ASEAN IVO FORUM 2021

OPTICAL SEGMENTATION ON E. COLI COLONIES FORMED ON SPECIALIZED E. COLI TEST PIECE- FOR THE DEVELOPMENT OF IOT DEVICES FOR WATER QUALITY MONITORING

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PROBLEM STATEMENT

- Increasing problem globally on supplying clean useable water due to limited water source
- Remote areas could not easily access laboratories to conduct water testing
- Handling water sample with possible E. Coli is hazardous and requires highly skilled personnel.
- Process of determining water quality which is based on CFU/100mL is still relatively disconnected

OBJECTIVE/SOLUTION

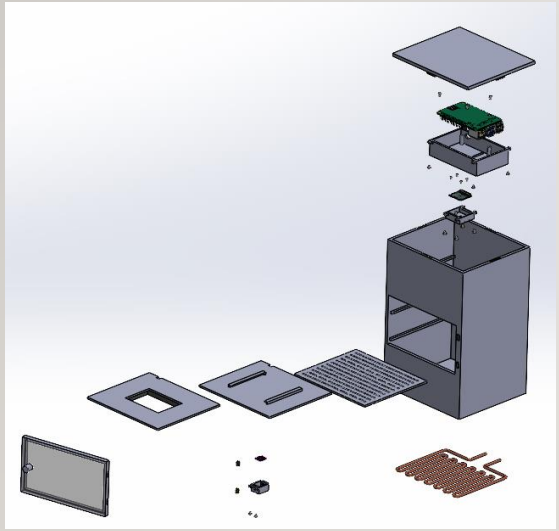
- To design a simple, functional yet cost effective portable machine vision system with a low cost and low power microprocessor residing in an enclosure assembly
- To investigate lighting effect on the colonies formed on the specialized E. Coli test film
- To segment the colonies from background of the specialized E. Coli test piece optically before image processing and analysis.

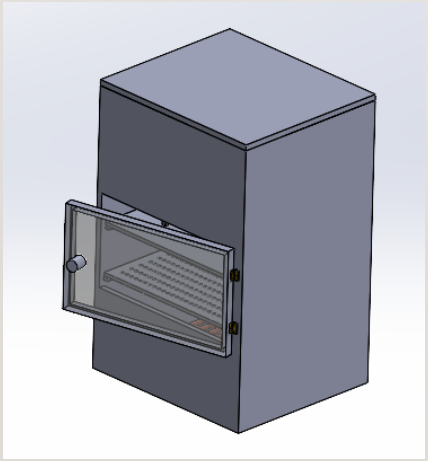
HOW IS WATER QUALITY DETERMINED?

Sample of Specialized E. Coli Test Film

- Water quality is determined in colonies forming unit or CFUs/100 mL of water
- There is a standard to abide to based on the application of the water.
- For example; safe drinking water has to be 0 CFUs/100ml of water.
- Therefore, specialized E. Coli test film is used to test the presence of E. Coli in water

ENCLOSURE ASSEMBLY





- Designed to house all the necessary sensors for machine vision system
- Portable and easy to use for all
- Low-cost and low-power microprocessor
- All processes for water quality determination is done directly from the enclosure (incubation to Machine Vision image acquisition)

