



AUTODOCTOR

Prototype Presentation

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01

Introduction



How to evaluate health conditions?



Glasgow Coma Scale Parameters:



Eye health

Verbal health



Motor health



Heart Rate Monitoring

Continuous monitoring of passenger heart rate during an accident

Real time eye tracking



Real-time eye tracking system classifies eye status as Closed, Slightly Closed, or Open



Voice assistant

Voice assistant assesses the patient's verbal state, with text-to-speech used to interpret responses



Movement detection

Real-time movement detection system classifies movement or stationary behavior

02

State-of-Art



State of Art

Accurate contactless heart rate monitoring with Philips' vital signs camera for automotive

This paper presents an integrated monitoring system for the driver and the vehicle in a single case of study easy to configure and replicate. On-board vehicle sensors and remote sensors are combined to model algorithms for estimating polluting emissions, fuel consumption, driving style and driver's health.

SSW: Smart Steering Wheel for Real-Time Heart Rate Monitoring of Drivers

This work is aiming for the development of a system which includes multiple sensors incorporated with the steering wheel which is capable to measure the pulse rate and alert the rescue team dynamically about the health-related data of a driver, to prevent accidents.

Sapra A, Malik A, Bhandari P. Vital Sign Assessment.

Improvements in emergency response can help prevent deaths and life-changing injuries in road collisions. However, emergency response has not been getting a fair share of attention in terms of research, best practice exchange and measures in the European Union. (Source: European Transport Safety Council)



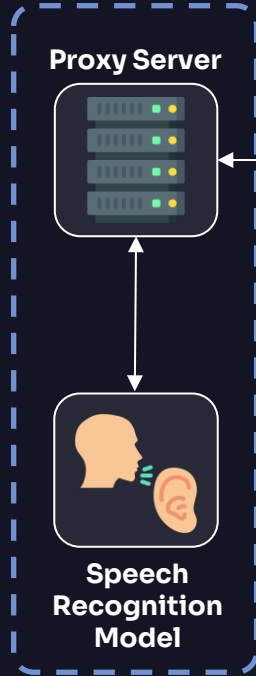
03

System Description

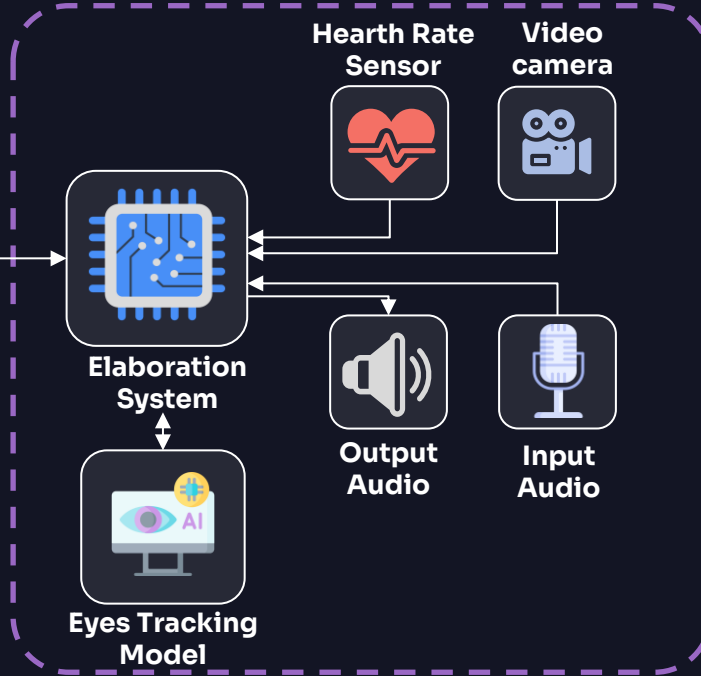


System Description

REMOTE ZONE



LOCAL ZONE



04

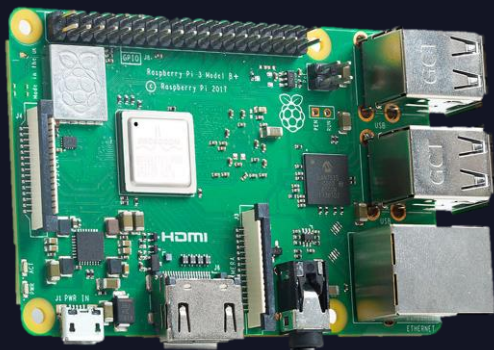
Prototype Description



Elaboration System



Raspberry Pi 3 model B+



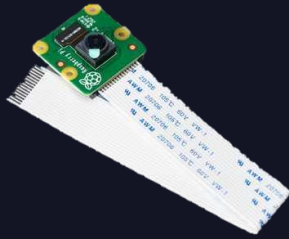
Specifications

- Broadcom BCM2837B0 system-on-chip
- 64-bit quad-core ARM Cortex-A53 processor running at 1.4 GHz
- 1 GB of LPDDR2 SDRAM
- Integrated dual-band Wi-Fi (2.4 and 5 GHz)
- Bluetooth 4.2/BLE
- Gigabit Ethernet interface routed via USB 2.0
- HDMI 1.3a

