Electrolysis Bubble Display based Art Installations

課程：科技藝術書報討論Seminar of Technology and Arts

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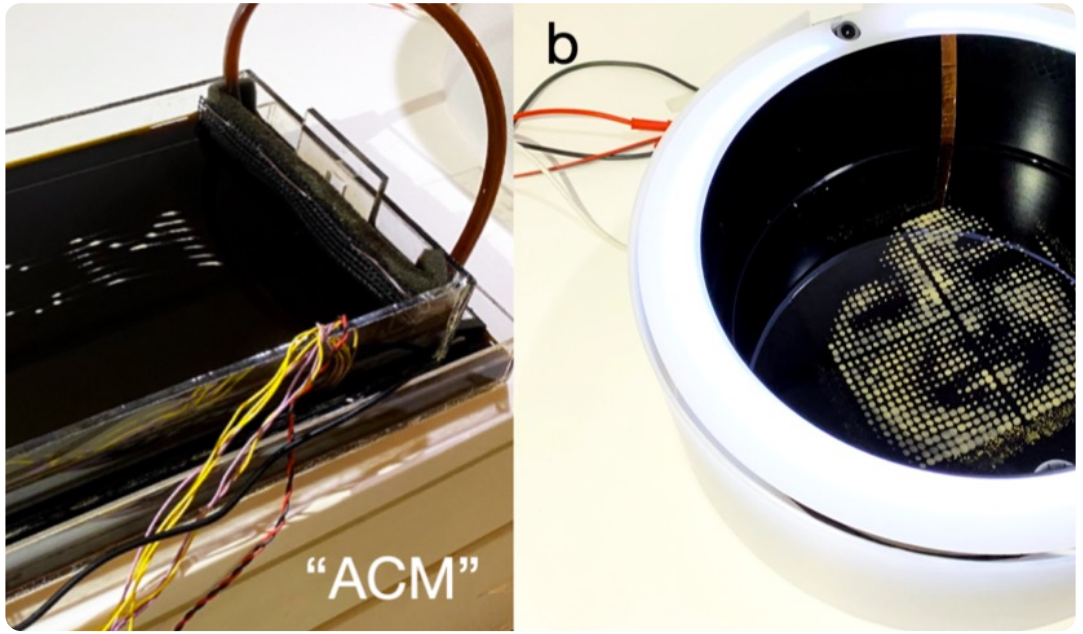

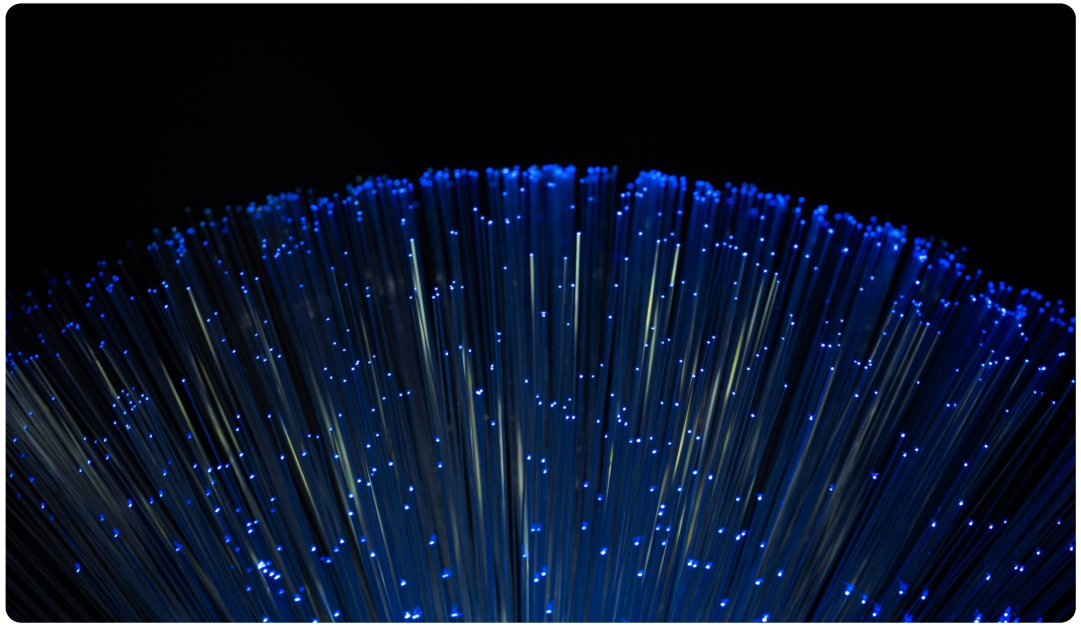

ACM ART 2021

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Keyword and other information

CCS CONCEPTS

• Human-centered computing → Human computer interaction (HCI); Displays and imagers.

KEYWORDS

Bubble Display; Electrolysis; Water; Art; Ephemeral User Interface

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Abstract

"Research was conducted on a digital information display using electrolysis bubbles. "

- The interface displays information as bubbles during the digital signal transition and translates the data as bubbles.
- The various things during this research review the liquid and the bubbles with the time and activities during the data transition.
- The data displayed through the devices contain the digitalized information and optimized the bubbles through various materials when generated the bubbles.

Information

- The first artwork is “UTAKATA,” a ticker-like bubble display using a running-water channel

- The second artwork is a “Bubble Mirror,” which is a water pan with a camera that captures a visitor’s face and displays it using grayscale pixels of bubble clusters generated from the electrolysis of water.

Contributions in this paper

In the previous study, the pixels of electrolysis bubble clusters required a much longer time to disappear (more than 1 min), whereas they were generated in seconds.

