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Paul Bourke



Singapore Expo Centre



Omni-Tube: A Low-Cost Portable Omnidirectional Interactive 3D Display

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Overview

• **Omni-Tube:** A novel omni-directional (360-degree) interactive 3D display.

• Features:

- Display multi-view images without the requirement of special glasses.
- Overcomes the general limitation of viewing distance and angles for low-cost 3D display.

• Advantages:

- Ease of use.
- Low production cost.
- High portability and mobility.

• Design (two functional parts):

- Optical device: easily mounted to any commercial micro projector.
- Projection image transformation algorithm: manages the optical distortions.



Related Works

• High-speed rotary LED approach

SONY RayModeler [Ito et al. 2010]: employ 2D LED dot matrix and high-speed rotary motor to display different viewing point images.



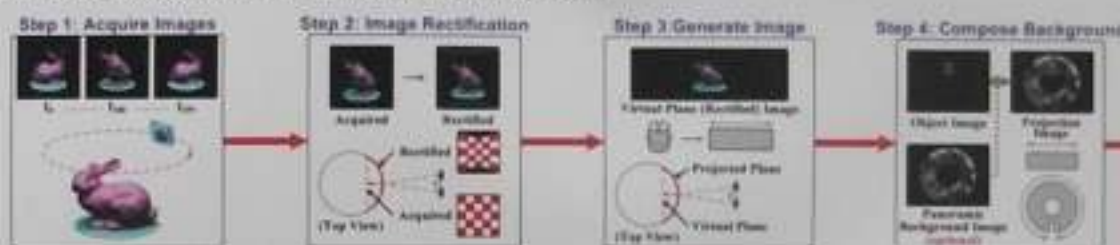
• Multi-projector approach

Osaka university [Yagi et al. 2011]: utilize three micro projectors to show three images simultaneously on a fog screen.



Projection Image Convert Workflow

- **Acquire Images:** acquire images from all viewing points.
- **Image Rectification:** rectify image distortion caused by the cylindrical screen.
- **Generate Position-Aware Image:** generate a display image according to users' locations.
- **Compose Background:** optionally add the background.



System Optical Architecture

• Projection Supporter:

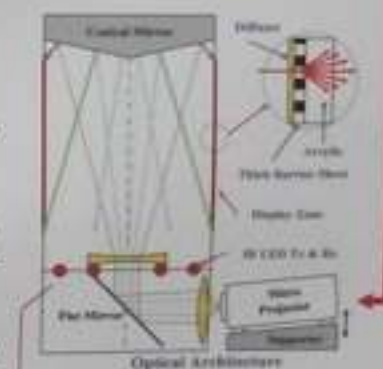
To counterbalance the inherent upward projection angle for any commercial micro projector.

• Lens & Mirror Group:

Consist of convex lens, flat mirror, concave lens, and conical mirror. It bends the rays more strongly and forces them to focus on the conical mirror.

• Display Material:

A special purposed diffuser and a special designed thick barrier sheet work together to produce different brightness attenuation according to different viewing angles.



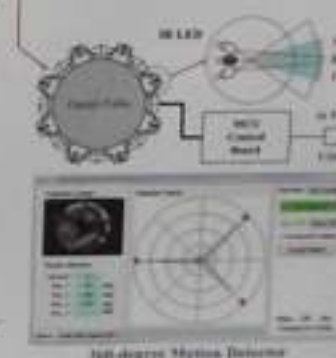
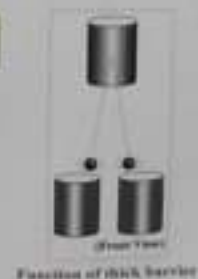
360-degree Motion Detector

• Infrared Tx & Rx LED:

Eight sets of Tx/Rx IR LED were employed to measure reflection energy from cylinder surroundings.

• MCU control board:

Compute users' position and distance based on eight Rx.

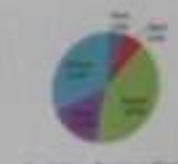


The User Study

The specification of the current Omni-Tube system is shown below:

- Tube Size: Ø100 mm
- Tube Height: 150 mm
- Total Height: 210 mm
- Display Resolution: 72 ppi
- IR Sensor: 940 nm
- Motion Detection: 360 degree, <150 cm
- Prototype Cost: < \$ 300 USD

Forty-five users were invited to our user study, and 89% of them were impressed with the Omni-Tube display and gave very positive feedback.



Depth perception score (1-5)
Fig. 1: (a) image background image without dark barrier
Fig. 2: (b) image background image with dark barrier
Fig. 3: (c) image background image without dark barrier
Fig. 4: (d) image background image with dark barrier

References

- (1) Ito, K., Kawachi, H., Nakano, H., Kishimoto, I., Yamaguchi, H., Min, H., Takayama, K., Ishikawa, H., Hasegawa, K., and Tsuyama, S. "360-degree Autostereoscopic display". In: *ICIT 2010: 2010 Emerging Technologies*.
- (2) Yagi, A., Iwano, M., Kuroki, Y., and Ohtsuka, G. "360-degree flip projection interactive display". In: *ICIT 2011: 2011 Emerging Technologies*.

