Integration of artificial intelligence into algal culturing system for enhanced bioenergy production and lower carbon impact

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Abstract (300 word limit)

Bioenergy has become an important green energy, and may substitute for petroleum soon. Microalgae can be a better bioenergy resource than crops because of faster growth rate, higher usage ratio, and potential of lower carbon impact (more efficient carbon fixation). However, main challenge of microalgal culturing includes sufficient supply of nutrients and constant of environmental condition. In this study, we conducted a real-time monitoring and controlling system to a algal photobioreactor. Real-time data of environmental parameters, such as light intensity, pH, temperature, and so on can be monitored and transmitted to microcontroller unit (MCU). These data were stored in the cloud and gradually organized into a database. Through analyzing the database, we are setting an automatic feedback and control parameter. Furthermore, remote users can check the real-time culturing condition through computer or smart mobile by a graphical user interface (GUI). After we integrated this artificial intelligence into microalgal culturing system, the accumulation of biomass was increased from 2.84 g/L to 3.37 g/L. In this stage, we have achieved a near 20% advance. We expect a higher productivity both in biomass and lipid, which can be converted into different source of bioenergy (bioethanol, biodiesel, etc). Because of a delicate design in this artificial intelligence system, both energy and water consumption were decreased, leading to a lower environmental carbon impact.

Image

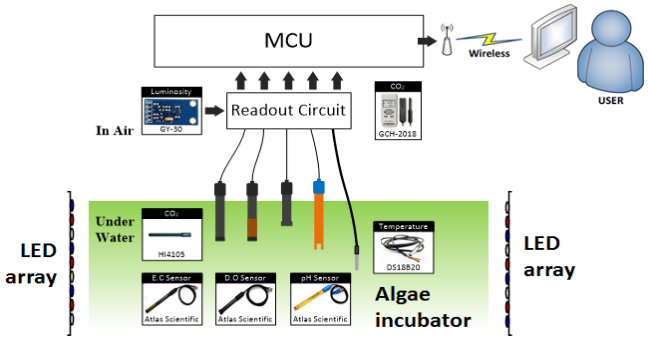


Figure 1: Sensors were equipped in incubator, and data can be read through wireless sensor network and graphical user interface.

Recent Publications (minimum 5)

1. Huang YT, Lai CW, Wu BW, Lin KS, Wu, JCS, Hossain MSA, Yamauchi Y, Wu KCW (2017) Advances in bioconversion of microalgae with high biomass and lipid productivity. J. Taiwan. Inst. Chem. E. 79:37-42.
2. Venault A, Ballad MRB, Huang YT, Liu YH, Kao CH, Chang Y (2016) Antifouling PVDF Membrane Prepared by VIPS for Microalgae Harvesting. Chem. Eng. Sci. 142:97-111
3. Huang YT, Yamauchi Y, Rawat A (2015) . Gene *polA* as a suitable reference for studying antibacterial effect of Hydroxyapatite. J. Biomed. Nanotechnol. 11(5):906-912.
4. Chiang YD, Dutta S, Chen CT, Huang YT, Lin KS, Wu, JCS, Suzuki N, Yamauchi Y, Wu KCW (2015) Functionalized Fe3O4@Silica Core–Shell Nanoparticles as Microalgae Harvester and Catalyst for Biodiesel Production. ChemSusChem 8(5):789-794.
5. Huang YT, Yamauchi Y, Lai CW, Chen WJ (2014) Evaluating the antibacterial property of gold-coated hydroxyapatite: a molecular biological approach. J. Hazard. Mater. 277:20-26.
6. Huang YT, Su CP (2014) High lipid content and productivity of microalgae cultivating under elevated CO_2. Int. J. Environ. Sci. Te. 11(3):703-710.



Biography (150 word limit)

Yu-Tzu Huang has her expertise in Molecular Biotechnology and passion in developing the bioenergy and green nanomaterials. She integrated artificial intelligence into algal culturing system, creating further improvement both in biomass and bioenergy productivities. At the same time, lower carbon impact and more efficient water usage can be achieved. Her study on antibacterial effects of Hydroxyapatite-derived nanoparticles opened a wider application of these nanomaterials on biomedical and environmental fields. She has also developed a system for monitoring the dynamics of bacterial community and functional genes in wastewater treatment processes for setting the optimal operation parameters.

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Notes/Comment