The Bubble Mirror is the first attempt to realize a high-resolution (1024 pixels) grayscale (6 levels) display using electrolysis bubbles.

(1) We present and implement the novel artworks, i.e., “UTAKATA” and “Bubble Mirror,” that use the electrolysis bubble display mechanism.
(2) We address two major technical issues remaining from the previous electrolysis bubble display (i.e., we improve the re-fresh rate and increase the expressive tone range of bubbles).
(3) We evaluate and investigate the output properties of the proposed systems.
(4) We discuss further possible expressive implementations based on the findings and user feedback.

RELATED WORK

Bubble Display

generates soap bubbles.

"These systems require moving parts, such as air compressors and electromagnetic valves for each pixel or column, to supply air from the outside in order to control the bubbles. "

"In terms of high-resolution bubble displays, Volumetric Bubble Display [11] has been proposed. This is a high-resolution 3D display unit that uses microbubbles generated in a high-viscosity liquid (e.g., glycerin) using focused femtosecond laser pulses."

"In our system, a low-viscosity liquid can be used as the electrolytic solution, thereby avoiding a low refresh rate due to the solution's high-viscosity."

"Used clusters of bubbles formed on the surface of a tinted electrolytic solution (e.g., coffee) as pixels to display a character or images."

Bubble display

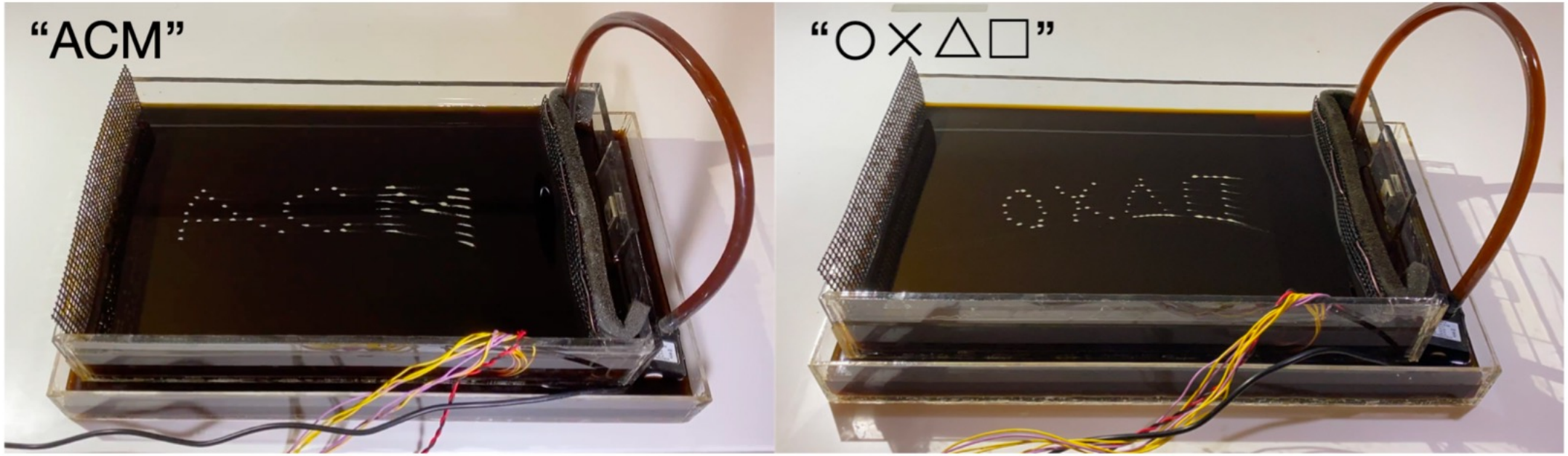


Figure 2: Display examples by UTAKATA. “ACM” (left) and symbols (right).

Applied a low-noise and high-efficiency electrolysis mechanism for display devices and created novel artworks that afforded new experiences with the bubbles on the water surface.

User Interfaces and Artworks with Ephemerality

Interfaces that remain for only a limited time are referred to as ephemeral user interfaces (EUIs)

- Bubble Cosmos is a soap bubble display wherein an image is projected onto real soap bubbles with white smoke encapsulated inside them
- Focused on the ephemerality of water and bubbles, and utilized them in artworks to create unique experiences.