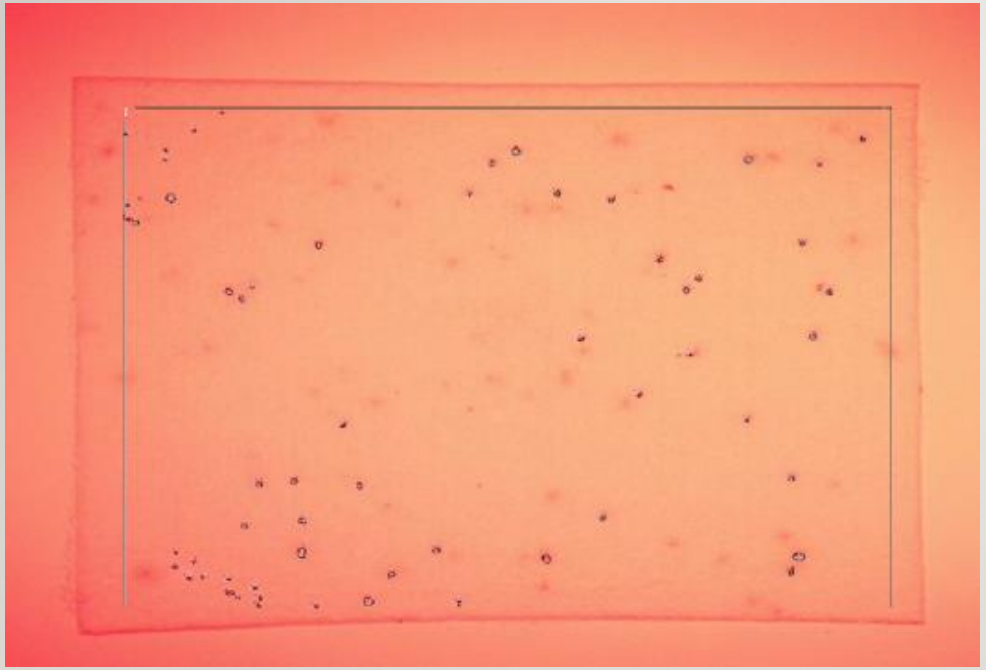
PRELIMINARY RESULTS

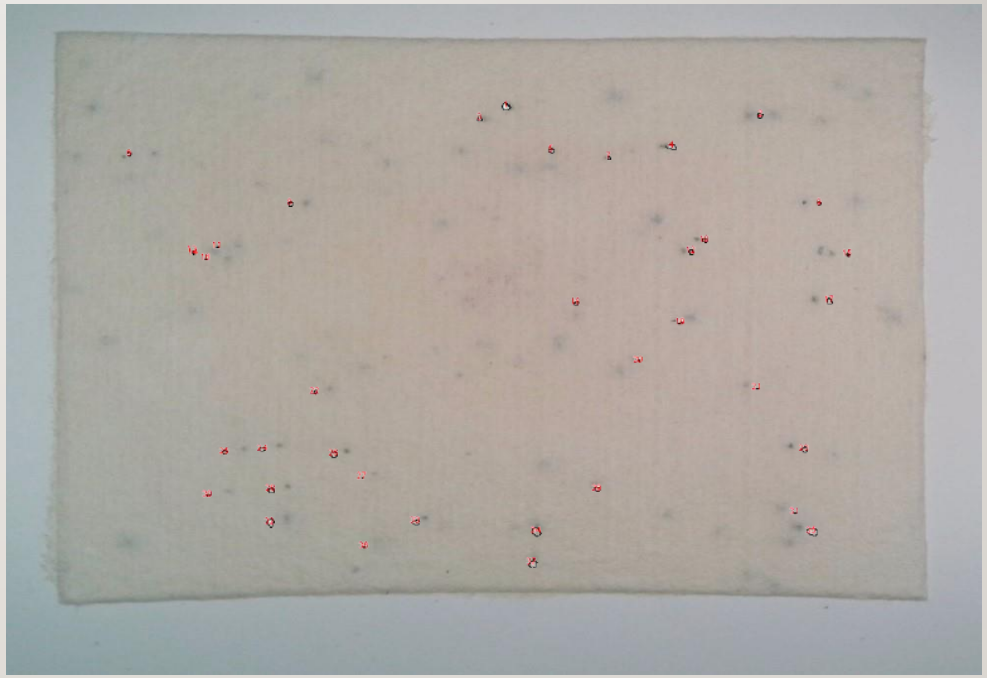
MACHINE VISION LIGHTING

Comparison of Red and Blue lighting with the white lighting as control

- Different lighting colour different quality of the image due to the wavelength of the respective lights (Red is 650nm & Blue is 400nm)
- Red lighting gave the best overall result with majority of dot (representing presence of E. Coli colonies) clearly visualise under the camera. Blue lighting gave the worse lighting with almost no details picked up

