Simulating a touchscreen using distance sensors

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abstract

２つの距離センサー、そして三辺測量と呼ばれる手法を用い物体のxy座標を取得できる

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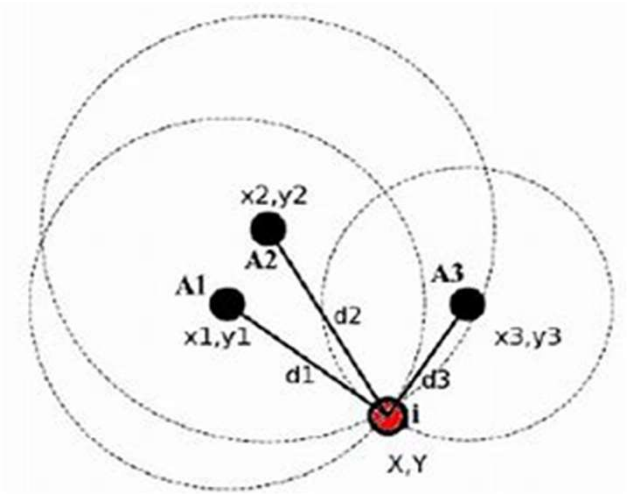
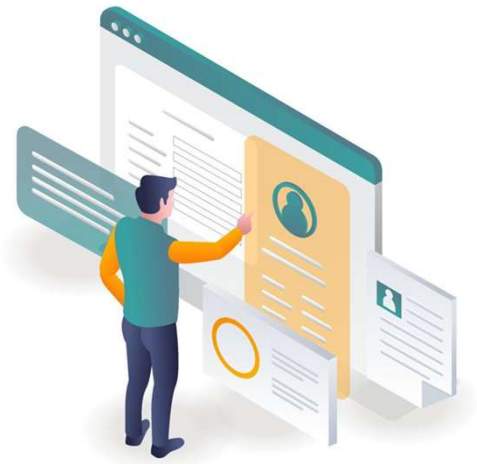
　手のxy座標を取得し遠隔操作可能なタッチスクリーンとしてシミュレート



Background

- What if we can operate anything from afar, as if we are using a touchscreen?
- We made simple app as a proof of concept. The user interacts with the app using only the hand position calculated using the sensors' data



Current technologies

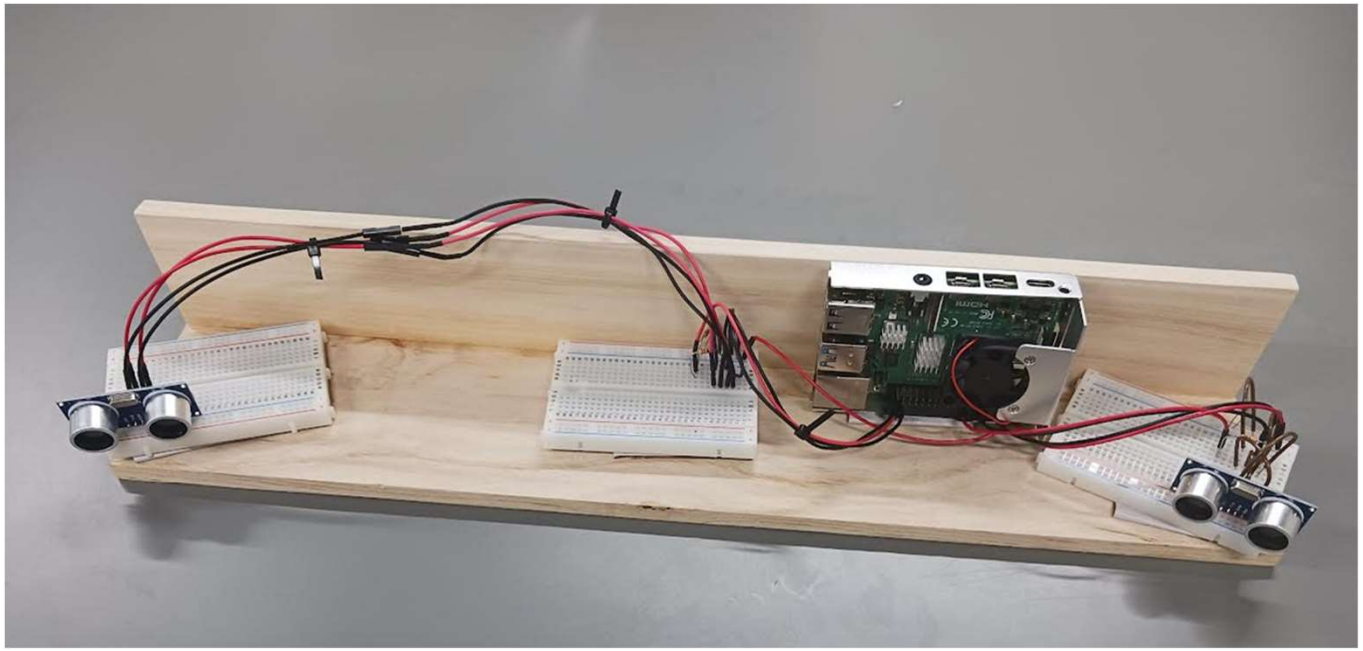
- Similar implementations exist, but they use very expensive laser technology

