Characterization of an automated, portable, and reusable enterococcus faecalis biosensor for beach water quality.

Pedro Resto Irizarry[1], Katerin Rodriguez[1],Ted Berrios[1], Francisco Rosado[1], Javier De Jesus[1]
BioMEMS and Lab-on-a-Chip Systems Laboratory, Mechanical Engineering Department, University of Puerto Rico Mayagüez

Introduction

Efforts to provide an alternate predictive method to perform water quality of the beaches result the development of an automated, portable and reusable biosensor. Biosensor is composed of a millifluidic device as sample handling, a hot plate as incubator, a led array as UV light source, a PiCam for image acquisition, and electronic components as hardware and data control; it is used Enterolert (IDEXX) as a reagent for bacteria detection. Preliminary data showed to be successful both for handling of the sample and for the data acquisition. On this stage is sought to characterize the fluidic behavior to find the volume of clean water needed to wash away the standing solution in the chip. It is used the ESELog system (QIAGEN) to measure the filling and emptying of a single well using a fluorescent substance.

Methods

This work consisted of improvement the hardware structure and the evaluation of filling profile of the chip. There were built several structures to minimize connection failures, to optimize the space used and looking into a portable and strong structure for biosensor. Different fluorescence solutions and initial conditions were used to identify the filling and emptying profile of a single well of the chip, measuring the volume of clean water needed to wash away standing solution too.

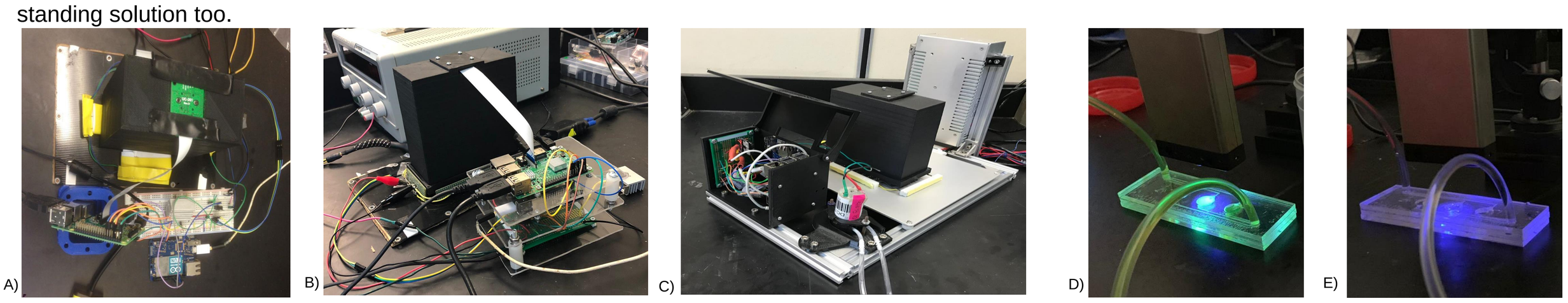
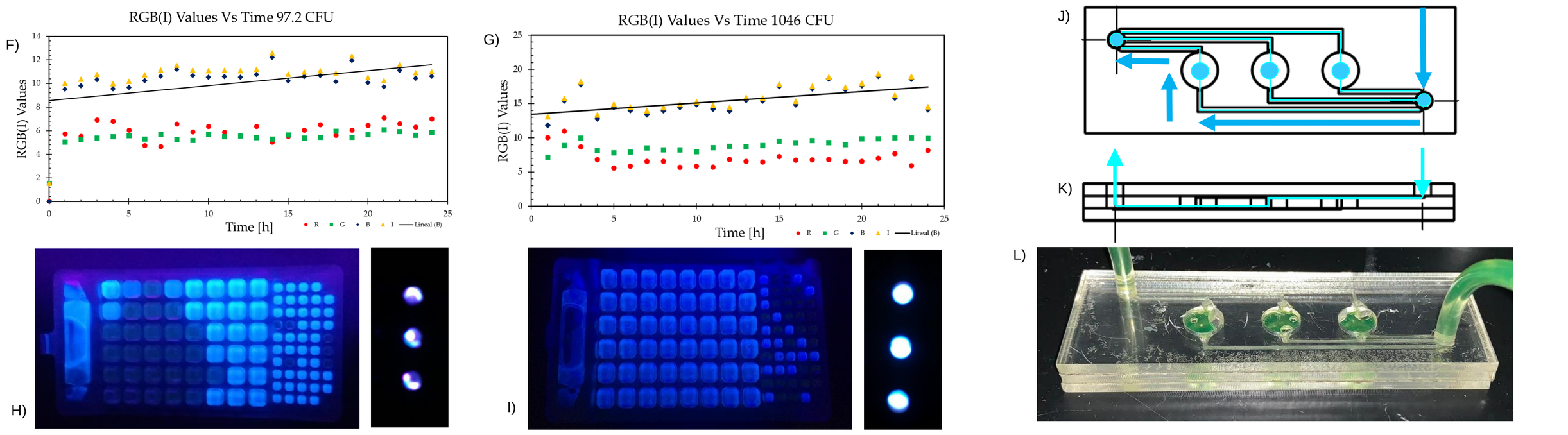