Camera



Raspberry Pi Camera Module 2



Specifications

- Sony IMX219 sensor with 8 MP resolution, capturing still images up to 3280×2464 pixels
- Records video up to 1080p at 30 fps, 720p at 60 fps, and 640×480 at 90 fps
- Fixed-focus lens



Raspberry Pi Camera Module 2



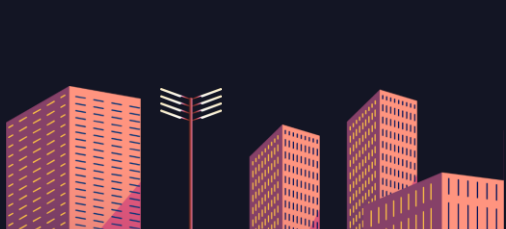
Face Recognition

Histogram of Oriented Gradients (HOG) combined with a Support Vector Machine (SVM), predicts 68 landmarks, including the eyes



Eye tracking

Pupil position is estimated from eye landmarks using contrast-based analysis for real-time tracking



Heart rate sensor

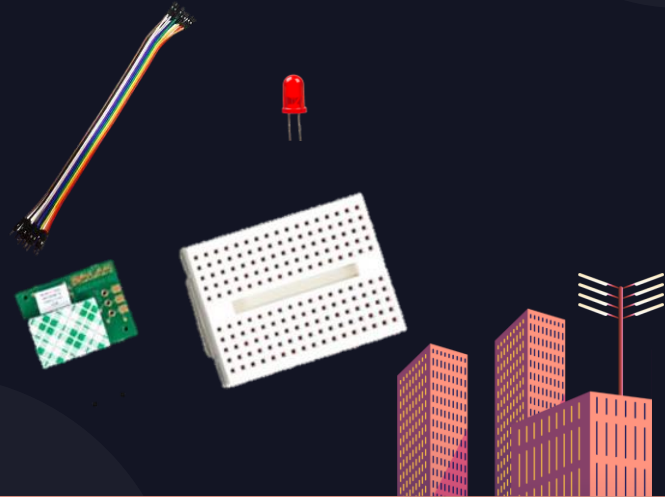


Heart Rate Monitoring

Polar T34 Heart Transmitter

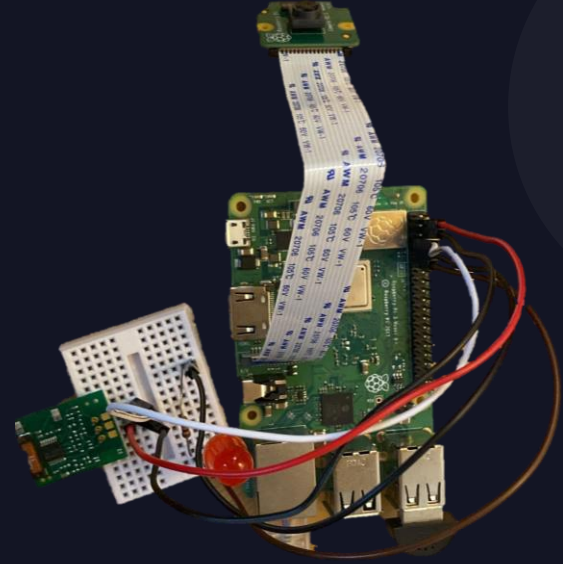
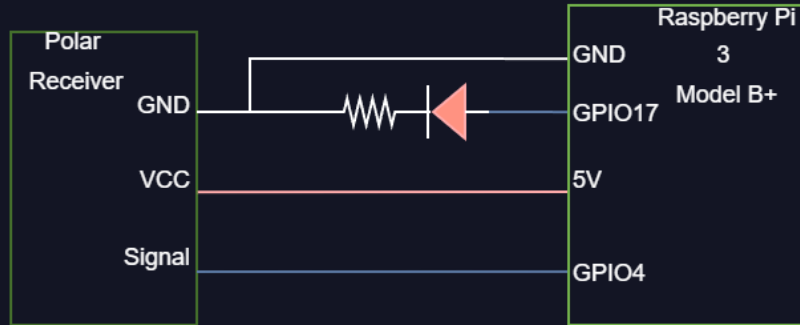


Polar T34 Heart Receiver +
Breadboard + Led + Jumper
wires





Polar T34



HR Software Integration



How to handle GPIO in Python?



pip install RPi.GPIO

This package provides a Python module to control the GPIO on a Raspberry Pi.