Our system

- We use two cheap and easily available sensors (HC-SR04) to achieve the same results.

Implementation(実装)

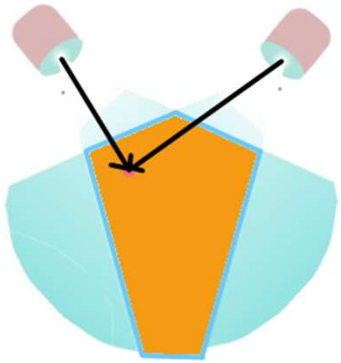
- Raspberry Pi and two HC-SR04 ultrasonic distance sensors are used in the following setup:

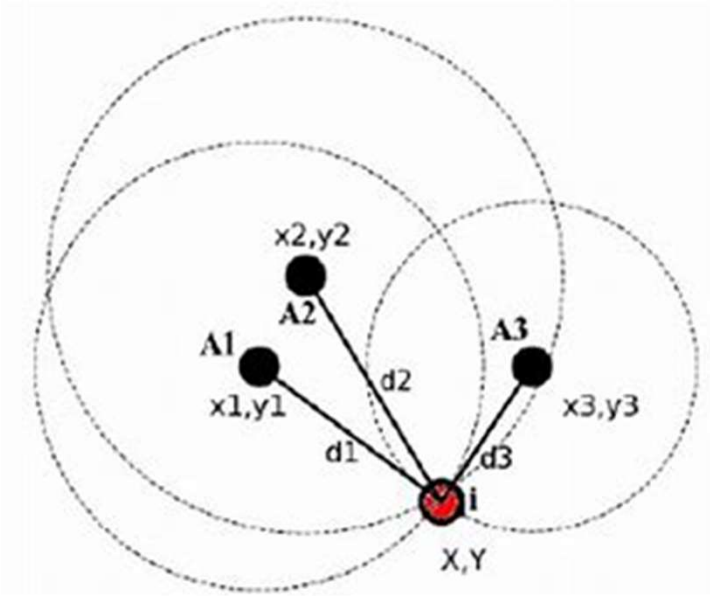


Implementation(実装)

• Knowing only the distances from the sensors, **trilateration** (三辺測量) can be applied to get the position

- Our system makes it even simpler. By restricting the FoV, we can reduce it to only **two sensors**



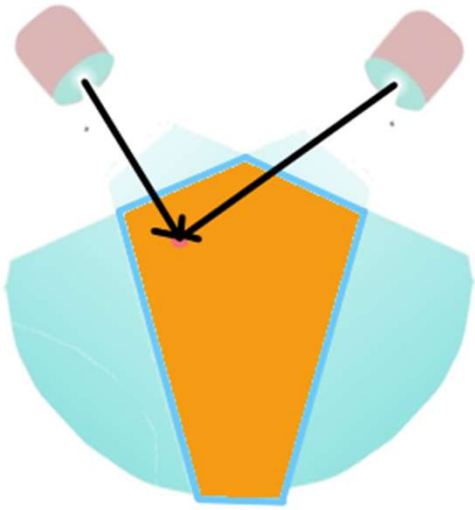


Implementation(実装)

- We set the first sensor's position at (0,0) and the second at (0,d)
- Distances D1 and D2 are measured from the first and second sensors
- We calculate (x,y) by doing:

