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A device reporting cell culture growth in CO_2 incubator via Bluetooth

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Motivation and Aim: Cell cultures are widely used in today's industry and research. Cells are an irreplaceable laboratory material in biomedical research, just as biotechnology cannot be imagined without the use of cell cultures as well.
It is substantial to maintain certain conditions during cultivation, including the control of concentration of cells. For all cells, and especially for bacteria, growth phases can be distinguished. Many existing methods for assessing the state of cell culture require sampling of the material. As cells are cultured under sterile conditions and often inside specialized equipment (for instance, CO_2 incubators), this can be problematic because: 1) the risk of culture contamination increases; 2) the sampling location can influence the result because cells can be unevenly distributed in the flask; 3) sampling leads to a change of (at least) volume, and possibly other parameters of the cell environment 4) this type of measurement cannot be instantaneous. Even if the process is completely automated, there is a period of time between sampling and measurement. Thus, it becomes necessary to monitor the cells without entering the sterile zone.
Methods and Algorithms: We present a non-sampling device for monitoring cell culture growth based on light scattering. A horizontal laser beam with a wavelength of 850 nm is directed into the culture flask with cells through the side surface. In this case, the culture flask is placed on a panel with vertical holes located along the laser beam at the same distance from each other. Through these holes, the light scattered by the medium with cells enters the board with photodiodes. The photodiode signals are converted to a digital signal and transmitted via a Bluetooth adapter to an online data store. Cell concentration is estimated from the dependence of the side light scattering signal on the distance along the laser beam.
Results: The device was tested on calibration polystyrene beads with size 3.7, 6 and 15 um. The concentration obtained by the new device coincides with the given concentrations. We plane to demonstrate measurements for cell culture Jurkat soon.
Conclusion: This device is easy to reproduce and is quite cheap, while it completely solves the problem of measuring the concentration of cells inside the sterile zone without sampling.
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