Arbitrarily Focused Video Using High-Speed Liquid Lens

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Abstract

Focusing and blurring are essential techniques employed by photographers to emphasize a given photographic subject. Recent developments on synthetic digital photography permit the manipulation of focus and depth of field after the picture has been taken off-line.

In this work, we propose a high-speed focus-scanning technique and a simple algorithm to synthesize arbitrarily refocused images using a set of differently focused images named a 'focal depth image set'. The high-speed focus-scanning is achieved by a high-speed liquid lens called Dynamorph Lens (DML). The DML has a liquid-liquid interface that works as a refractive surface and can be arbitrarily reshaped to modify the focal length in a few milliseconds. A new camera lens system including the DML prototype as a focusing component was developed and coupled with a high-speed camera. It achieved practical imaging performances and wide angle of view. High-speed capture rate of 100 focal depth image sets per a second and synthesize of arbitrarily focused video of dynamic scene with little artifact due to the high-speed capture rate were demonstrated.

Background

Motivation

- The manipulation of focus and depth of field *after* the picture has been taken

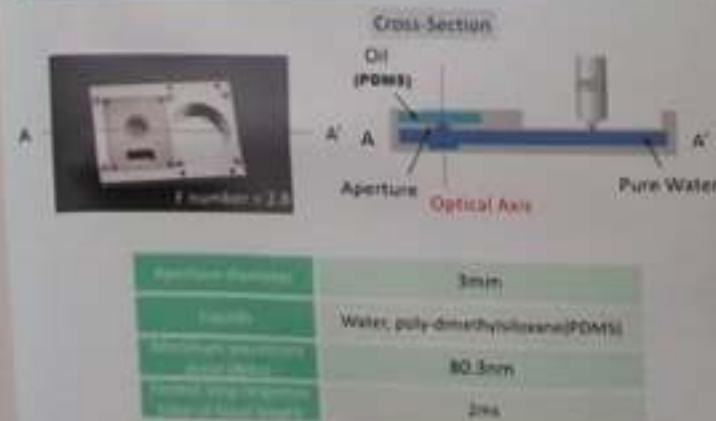
Previous Work

- Light Field Camera [Ng et al. 2005]
 - ✗ Low resolution
 - ✗ Hard to apply to wide angle lenses
- Focus-scanning Photography [Kodama et al. 2006]
 - ✗ Hard to obtain differently focused images with high speed

Our Approach

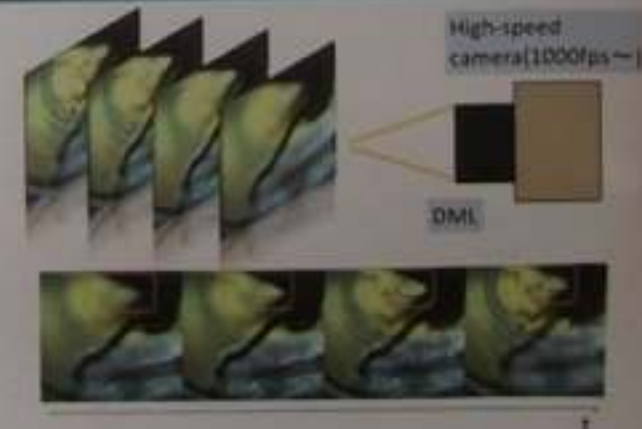
- We propose
 - a new focus scanning technique using a high-speed liquid lens called Dynamorph lens.
 - an algorithm to synthesize arbitrarily refocused images using a set of differently focused images named 'focal depth image sets'.
 - an arbitrarily refocused video by stacking synthesized images in chronological order. The high capture rate of the focal depth image sets enables us to synthesize a high frame rate video.

Dynamorph Lens



- A high-speed liquid lens with a practical imaging performance
- Two immiscible liquids are infused in a rigid container
- Change the interface shape by liquid pressure using a piezoelectric actuator (PZT)

Focal Depth Image Sets



- A sequence of images captured at differently focused depth
- If the acquisition rate of the focal depth image set is relatively high, we can reduce the effect of temporal variations in illumination or object motion during the acquisition.



(a)

(b)

(c)

(d)

Figure 1: (a) One of synthesized images. (b), (c) and (d) are magnified views of synthesized image. (b) is a close-up of (a), focused on the ball. (c) is focused on the ant. (d) has a wide range of depth of field.

Poster + emerging technology

Fuwa-Vision

An auto-stereoscopic floating-image display

email: h-nii@ij.ad.jp movie: <http://vimeo.com/45167701>

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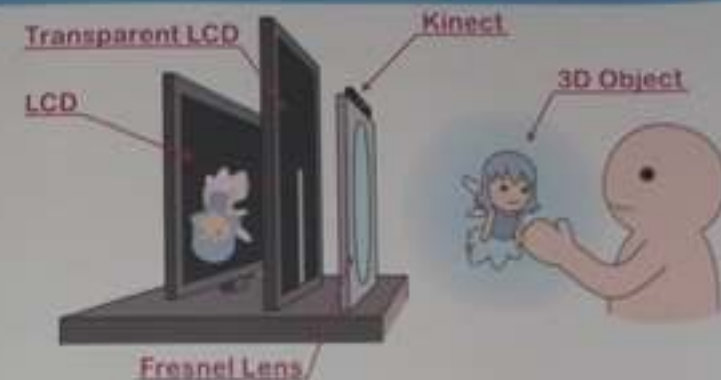
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IJ INNOVATION
INSTITUTE



Abstract

Fuwa-Vision is a simple interactive auto-stereoscopic display for multiple users without glasses or mechanical moving components. This system can project the 3D object as if it floating in midair.