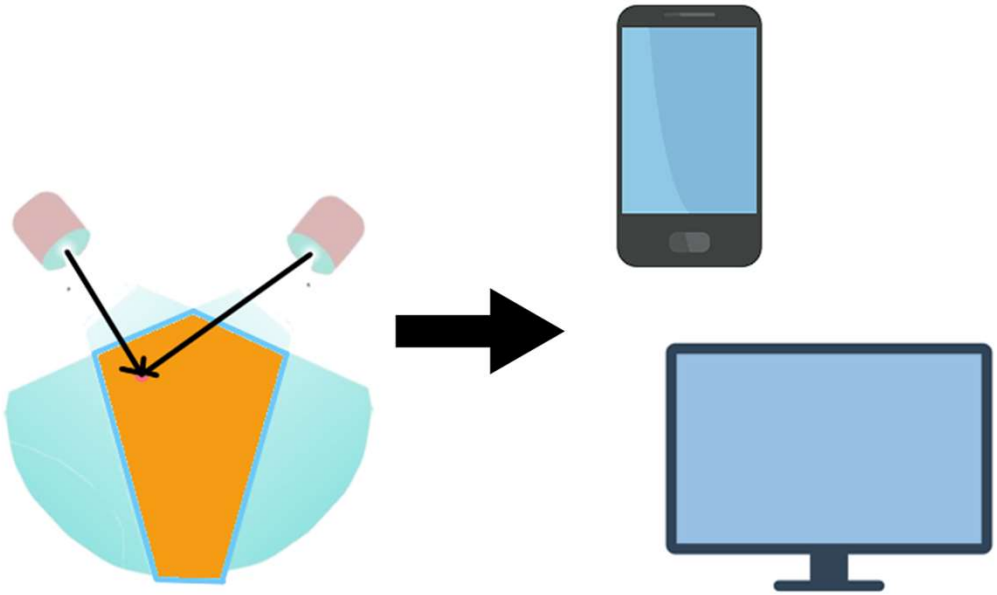
$$x = \frac{D_1^2 - D_2^2}{2d} + \frac{d}{2}$$

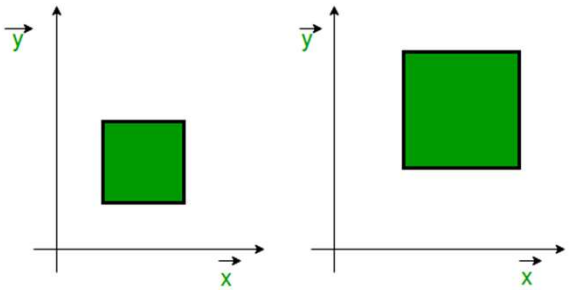
$$y = \sqrt{D_1^2 - x^2}$$



Implementation(実装)

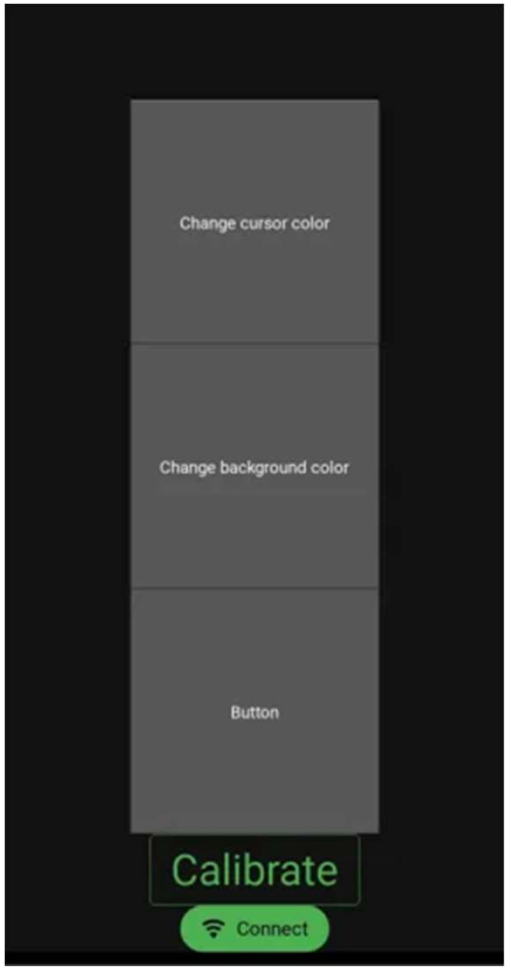
- Once the app is obtaining the distance position from the sensors, we can make a calibration to map the points (x,y) to pixels in the screen





