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An automated approach for fibroblast cell confluency characterisation and sample handling using AIoT for bio-research and bio-manufacturing

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Abstract

Author keywords

SciVal Topics

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Abstract

Current methods used in cell culture monitoring, characterisation and handling are manual, time consuming and highly dependent on subjective observations made by human operators, resulting in inconsistent outcomes. This project focuses on developing an automated system for cell growth analysis, utilising Artificial Intelligence of Things (AIoT) for use in bio-manufacturing and bio-research. The proposed AIoT system applies a U-Net convolutional neural network (CNN) model for fibroblast cell segmentation to monitor confluency and incorporates a mechanical robotic arm for automated sample handling. Intel Movidius Neural Compute Stick 2 (NCS2) and OpenVINO Toolkit were used to

allow for standalone deployment on an UP2 Squared and a Raspberry Pi board that is integrated with a digital microscope system. The robotic arm was programmed to pick, place and sort the cell samples within the working environment. The results obtained from the CNN model development achieved an accuracy of 95% and an intersection over Union (IoU) of 66%. The OpenVINO Toolkit successfully optimised power-consumption and accelerated the segmentation on a 2K image to be completed in less than 13 seconds. The AIoT cell detection and characterisation system is able to automatically analyse the cell culture while reducing manual sample handling by laboratory personnel. Eventually, it is hoped that this AIoT automated cell detection and characterisation system will have a positive impact and contribute towards the implementation of the Industrial Revolution IR4.0 in bio-based research and industries. © 2023 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group.

Author keywords

AIoT; cell culture; CNN; confluency; deep learning; fibroblast cells; microscopic analysis; microscopy image segmentation

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