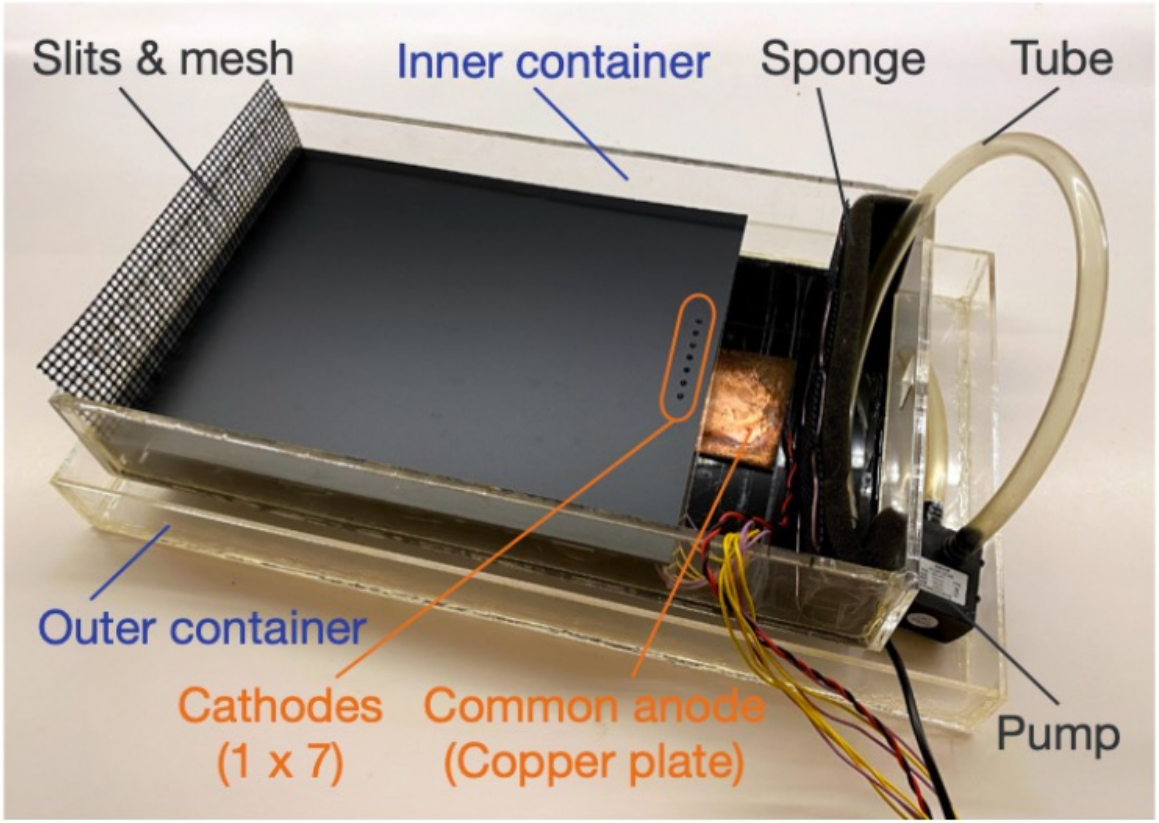
- **Bit.Flow** has a ticker-like structure to present information by the flow of water. **Wooden Mirror** is a display that uses pieces of wood as pixels.

UTAKATA

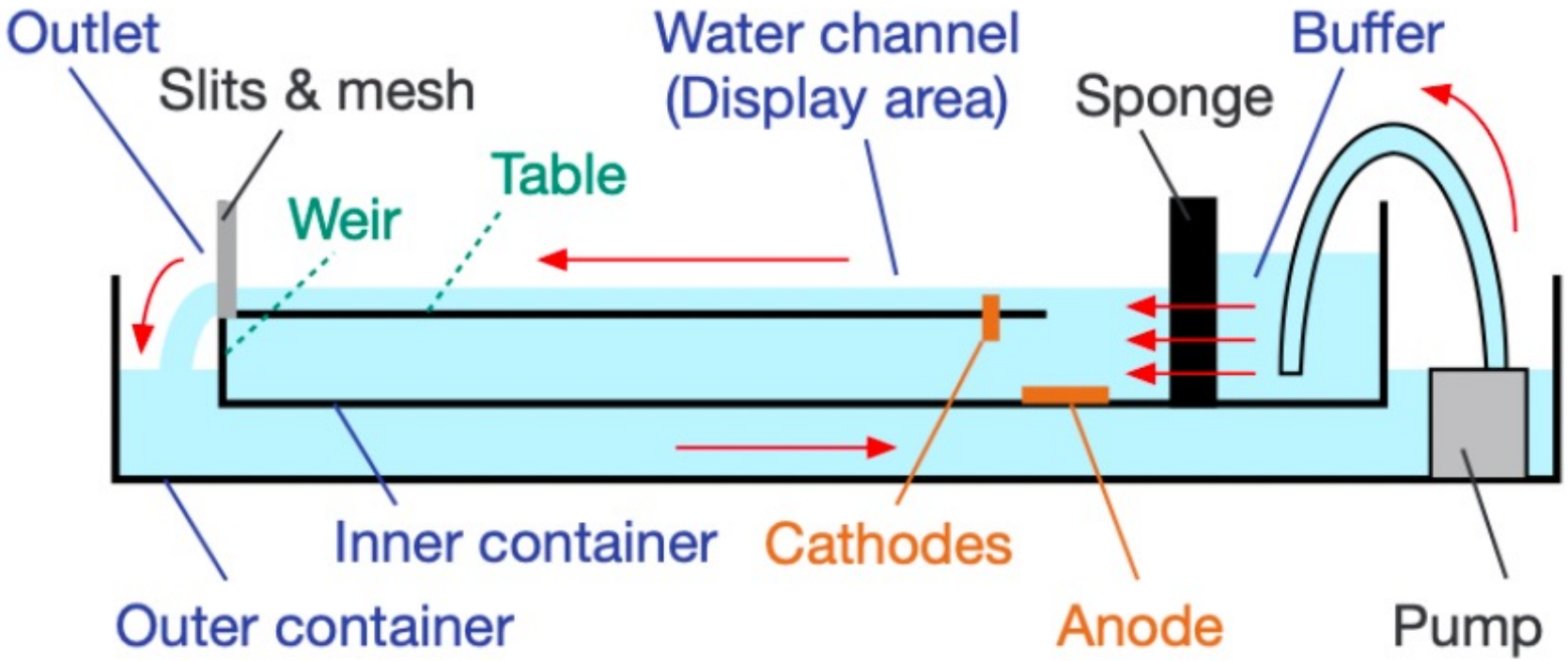
a ticker-like bubble display using a running-water channel.

