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An Automultiscopic Projector Array for Interactive Digital Humans

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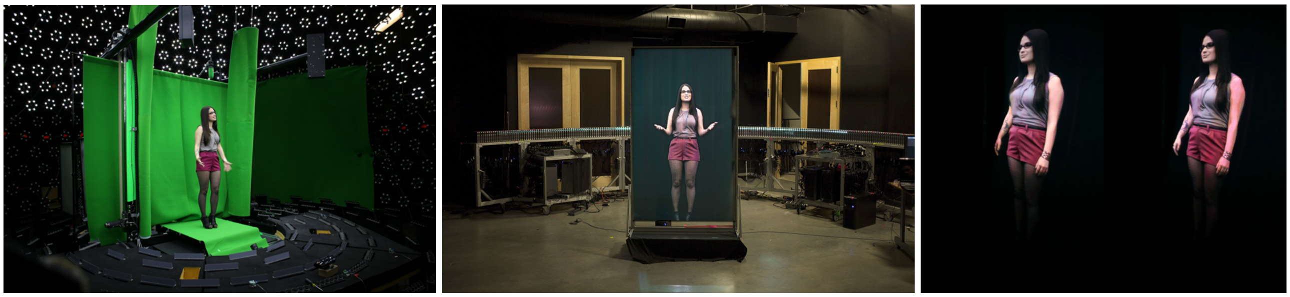

Figure 1: *(left) Subject is recorded by an array of HD camcorders under controlled lighting. (Center) Subject shown on the automultiscopic projector array. The display can be seen by multiple viewers over a* 135° *field of view without the need for special glasses. (Right) Stereo photograph of the subject on the display, left-right reversed for cross-fused stereo viewing.*

Introduction Automultiscopic 3D displays allow a large number of viewers to experience 3D content simultaneously without the hassle of special glasses or head gear. Our display uses a dense array of video projectors to generate many images with high-angular density over a wide-field of view. As each user moves around the display, their eyes smoothly transition from one view to the next. The display is ideal for displaying life-size human subjects as it allows for natural personal interactions with 3D cues such as eye-gaze and spatial hand gestures. In this installation, we will explore ”time-offset” interactions with recorded 3D human subjects.

For each subject, we have recorded a large set of video statements, and users access these statements through natural conversation that mimics face-to-face interaction. Conversational reactions to user questions are retrieved through speech recognition and a statistical classifier that finds the best video response for a given question. Recordings of answers, listening and idle behaviors, are linked together to create a persistent visual image of the person throughout the interaction. While it is impossible to simulate all possible questions and answers, we are scaling our system to handle up to 10-20 hours of interviews that should make it possible to simulate spontaneous and usefully informative conversations. More details on our natural language engine can be found in [Artstein et al. 2014].

Recording We record each subject over a 180 degree field of view using an array of 30 Panasonic X900MK 60fps progressive-scan consumer camcorders, each four meters from the subject. Since our cameras are much further apart than the interocular distance, we use a novel bidirectional interpolation algorithm to upsample the six-degree angular resolution of the camera array using pair-wise optical flow correspondences between cameras to 0.625 degree resolution. As each camera pair is processed independently, the pipeline can be highly parallelized using GPU optical flow and is faster than traditional stereo reconstruction. Our view interpolation algorithm maps images directly from the original video sequences to the projector display in real-time.

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Display We display the automultiscopic video on an array of 216 closely-spaced video projectors 3.4m behind a 2m tall diffusing screen. For convincing stereo and motion parallax, the angular spacing between between views was chosen to be small enough that several views are presented within the interocular distance. Our 216 video projectors form 135 degrees of a circle behind the screen. We use LED-powered Qumi v3 projectors in a portrait orientation, each with 1280×800 pixels of image resolution. At this distance the projected pixels fill a 2m tall projected area with a life-size human body (Fig. 1). The screen material consists of an anisotropic light shaping diffuser manufactured by Luiminit which scatters light vertically (60°) so that each pixel can be seen at multiple viewing heights and maintains a narrow horizontal blur (1°) to fill in the gaps between the projector lenses as in Jones et al. [2014]. We use six computers to render the projector images. Each computer contains two ATI Eyefinity 7870 graphics cards with 12 total video outputs. Each video signal is then divided three ways using a Matrox TripleHead-to-Go video DisplayPort splitter. To maintain modularity and some degree of portability, the projector arc is divided into multiple carts each spanning 45 degrees of the field of view.

Interactive Content We envisage time-offset interactions to have a wide range of applications from entertainment to education. For this installation, we will feature digital versions of television personalities Morgan Spurlock and Cara Santa Maria who will explain some of the workings of the display. We will also feature an extensive dataset based on interviews conducted with Holocaust survivor Pinchas Gutter. Example conversations which can be held with the virtual Mr. Gutter include conversations about his family, his religious views, and resistance during World War II.

References

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