slide or if the image with the QR-code has disappeared as a result of a automatic operation in the presentation software (which could be a Powerpoint animation).

We created 4 planes, in suitable location for our 27-degree tilted dome with seats on differents levels, faced in more or less the same direction (slightly curved like a cinema). Thus we end up with 4 different markers, one for each plane, as well as one for hiding all, as seen in Figure 1. Figure 2 showcase an example of how slides from a Powerpoint is displayed in our dome.

![Figure 1](QR codes for operations which can be incorporated into a presentation and detected by our display software. The graph in the upper section indicates what kind of operation the presenter wants to achieve.)
III. RESULTS

The tool/software we developed to use and test our approach was named ImPres (Immersive Presentation) and is open source and currently available on Github (https://github.com/c-toolbox/ImPres). While we could apply this concept and software in various environments, we have currently developed a first specific application case within this software, specific for domes, which we named DomePres (Dome Presentation). DomePres detects the markers, see Figure 1, contained in the presentation slides and a presenter can perform a presentation, as seen in Figure 2.

As DomePres is specifically created for domes, we have added additional functionality for flexible presentation. We can drag-and-drop any image in the application and place them as either background fisheye images or as flat image anywhere on the dome surface. Our software is also capable of capturing a live fisheye input (up to 4K @ 60Hz, limitation based on capture card) from a gaming machine (currently through 2 DP outputs) and displaying it in the background of the immersive presentation from the presenters connected device, which enables a real-time fulldome show during the presentation.

Our software is based on our own developed open-source toolkit SGCT (Simple Graphics Cluster Toolkit), also available on Github (https://github.com/opensgct/sgct), which supplies the features required to support any immersive display software, such as synchronizing across a cluster of image generating computers (IGs), various projections, software warping and blending based on various formats in the industry.

DomePres has been used on a number of special occasions, as for example a docent lecture as seen in Figure 2 (right). One of the current drawbacks experienced during usage has been that the presenter needs to understand that he/she needs to avoid transitions or fading effects when the QR-codes are used, as they will be visible for a while if they are faded in, until our system detects them and freezes the image. DomePres can by itself fade in/out the various planes when they are enabled/disabled. Also, you cannot reverse a slideshow and get the same outcome, so preferably the presenters would move to a slide where all planes are cleared (containing the orange QR-code) and move forward from there.

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