COUNTING OF COLONIES USING IMAGE J





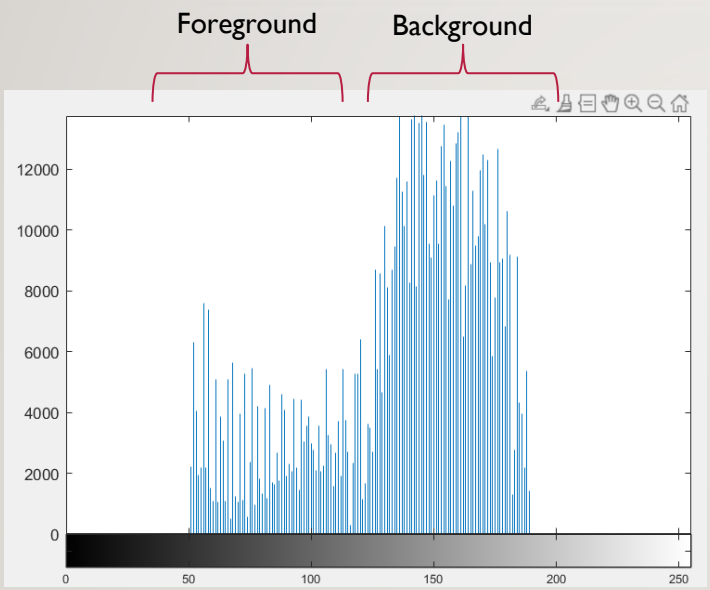
- By comparing, the dots picked up by Image J on the red lighting is much higher than the white lighting.
- Red lighting is able to picked up the details in the image more effectively

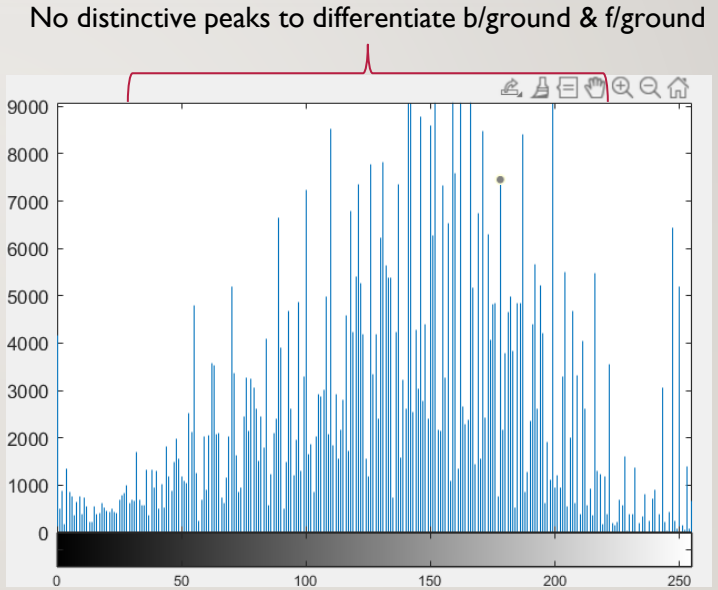
COMPARISON BETWEEN DIFFERENT LIGHTINGS

Comparing a specific area of the E. Coli test piece under different lighting conditions

- The pigmented dot (presence E. Coli) highlighted in red defines that there is a great distinction of background and foreground, therefore easily detected by Image J.
- Taken from an identical area of the respective image, the red is able to produce a more in-depth of the detail, thus easily detected the Image J software
- Indicated using the red arrows are the difference between the two image in terms of the dots recognised by image J. Image with lighting has a higher count of the dot as compared to the white lighting counterpart.

THRESHOLDING USING OTSU METHOD





(L to R) The histogram of red and white lighting

- Red lighting shows a very distinctive difference between the foreground and background evident by the 2 peaks in the histogram
- White lighting shows no differentiation between the background and foreground. The bars in the histogram are randomly scattered with no peaks.
- Clearly, red lighting has a better power of segmenting the image as compared to the white lighting

Q & A Session

Thank You
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