System Description

Theoretical Principle of Fuwa-Vision

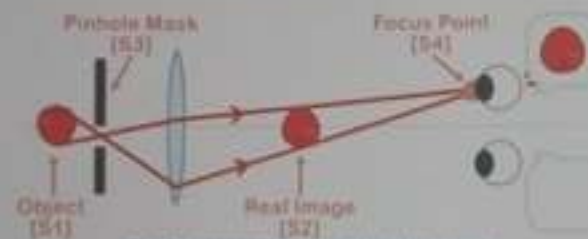


Fig. The concept of the light field control

Basic Idea

The object is installed at point S1, the real image appear at point S2. The pinhole mask is installed at point S3, the light ray of the object goes through the pinhole and makes the real image, and finally intersects at S4. Therefore viewer can see the real image at S4.

Auto Stereoscopic

The projection area will be moved according to the position of pinhole mask. Therefore this system projects different images to viewer's left and right eyes alternatively. By switching shutter pattern at the point S3, the auto-stereoscopic image appears.

Design of the System

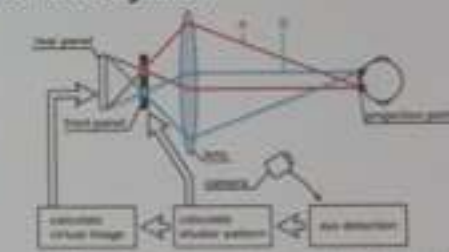


Fig. The simple block diagram of the 3D display

Two LCD panels

The rear LCD panel shows the auto-stereoscopic image and the front transparent LCD panel shows the slit image.

Lens

The lens makes the projected real image by merging the images on these LCD panels.

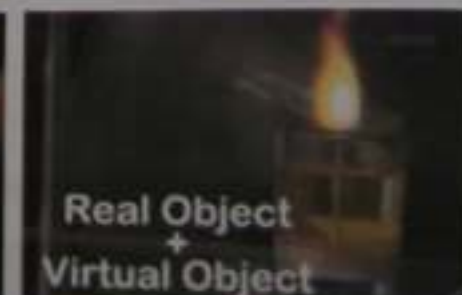
The shutter pattern of the front LCD

The shutter pattern controls the projection area of the auto-stereoscopic image, like the 3D shutter glasses.

