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Use of Artificial Intelligence and Edge Computing for Remote Cuff-Free Monitoring of Blood Pressure

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Introduction

Because of the growing population, traditional health diagnostic services are unable to meet the demand for low-cost, high-quality healthcare. Because of recent advancements in the field of mobile devices and communication, the development of a remote mobile health monitoring system is now possible. Physicians can use such a system to provide these services at all times, improving the patient experience and reducing the burden on the public health system. In a standard sensor-cloud architecture, the monitoring system sends measurements to the cloud for processing, which is an appropriate approach for low information rates.

However, when this architecture is used for high-frequency measurements, it falls short of providing the service in terms of performance guarantees. The capacity of a communication channel is generally limited, and constant data transmission at a high frequency necessitates a significant amount of energy. As a result of these difficulties, computational capability has shifted from the cloud to the edge. By processing data at a device physically closer to the sensor, edge computing improves system efficiency. Despite the fact that much research has been conducted on this topic, issues associated with high data volumes require further investigation.

Description

Edge computing benefits include lower energy consumption for battery-powered devices, faster response times, and reduced network bandwidth consumption. Long-term electrocardiogram (ECG) monitoring is one example of a big data healthcare use case. The required bandwidth is determined by the sampling rate, resolution, and number of leads, but a typical ECG recording device samples at 100-1000 Hz and has an 8-16 bit resolution per data sample. For one day of single-lead ECG transmission, this results in a data volume ranging from 8.64 MB to 172.8 MB. This volume of data necessitates a substantial amount of transmission time, resulting in increased energy consumption [1-3].

We use an existing algorithm to estimate blood pressure (BP) through ECG monitoring to evaluate the benefits of edge computing for real-time ECG monitoring. The algorithm is implemented in three variants of a sensor-edge-cloud system: edge processing, cloud processing, and cloud processing with compressed transmission. In order to better understand the results, the third compression approach is used as a hybrid approach between edge processing and cloud compressing.

These approaches are then weighed in terms of application latency, communication latency and data volume, and energy consumption. This study can help researchers in both fields of study make more informed decisions about real-time monitoring architectures by combining a performance evaluation of edge computing with cuff-less blood pressure monitoring. Section 2 provides background information on cuff-less blood pressure estimation as a use case example in remote health monitoring with a high sampling frequency requirement. It also describes some of the methods, algorithms, and results that are appropriate for this use case. Section 3 describes our system model and its implementation [4,5].

Conclusion

Blood pressure (BP) is traditionally measured with an inflating cuff wrapped around the arm. Each measurement is made up of three parts: systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP) (MAP). Because of the inflation and deflation of the cuff, this method is reliable and precise, but it is inconvenient for long-term BP monitoring at home. To address this issue, new techniques based on physiological signals such as the ECG and photoplethysmogram were developed. It is possible to estimate BP with high accuracy by applying machine learning (ML) algorithms to this data. Researchers have recently become more interested in ECG-only estimation because devices that measure two signals are more complex and energy-consuming.

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Conflict of Interest

Authors declare no conflict of interest.

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