By activating only the appropriate electrodes among the seven, an N × 7 dot-matrix display with a short refresh time can be implemented as the bubble clusters float downstream.

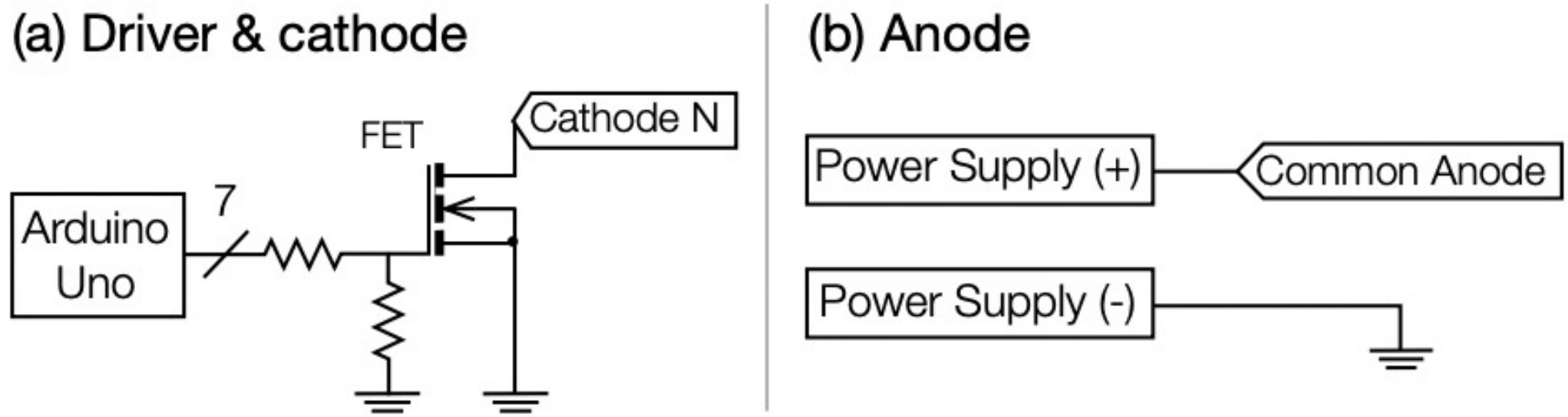
(a) UTAKATA without liquid



Water Circuit



Bubble Generation

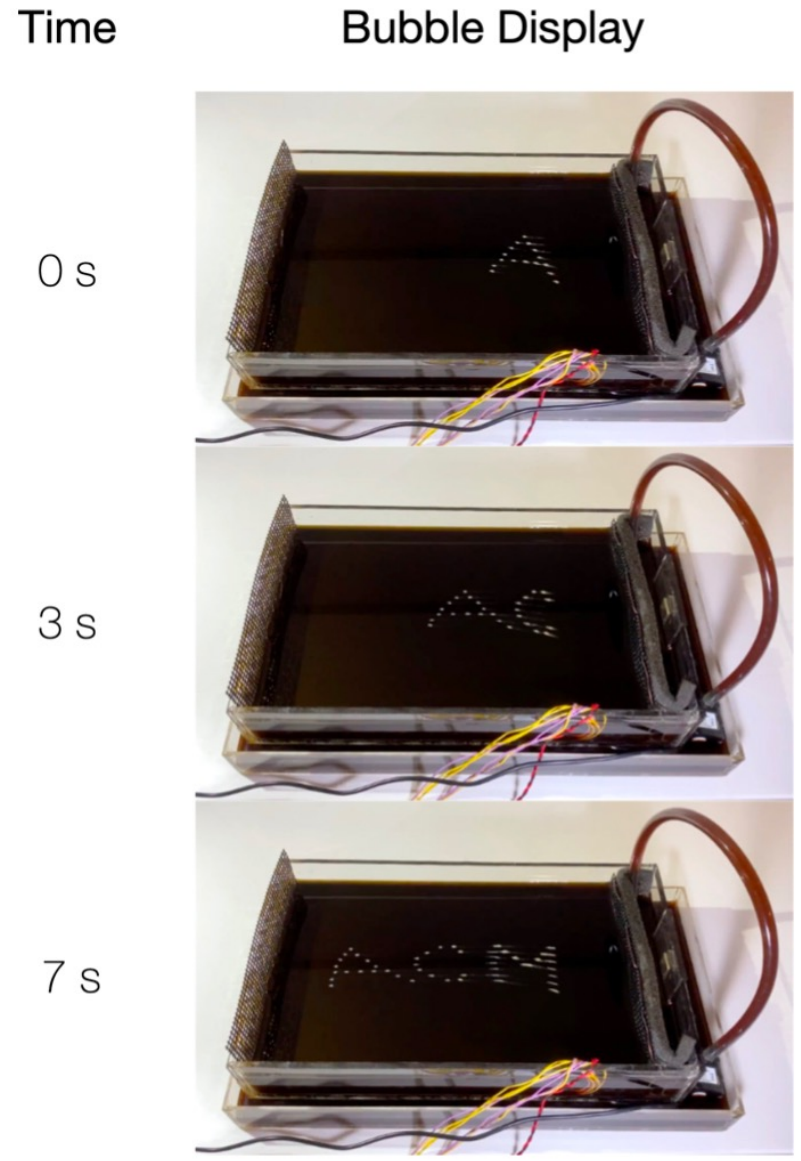


Circuit diagram representing wiring of Line N. (N = 1 to 7)

Coffee was used as the electrolytic solution; we used instant coffee (prepared using 1.5 % w/v coffee powder) with sodium bicarbonate (0.4 % w/v) to promote electrical flow and cornstarch (0.25 % w/v) to provide sufficient viscosity and avoid the diffusion of bubble clusters.