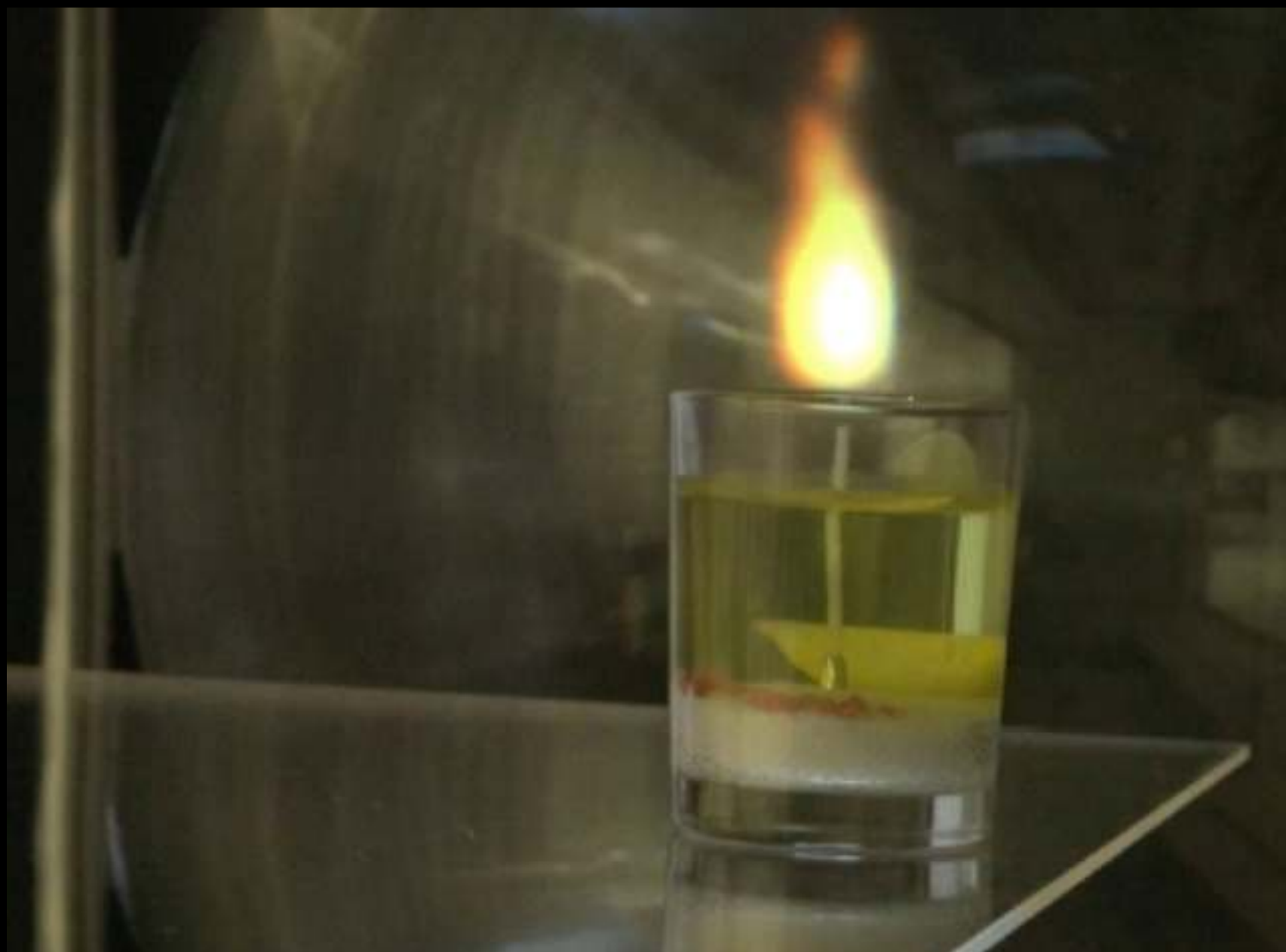
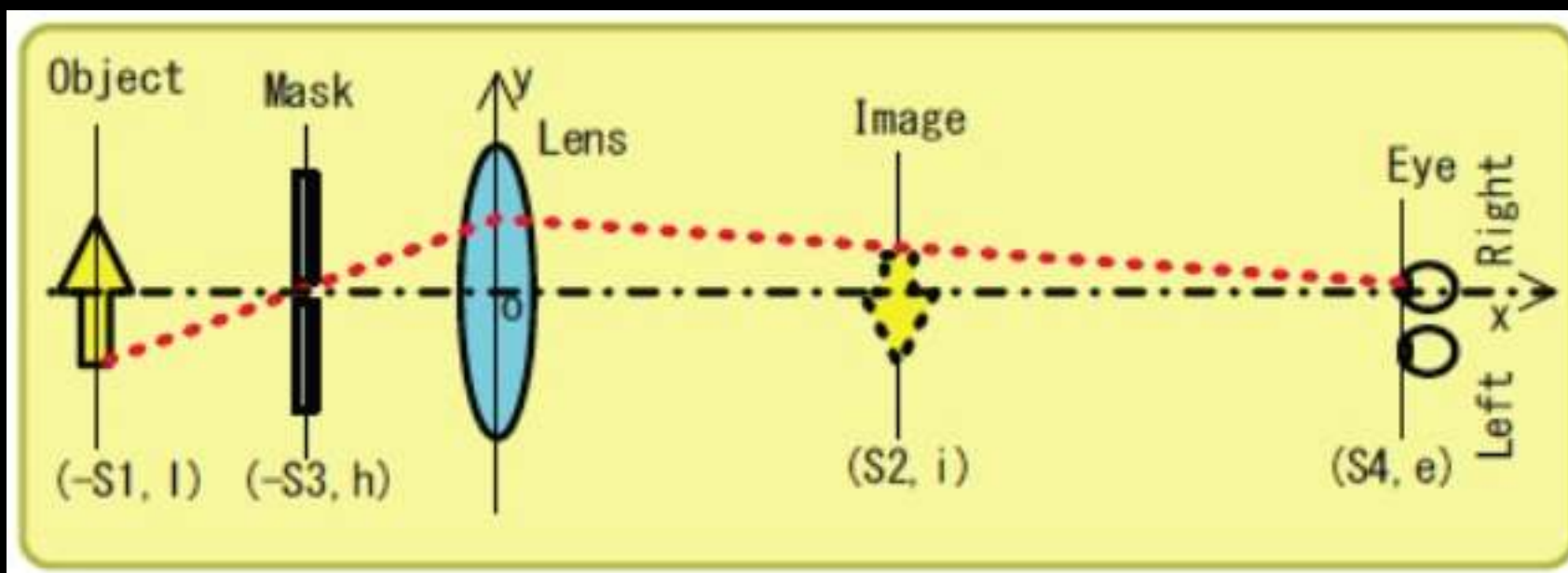
Eye Tracking System

Viewer's head position is detected by Kinect, so the suitable position of the slit and the viewing angle of the auto-stereoscopic image can be calculated.

