EvoBot in service: interface and interconnection of Microbial Fuel Cells (MFCs) with a liquid handling robot for optimised performance

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Abstract

Microbial Fuel Cells (MFCs) are bio-electrochemical devices that convert organic matter into electricity through bacterial digestion and respiration [1]. MFCs, unlike a battery, can generate electricity continuously as long as fuel is supplied. This has made MFCs an attractive alternative source of electricity for low-power robots. Robots are powered via conventional mains or battery means but this is also a bottleneck for wider deployment; it is therefore envisaged that green energy sources could be one way of powering the next generation of truly autonomous robots [2].

MFCs have previously been reported to power mobile robotic systems such as; Gastrobot, the four families of EcoBot (I, II, III and IV) and Row-bot (a floating robot). However, in order for MFCs to be implemented into the next generation of autonomous agents, their power output capability needs to be improved.

This was pursued using a liquid handling robot called EvoBot [3], which interacted with MFCs using a feedback loop mechanism. The real-time electrical output of the MFCs was monitored and fed back to the robot, which was triggering the robotic liquid handling head to supply fuel, in the event of underperformance. This self-managed maintenance mechanism that prompted a feeding “on demand” was able to accelerate the maturing process of the MFCs from 30 down to 6 days. Notably, it also increased the power output by almost 40% compared to the output produced by the manually maintained MFCs on the bench (19.1 mWm^{-2} to 26.5 mWm^{-2}). This experiment showed the potential of using EvoBot as a maintenance machine for optimising MFCs which can then power autonomous robots.

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