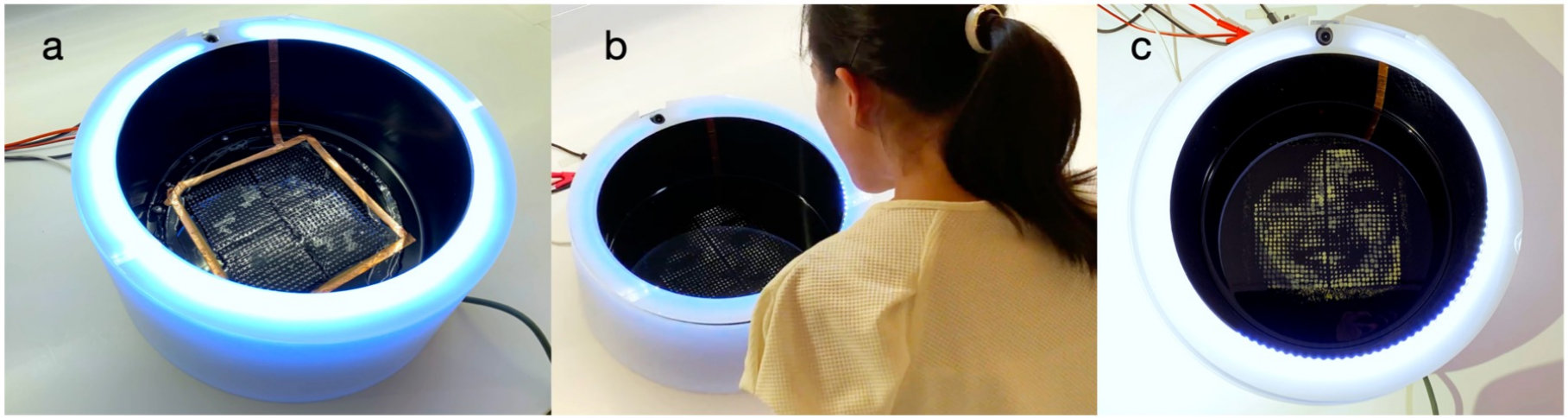
Technical Evaluation

- Each electrode is energized for 300 ms to display a single pixel.
- This generated bubble pixels that have approximately the same intervals as the interval of the cathode pins and the horizontal resolution was approximately 3 dpi.
- This allows a 1:1 aspect ratio display with UTAKATA.

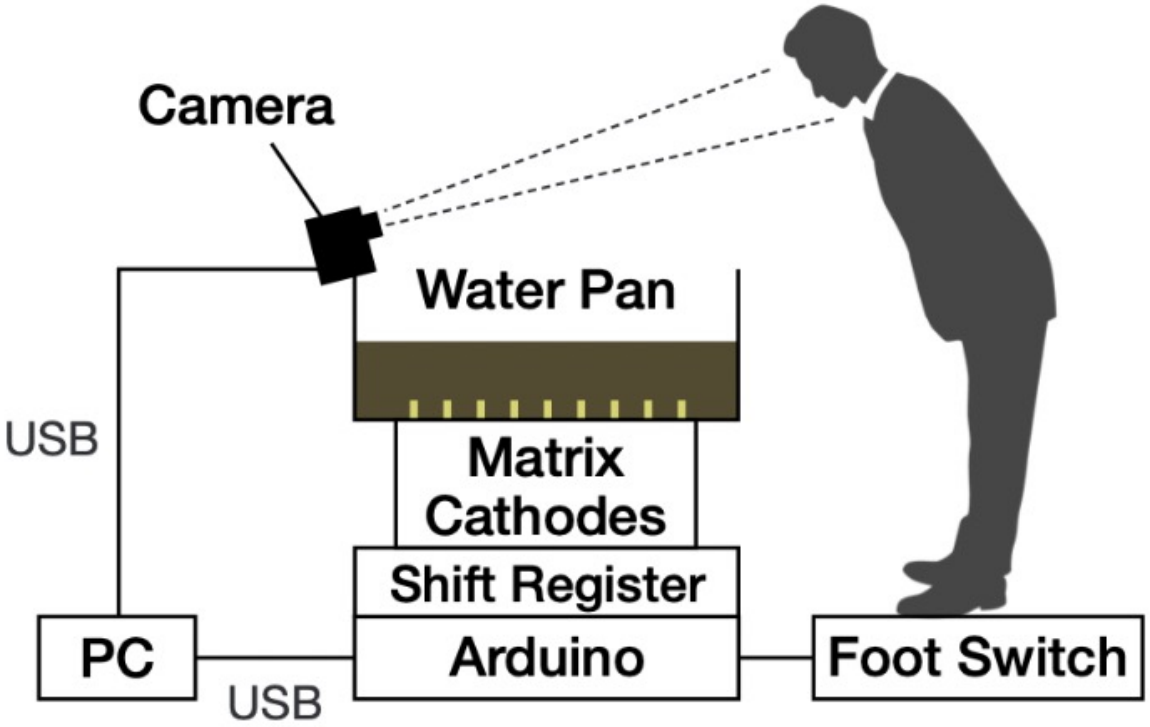


BUBBLE MIRROR

- The Bubble Mirror is a water pan equipped with 32 × 32 pixel electrodes and a camera
- Analogous to a water surface that reflects the face of the person looking into it, the Bubble Mirror displays the image of the face on the water surface when the person looks into the system
- Several technical challenges, such as the fabrication of a display with over 1,000-pixel bubbles and the appropriate electrode control for grayscale imaging.