Application







Poster + Emerging technology

Flying Head

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Flying Head

Rekimoto Lab.
Interfaculty Initiative in Information Studies
The University of Tokyo

A Head Motion Synchronization Mechanism
for Unmanned Aerial Vehicle Control

Flying Head is an unmanned aerial vehicle (UAV) control mechanism, which synchronizes human head and robot motions. Previous telepresence research has centered on the use of robots that move along the ground using wheels or legs. Recently, however, telepresence research has expanded to include the use of remote flying robots. The accurate manipulation of such robots, is difficult, however, as their control typically involves hand-operated devices such as proportional R/C systems or joysticks. Using the Flying Head system, we can incorporate a robot control using human motions such as walking, looking around and crouching. Our system synchronizes the operator and UAV positions in terms of the horizontal and vertical positions and the yaw orientation. The operator can use the UAV more intuitively, as such manipulations are more in accord with kinesthetic imagery. We will develop additional flying telepresence applications, such as capturing platforms, teleoperation, sports training.

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Here is the instruction of this demo.

The further instruction will be provided by the instructor.

1. One person at a time.
2. Please put on the bag first.
3. Please put on the HMD.
4. Wait for a second until the UAV flies.
5. Enjoy your experience.
6. Please take off the bag and the HMD.

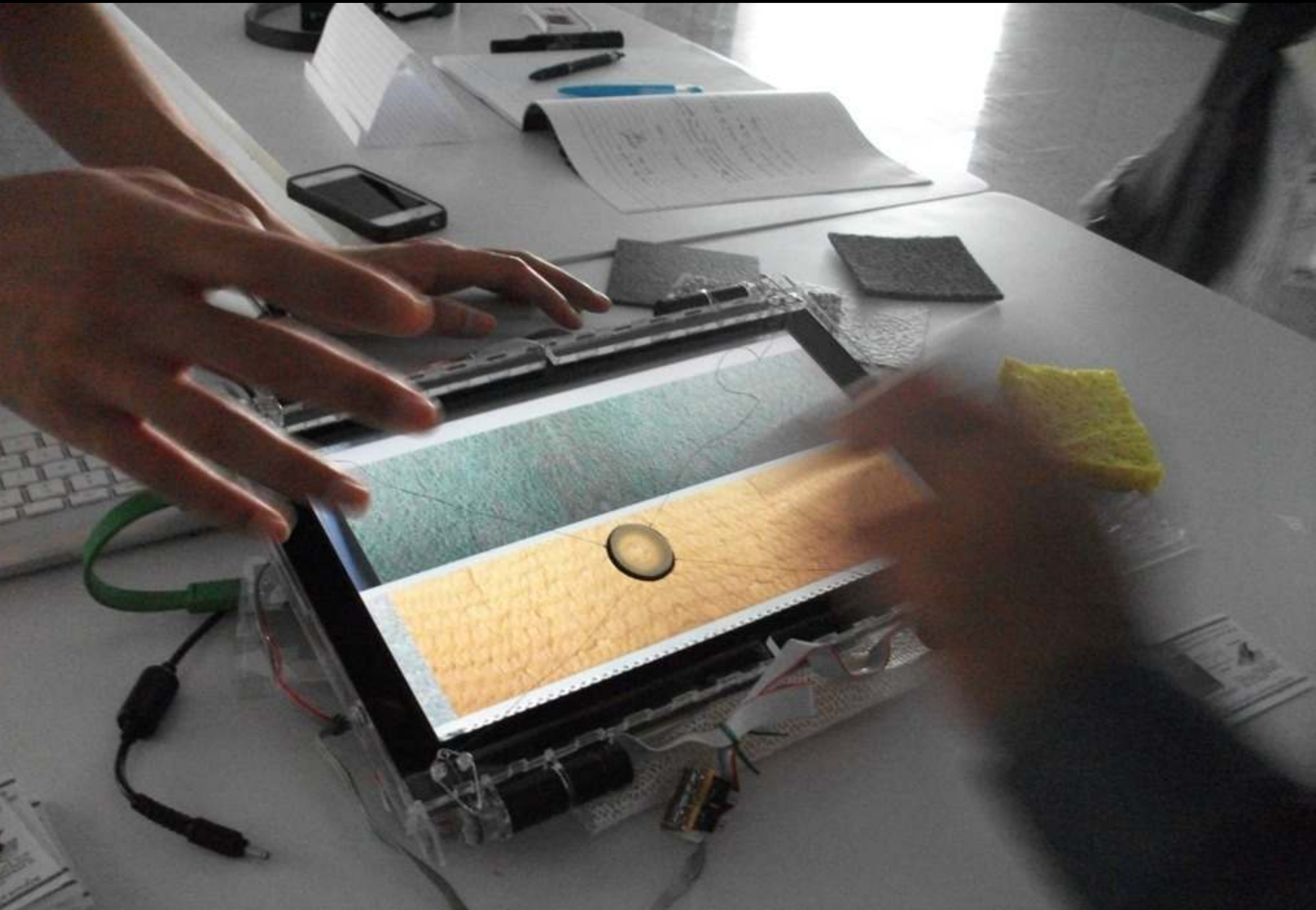
Precaution

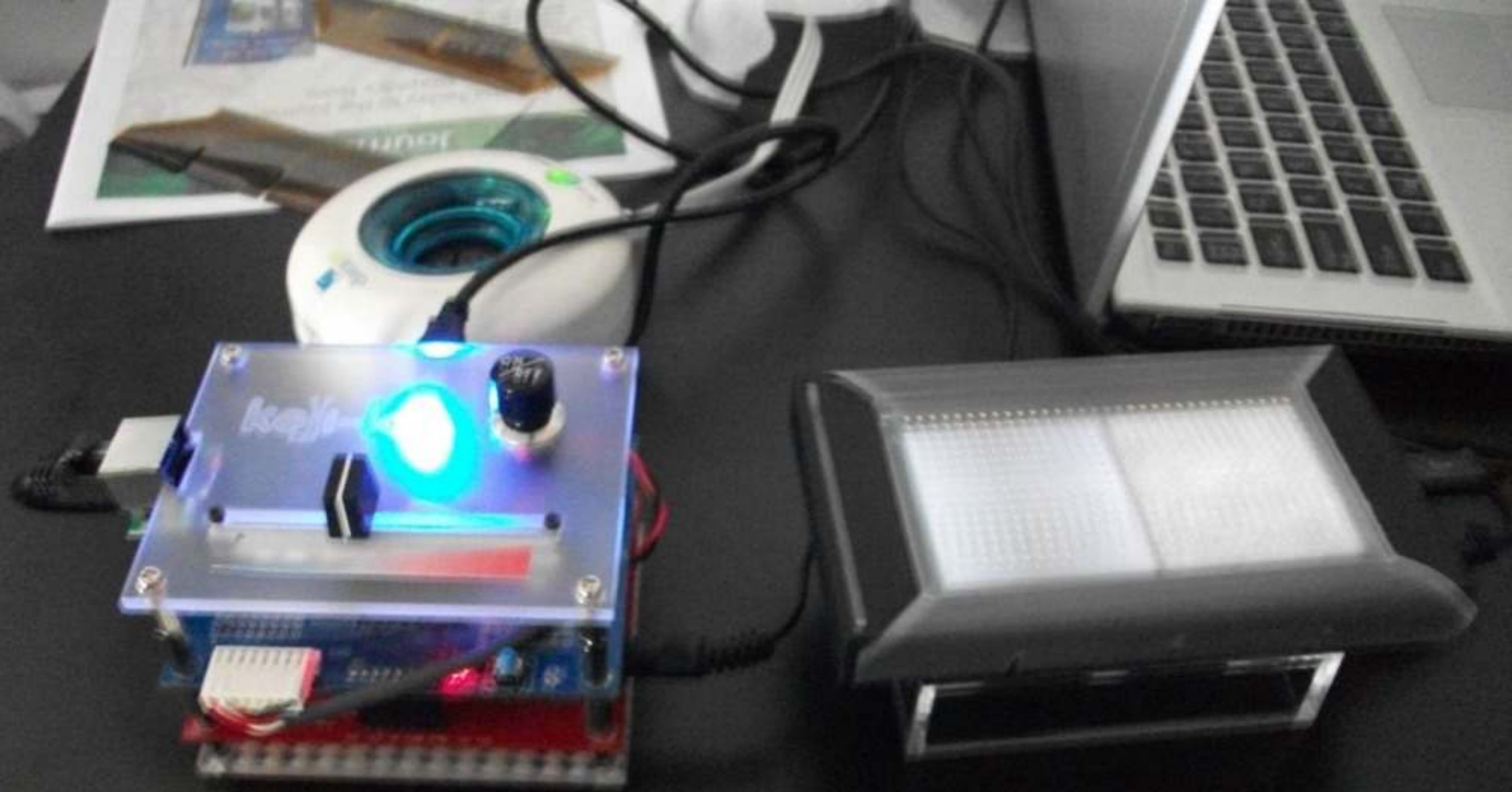
- Do not get out of the designated area.
- Do not touch the camera platform
- Do not run.
- Participants need to be over 18 years old due to the possibility of an intentional accident.