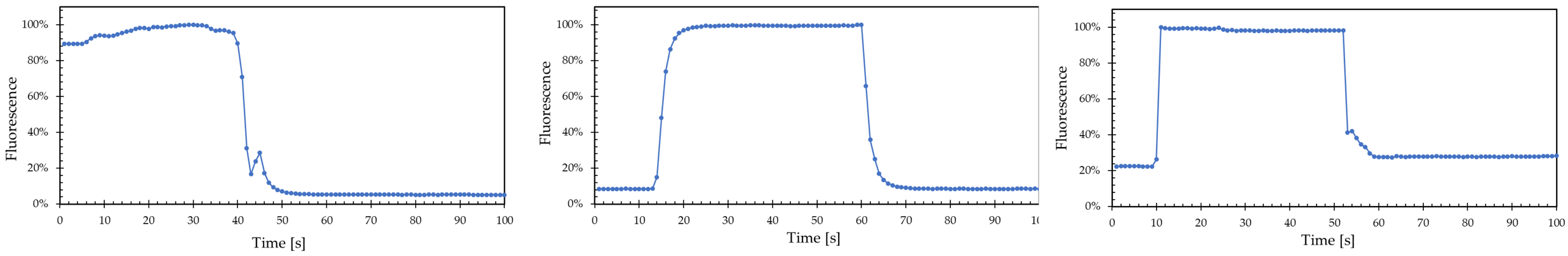
Figure 1. Construction stage of Biosensor system: A) initial, B) second, C) third. Testing of filling and emptying biosensor chip loaded with D) fluorescein, E) clean water using ESELog system (QIAGEN)

Results

- After the RGB(I) analysis, there is a rising trend observed between 0th and 24th hours in the blue value, which varies also with the final CFU concentration. Quanty-Tray was used as validation method.
- There is difference on filling profile on a single well according the initial condition: if full of fluorescein, air, water. Also, emptying profile change is the removal fluid is water or air.



- **Figure 2.** After 24 hours of incubation, RGB(I) Graphs for F) 97.2 CFU and G) 1046 CFU. IDEXX Quanty-Tray and biosensor chip loaded with H) 97.2 CFU and I) 1046 CFU. Top J) and side K) view for the fluid path filling the biosensor chip L).



- **Figure 3.** Filling and emptying profile of single well if initial condition is chip fully loaded of M) fluorescence, N) water, O) full of air

Future Work

- Continuous characterization of biosensor chip implies studies of hydraulic resistance on fluidic channels, diffusion and growth of bacteria within the device, to suggest design improvement.
- More work is required to automate the hardware completely, to optimize software interaction for data acquisition, and to reduce experimental errors.

References and Acknowledgements

- Renner *et al.,* Detection of ESKAPE Bacterial Pathogens at the Point of Care Using Isothermal DNA-Based Assays in a Portable Degas-Actuated Microfluidic Diagnostic Assay Platform, *Appl Environ Microbiol*., 2017 Feb 1;83(4). doi: 10.1128/AEM.02449-16.

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