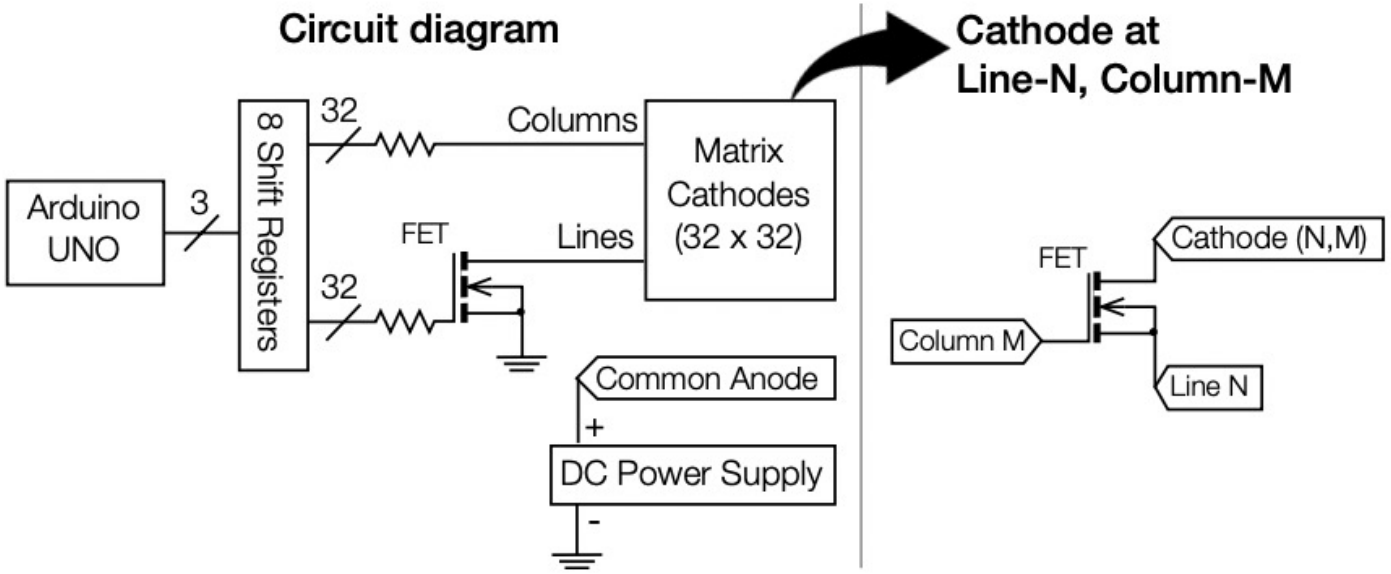


Overview and User Experience



The system is comprised of a water pan with an Arduino UNO controller, a foot switch[4], a USB camera, and a PC running Processing program on macOS.

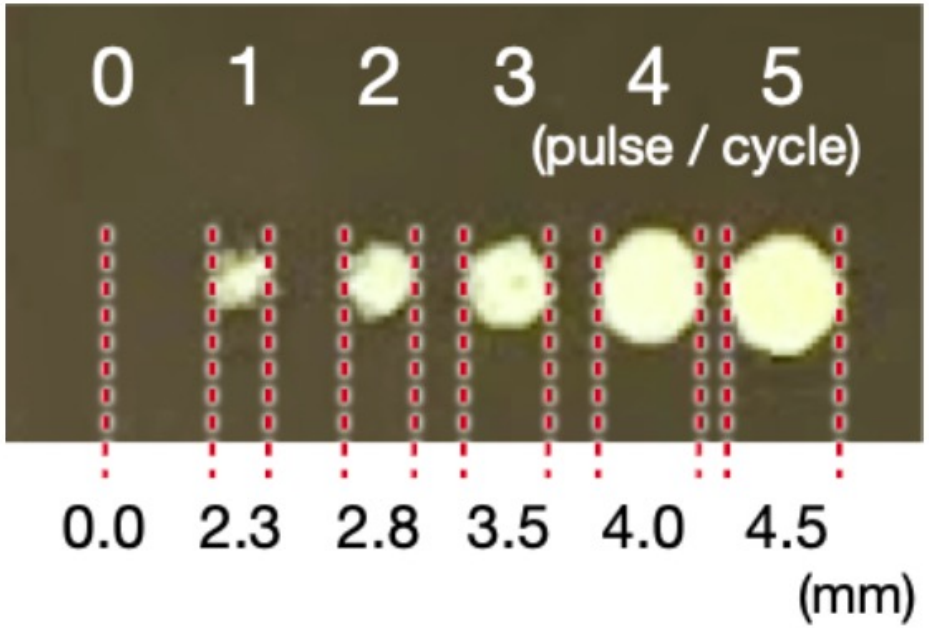
Bubble Generation



- Used instant coffee (prepared with 1.5% w/v coffee powder) with sodium bicarbonate (0.4% w/v) to promote electrical flow and cornstarch (0.2% w/v) to provide sufficient viscosity to avoid the diffusion of bubble clusters.