lab.rekimoto.org



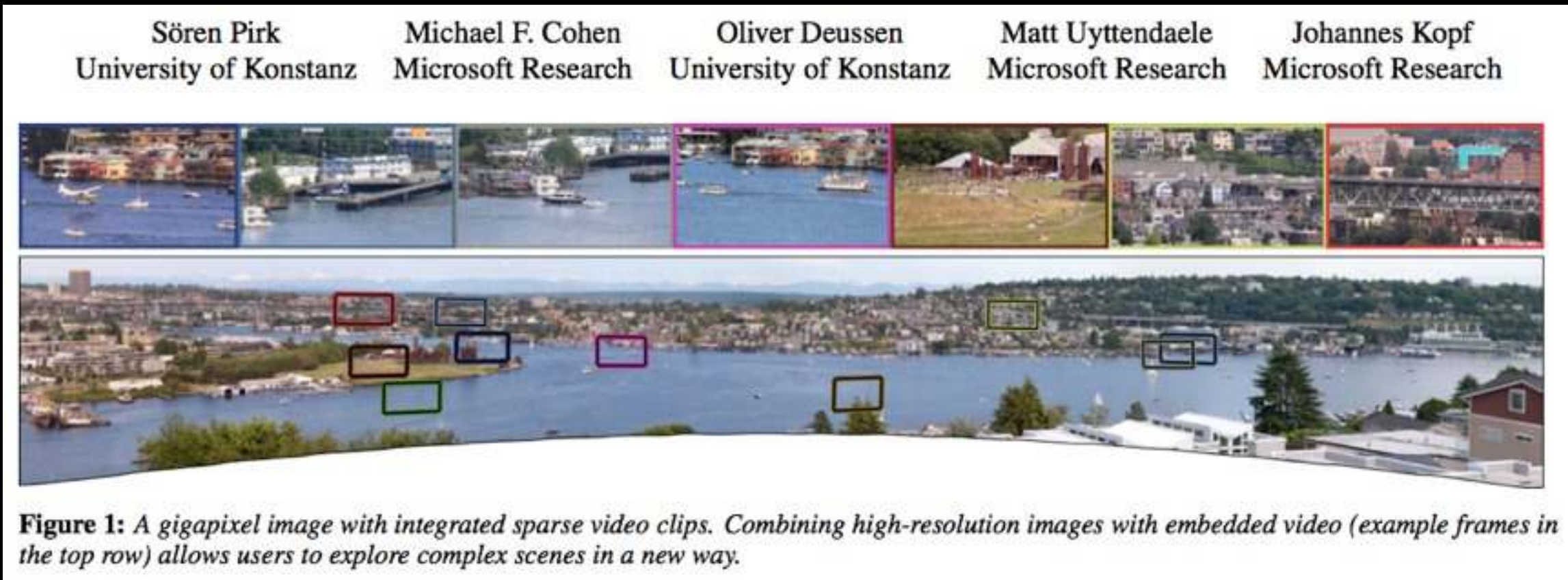
Emerging technology “theme”: touch





Papers: Video Enhanced Gigapixel Panoramas

- Add localised motion to gigapixel images.
- Video region may move across the image.
- Best of both worlds:
 - video has poor spatial resolution
 - gigapan images have poor temporal resolution.
- Key to the work is the video registration/blending, and their interactive viewer.



Canon 7D - 100 - 400mm Variable Zoom



Papers: Real or Fake? Human Judgments about Photographs and Computer-generated Images of Faces

- Determine factors that cause people to perceive images as real or CG.
- Concentrated on faces
- Outcomes
 - help cognitive scientists discover the mechanisms that underlie judgements of realism
 - help CG artist create more realistic characters
 - improve computational models in image forensics
- “One key finding was that participants discriminated between photos and CG images best for original images, less well for grayscale images, and worst for reflectance images. This suggests that shading may be more important than colour for judgments about visual realism.”
- Also experts outperformed non-expert but only for greyscale images.

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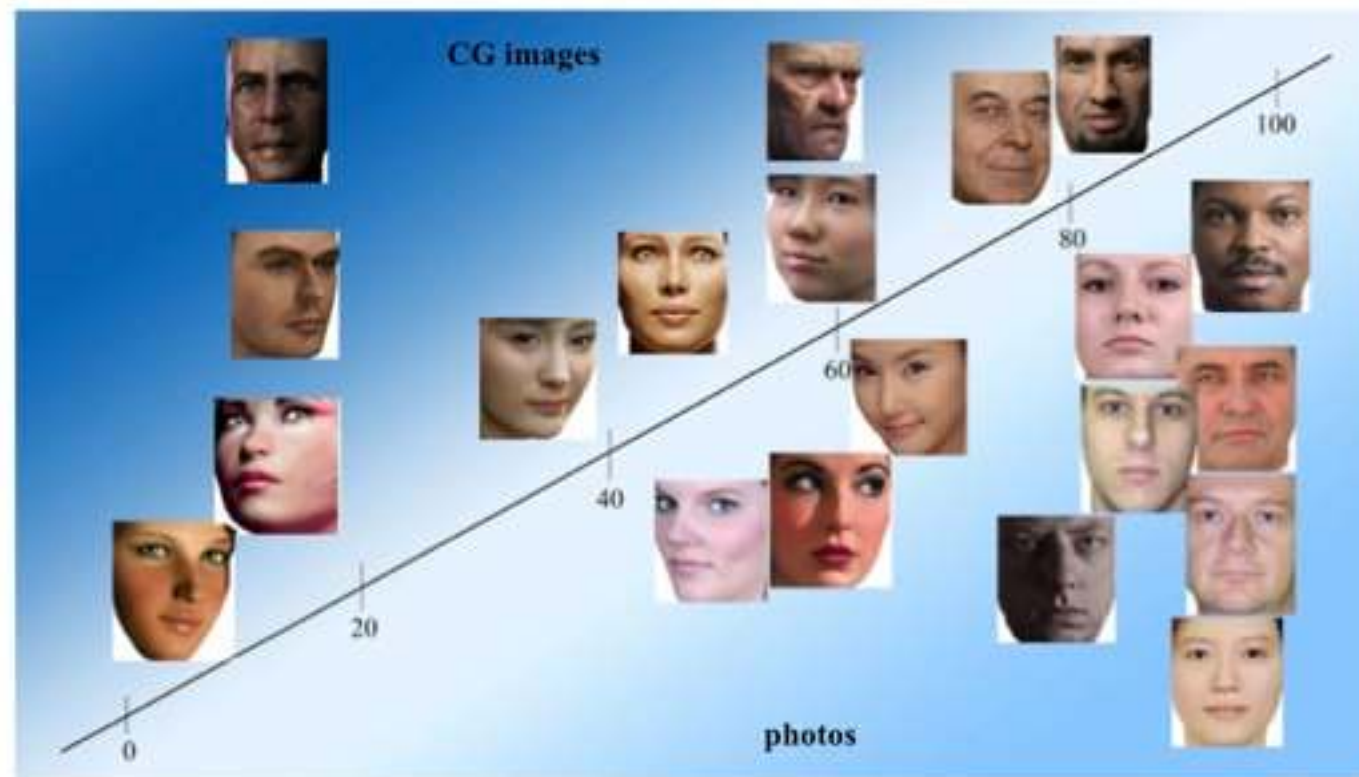