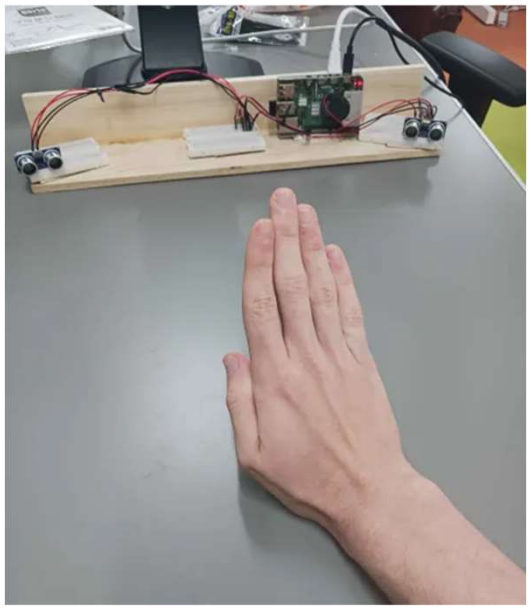
How to use

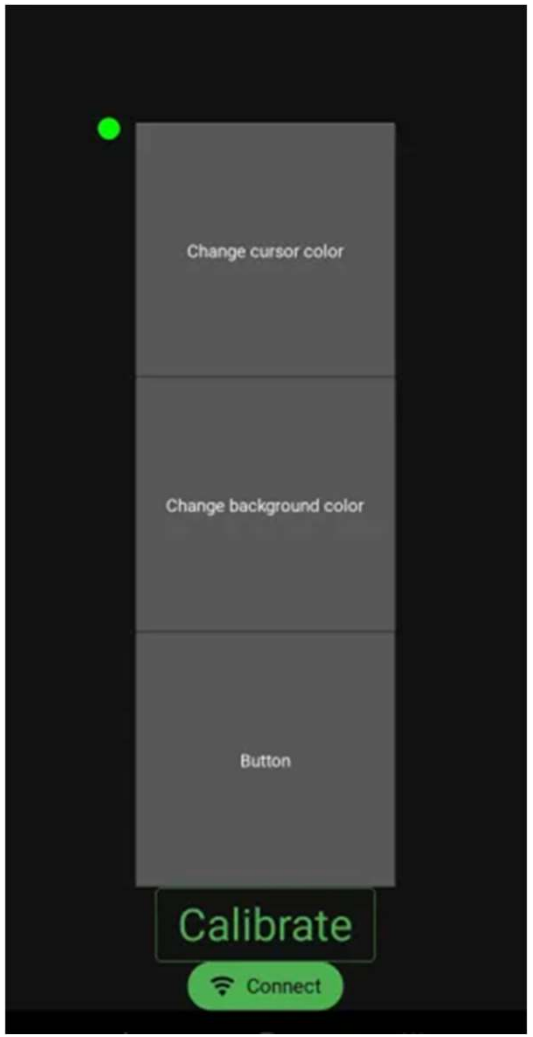
- Connect to the same network as the Raspberry pi and open the app
- Click the “connect” button to start receiving data



How to use

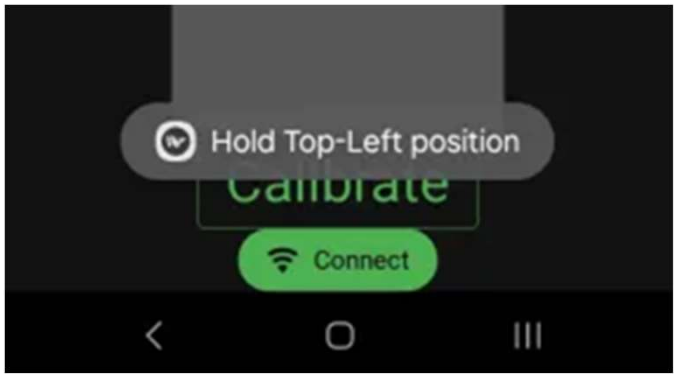
- You will now be able to see the “cursor”
- Move your hand in front of the sensor to see the cursor moving with it

