Resource Allocation in Edge Computing for Health Monitoring Systems

Team Members:

Vasudev Kishor - CB.SC.U4CSE23151

Rachit Anand - CB.SC.U4CSE23139

Rohith Abhinav - CB.SC.U4CSE23141

RG Shanmugam - CB.SC.U4CSE23257

Reference Paper Summary

Title: Priority-based Task Scheduling and Resource Allocation in Edge Computing for Health Monitoring Systems

Authors: Zubair Sharif, Low Tang Jung, Muhammad Ayaz, Mazlaini Yahya, Shahneela Pitafi

Published in: Journal of King Saud University – Computer and Information Sciences (2023)

Asked Questions

How is device failure managed?

If a hospital workstation (HW) or edge unit malfunctions, the system remains operational due to built-in fault tolerance and scalability. Multiple HWs are typically deployed, so if one fails, its tasks are rerouted to alternate HWs or the cloud. A monitoring mechanism continuously checks device health and reassigns workloads when necessary. Hardware and network redundancy ensures uninterrupted patient care.

Does one edge device serve a single patient?

No. Each HW is shared across several patients simultaneously. Tasks are queued and handled based on a priority level (K), enabling the system to serve more users efficiently. Additional HWs can be added to scale the system when demand increases.

Is offloading determined by priority or available resources?

Both factors play a role:
- Urgency level (K): Critical tasks are prioritized for local execution.
- System load: If local HW lacks resources, tasks are transferred to cloud infrastructure.
- Latency sensitivity: Tasks with real-time needs remain on the edge to reduce delay.

What trade-offs are involved in offloading?

Offloading involves balancing:
- Latency vs. computation power
- Bandwidth usage vs. local processing
- Responsiveness vs. energy and cost

Edge devices are quick but limited in power; the cloud can handle more but introduces delay and bandwidth consumption. The system chooses based on what's best for the task's urgency and resource availability.

How is the urgency value (K) computed?

The value K represents task urgency and is derived from live physiological signals gathered via wearable devices. Inputs include temperature, blood pressure, ECG, and glucose levels. The formula used:

$$K = ((ub - hpt)^2 - (lb - hpt)^2) / (ub - lb)^2$$

Where:
- ub = upper bound of safe value
- lb = lower bound
- hpt = current health parameter value

A $K \leq 1$ indicates normal status, while $K > 1$ triggers emergency protocols.

Who authored the original paper?

The research was conducted by:
- Zubair Sharif (Lead Author), Universiti Teknologi PETRONAS (UTP), Malaysia
- Low Tang Jung, UTP Malaysia
- Muhammad Ayaz, University of Tabuk, Saudi Arabia
- Mazlaini Yahya, Petronas
- Shahneela Pitafi, UTP Malaysia

What literature does the paper review?

The paper reviews various task scheduling models in Mobile Edge Computing (MEC), such as:
- HealthFog
- NBIHA
- HP-TDT
- SDFC
- FCB-HMS

While these models offer solutions for healthcare, they fall short in urgency-based

prioritization and efficient offloading, which this study addresses through its PTS-RA approach.

Main takeaway from the study?

The study proposes a smart edge computing model that efficiently processes healthcare data:
- Assigns urgency levels to incoming health signals
- Uses task priority and resource status to manage processing or offloading
- Shows significant improvements in latency, energy use, and system cost compared to existing models

Implementation Plan

Simulation Tools:
- Platform: iFogSim (Eclipse IDE)
- Models patients, devices (HWs), networks, and the cloud backend

Hardware (Optional Prototype):
- Edge Devices: Raspberry Pi 4 or NVIDIA Jetson Nano
- Sensors:
  - Body Temp: MLX90614
  - ECG: AD8232
  - Blood Pressure: API-based device
  - Glucose: Simulated or API input

Communication: Wi-Fi or Bluetooth, using MQTT or HTTP protocols

The system will simulate urgency assessment (K), resource-aware task scheduling, and edge/cloud interaction.