Figure 1: A psychophysical experiment explored factors underlying human judgments of visual realism for face images. The figure shows subjective realism score of 10 photo-realistic computer-generated (CG) images and 10 photos of faces. CG images are above the scale and photos below it. Overall, photos were judged to be more realistic than CG images.



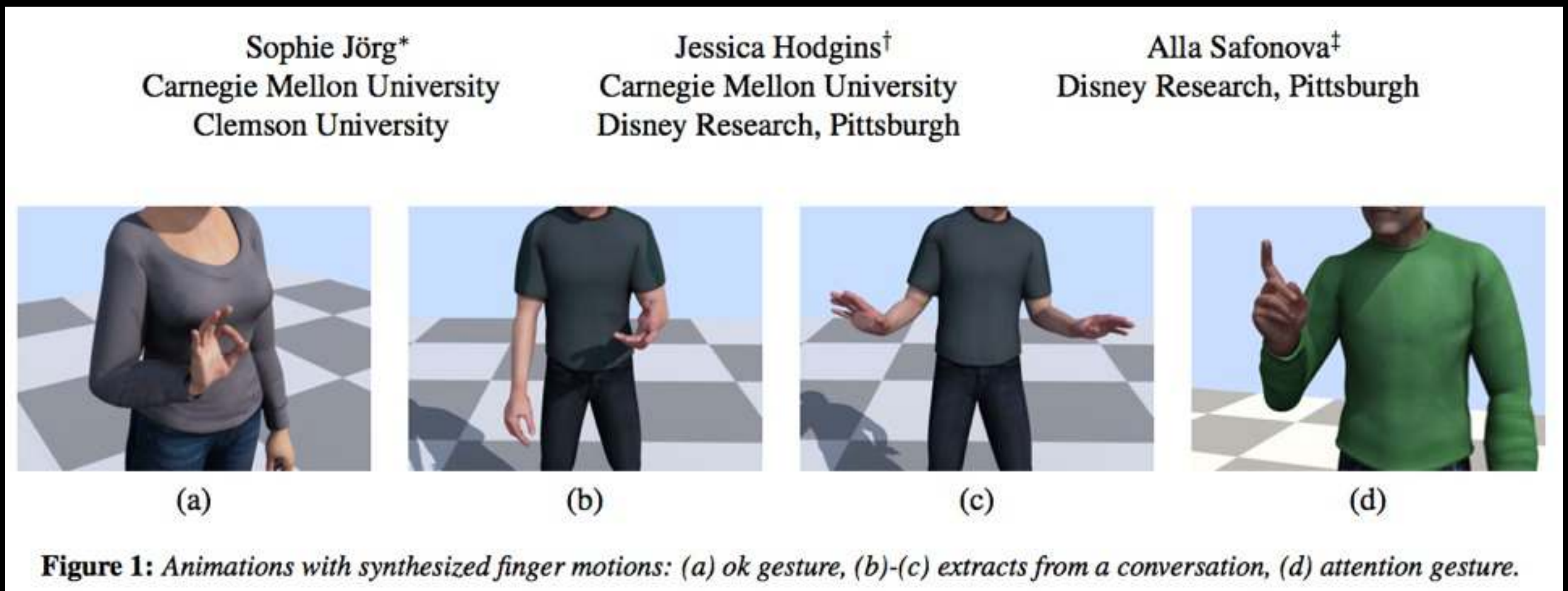
Our aim is to identify factors that influence visual realism for images of faces



Which of them are real? Which are fake?

Paper: Data driven finger motion synthesis for gesturing characters

- “In a controlled environment, we carefully captured and post-processed finger and body motions from multiple actors. To augment the body motions of virtual characters with plausible and detailed finger movements, our method selects finger motion segments from the resulting database taking into account the similarity of the arm motions and the smoothness of consecutive finger motions.”
- “Our key observation is that plausible finger motions can be inferred from the wrist motion.”





Art + emerging technology



Siggraph Asia in Hong Kong in 2013

Tuesday November 19 - Friday November 22