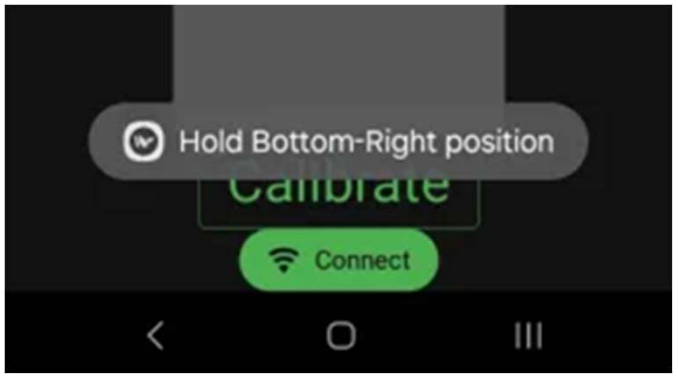


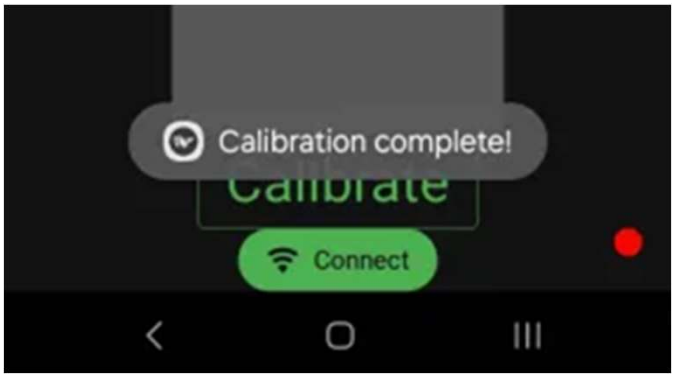


How to use

- Calibrate the sensors to your screen
- Choose the upper-left and bottom-right corners of the surface you want to use as your screen

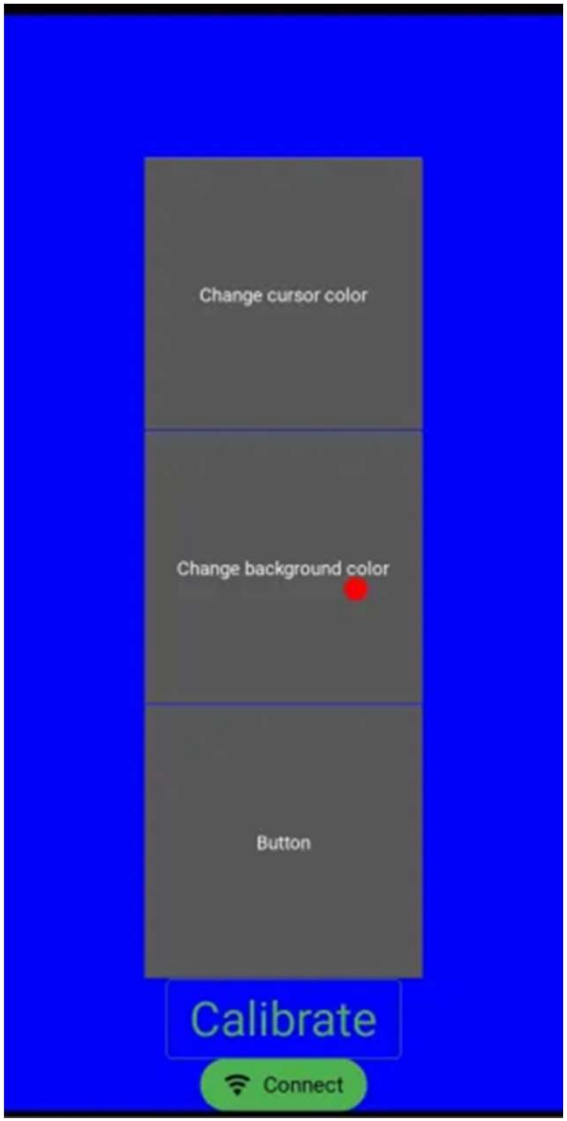






How to use

- Use your hand position to control the cursor on the screen;
- “Click” the buttons by hovering over each button for a few seconds.



Things to improve

- The most important variables for this project are the sensor's **Field of Vision (FoV)** and precision;
- If we have good enough sensors, **theoretically** we can achieve results equivalent to tablets or even big screens for a fraction of the price

Thank you for listening!