- In this device, 1,024 pixel electrodes were connected to an active-matrix circuit, and they underwent pulse-density modulation (PDM) by the Arduino to provide a grayscale display.

pulse-density modulation (PDM)



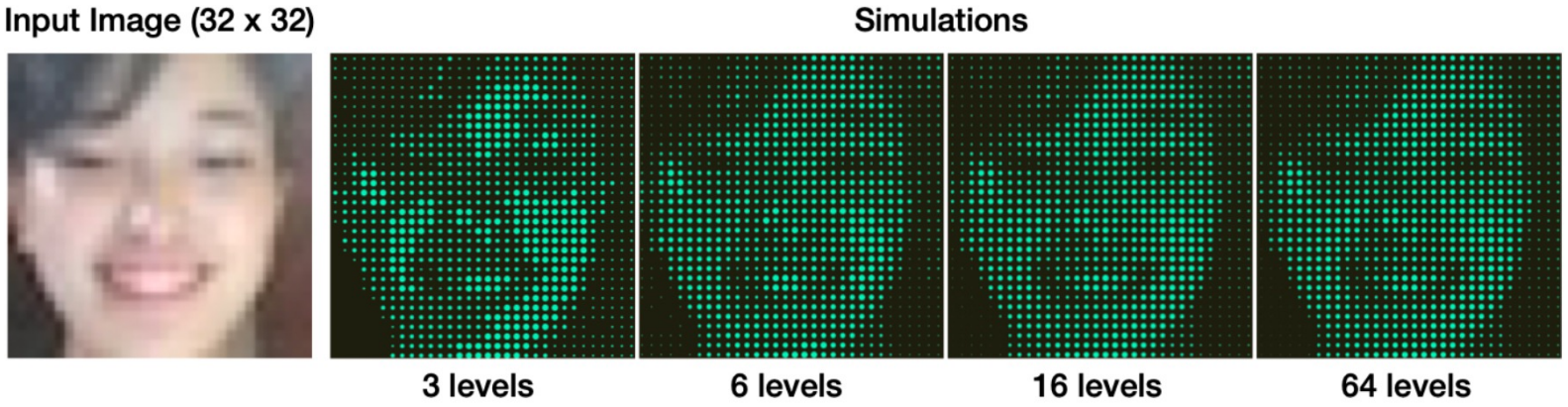
Bubble clusters generated by PDM current. Num- bers 0 - 5 indicates number of pulses (10 ms width) per re- fresh cycle (1.6 s). Numbers below are the actual diameters of the clusters of bubbles.

Facial Image Processing

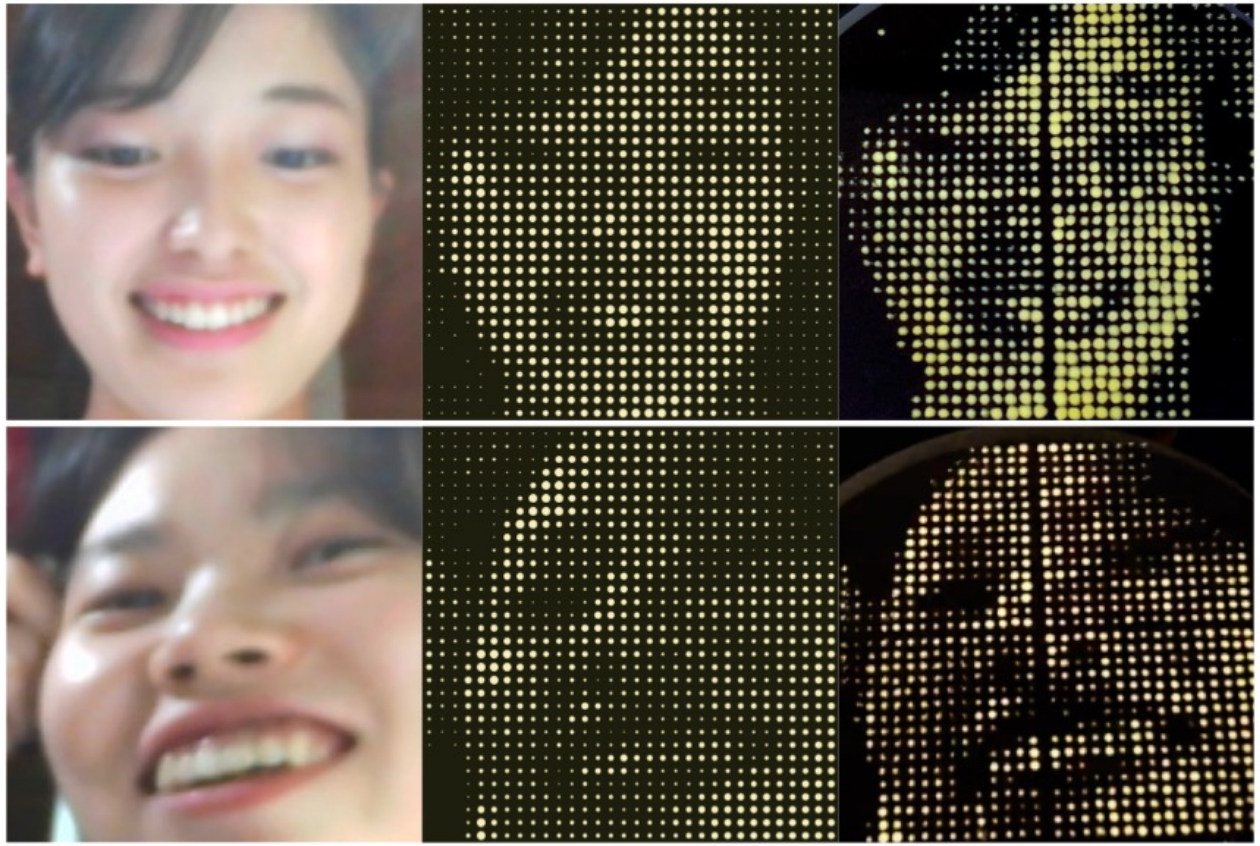
- The PC captures the visitor's face via the camera and converts it to the 32 × 32 pixels with six grayscale levels.
- To determine the optimal grayscale levels, we created simulation software that converts a 32 × 32 facial image to 1,024 halftone dots.

