Versatile Sample-to-Answer Platform for Rapid, On-site Detection of E. coli DH5α Strain and Occurrence of Antimicrobial Resistance

Summary

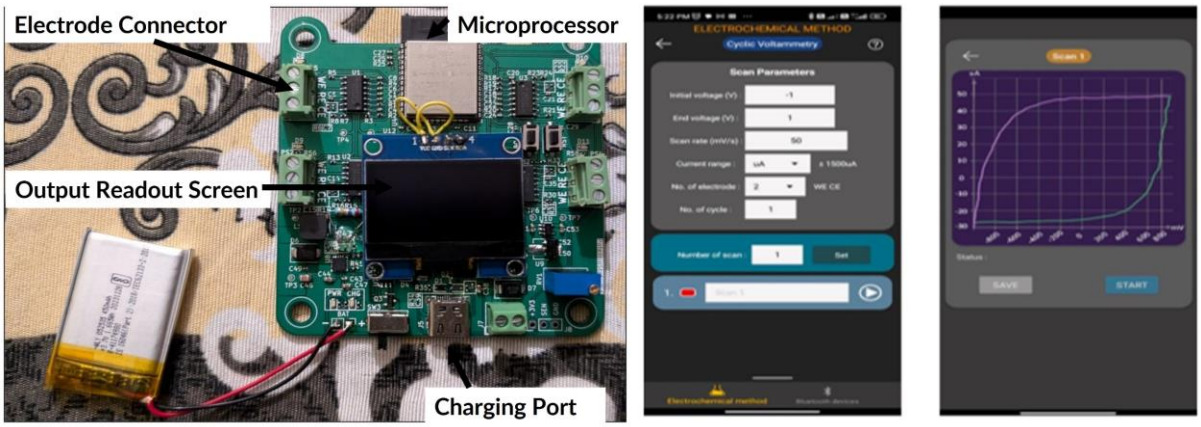
Antimicrobial resistance (AMR) is unquestionably a serious global health issue, potentially turning treatable infections into deadly illnesses. AMR has a significant impact on clinical and public health. Currently responsible for over 1.27 million deaths each year, AMR could beat cancer as the leading cause of death by 2050, claiming 10 million lives annually.

The consequences of AMR are devastating, particularly in low- and middle-income countries, where AMR not only prolongs illness but also increases healthcare costs, resulting in an overwhelming economic burden. In hospitals worldwide, doctors find it increasingly difficult to treat infections as more pathogens have become resistant to common antibiotics, leading to medical inefficiency, challenges of severe illness, and transmission.

As a result, an immediate action plan with a promising solution is required to combat the challenges associated with AMR. It requires a potent method that can be used to accurately and sensitively detect the presence of specific bacterial infections as it is a critical and initial step in ensuring the administration of appropriate treatment. Further, it helps clinicians to identify antibiotic-resistant bacterial strains. A low-cost and rapid point-of-care diagnostics kit combined with the microfluidics and electrochemical sensing platform can meet the challenges associated with the traditional approaches for detecting the presence of specific bacteria and resistant strains.

To enable the identification of antibiotic-resistant bacteria, we have developed an accurate, rapid, and cost-effective point-of-care testing (PoCT) system for the on-site detection of bacteria in real-time, ensuring appropriate treatment, particularly in resource-limited and remote settings. The developed platform is a versatile solution that can be seamlessly integrated with a smartphone and couples the advantages of microfluidics and electrochemical detection techniques. The sensing mechanism involves using a three-electrode system functionalized with specific biorecognition elements to generate precise signal readout upon pathogen interaction, which helps in sensitive and accurate detection. The developed device provides the functionality for an on-site bacterial incubation system and continuous monitoring of bacterial growth, offering results within a unique 6-hour window. In contrast, traditional techniques

require 24-36 hours of detection time. In addition, the developed device has cloud-based data storage and advanced machine learning algorithms, which continuously refine its diagnostic accuracy, ensuring reliable, rapid detection of resistant bacteria. The device interface is designed for simplicity and ease of use, requiring minimal training, making it highly adaptable to diverse healthcare environments. From rural clinics to urban hospitals, it empowers healthcare providers to make informed, timely decisions, directly addressing AMR at its source. The developed device is a standalone diagnostic platform for significantly enhancing and improving the global efforts to combat AMR, ensuring faster, more effective responses to this accelerating public health crisis.



Point-of-care device for rapid and on-site detection of various pathogens for combating antimicrobial resistance

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