The saved images are then resized to 32 × 32 pixels in 256 grayscale,

32 × 32 pixels of six grayscale (0–5) images are generated



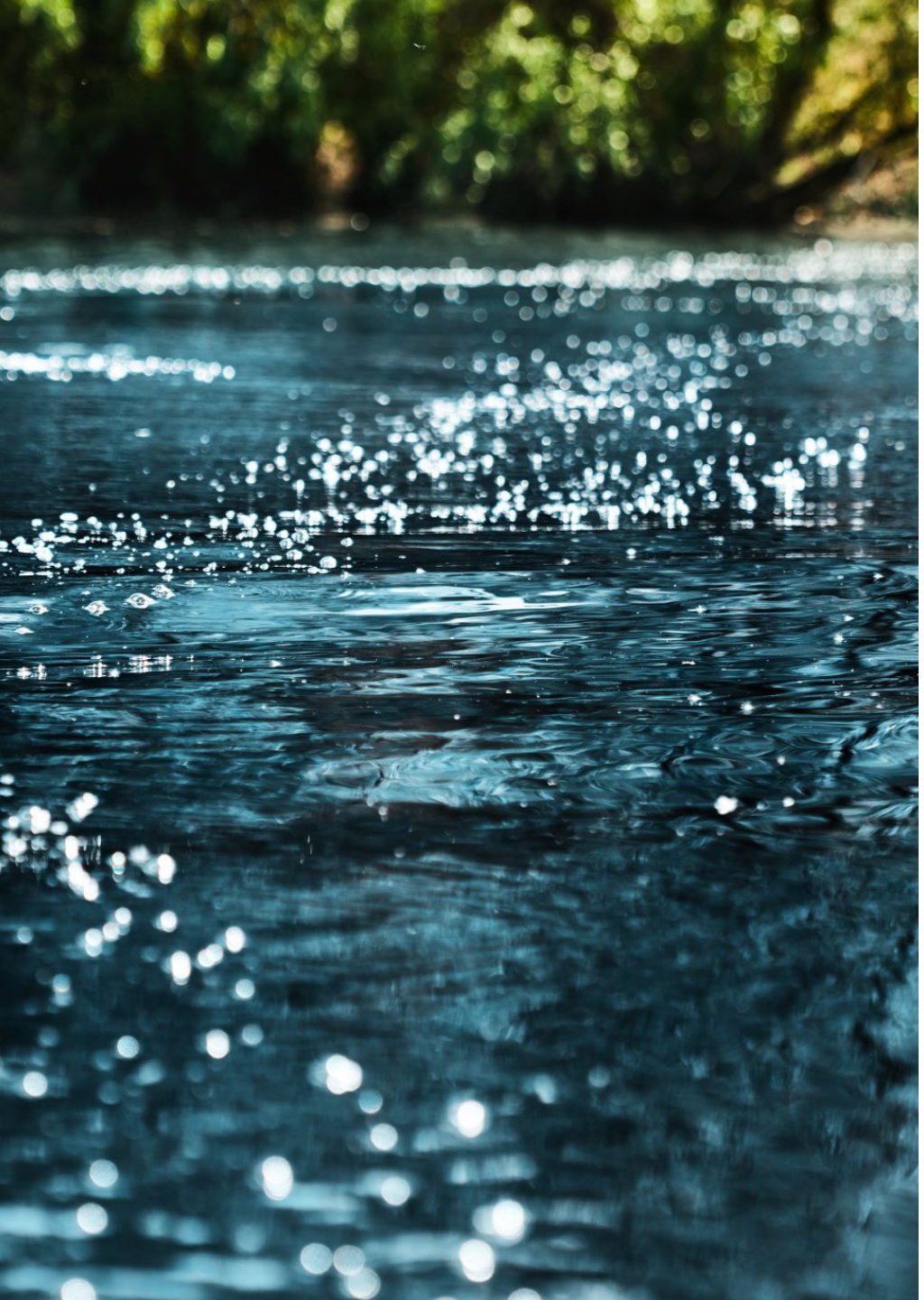
Measured the black-to-light-gray (BTG) and white-to-dark- gray (WTG) response times of the Bubble Mirror.



(a) Original image

(b) 32x32 face image of halftone dots (6 levels)

(c) Output of the bubble display



FUTURE VISION

- **UTAKATA:** Based on nature slow flow river to use this technology to display bubbles.

- **Bubble Mirror**: Consider improving it from an artistic perspective.

– 聯想與心得 (Connection)

- This paper is based on bubbles capabilities to enable two types of devices to describe the findings and the usage of the data transition during the water flow and some static usage with gray levels.
- Pixel base knowledge was reviewed during this research and found various capabilities to realize things in real.
- Water had some limitations during display, this used the bubble to leave the textual data more time with bubbles.
- The usage of material and the vision of humanity to realize the data transition through these methods. It contained the additional value with the display interface for this research.

– 對論文的評價 (Comments)

- The paper reviews previous studies and research about the water flow.
- It clearly replied the value of this research regarding the resolution and the gray level methods from the image.
- The interconnection with the bubble mirror provides some advanced mindset from image to grey pixel data which could be displayed with water and bubbles.
- I thought it is good for some digital imagination with some liquid material which could follow these processes to understand the key factor about the research in this field.