Implementation:

```
GPIO.setup( gpio_pin,           // Logical GPIO pin number
             GPIO.IN,           // Input MODE
             GPIO.PUD_DOWN      // Enabling Pull-Down Res
           )
GPIO.add_event_detect( gpio_pin , // Logical GPIO pin number
                      GPIO.RISING, // Detecting Rising Edge
                      interrupt_routine, // Callback Interrupt Routine
                      bouncetime
                    )
```

HR Software Integration



Interrupt-driven mechanism



Why?

Minimizes **CPU usage** and increases **responsiveness**



How it works?

Raspberry Pi is configured to trigger an **interrupt service routine** on each **rising edge** detected on the signal pin



Heart Rate Estimation

The time interval between successive heartbeats is computed using system timers, and the corresponding **BPM value** is derived from this interval



Microphone



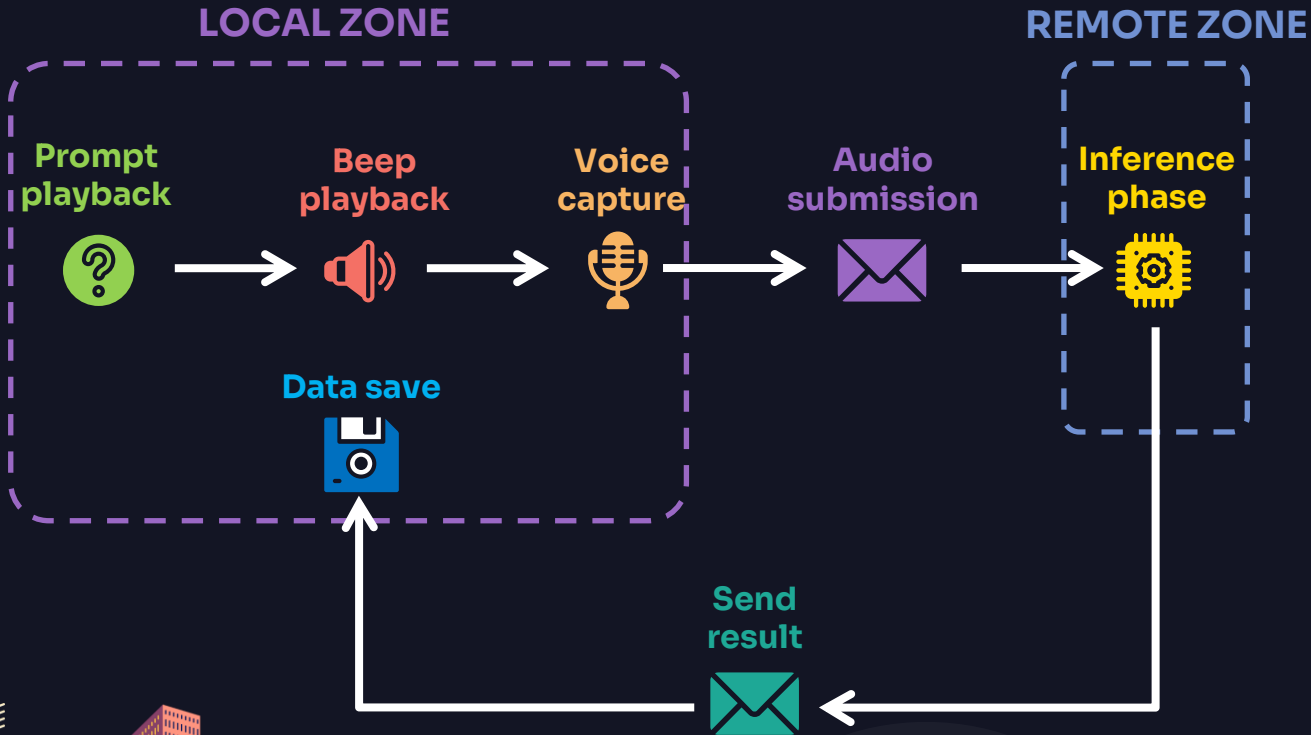
MINI Microphone



Specifications

- Model name MI-305
- USB 2.0 (digital audio)
- Sensitivity -67 dBV/pBar, -47 dBV/Pa \pm 4 dB
- Frequency response 100 Hz – 16 kHz
- Noise Cancellation
- Dimensions 22 mm x 19 mm x 7 mm

Voice Transcription



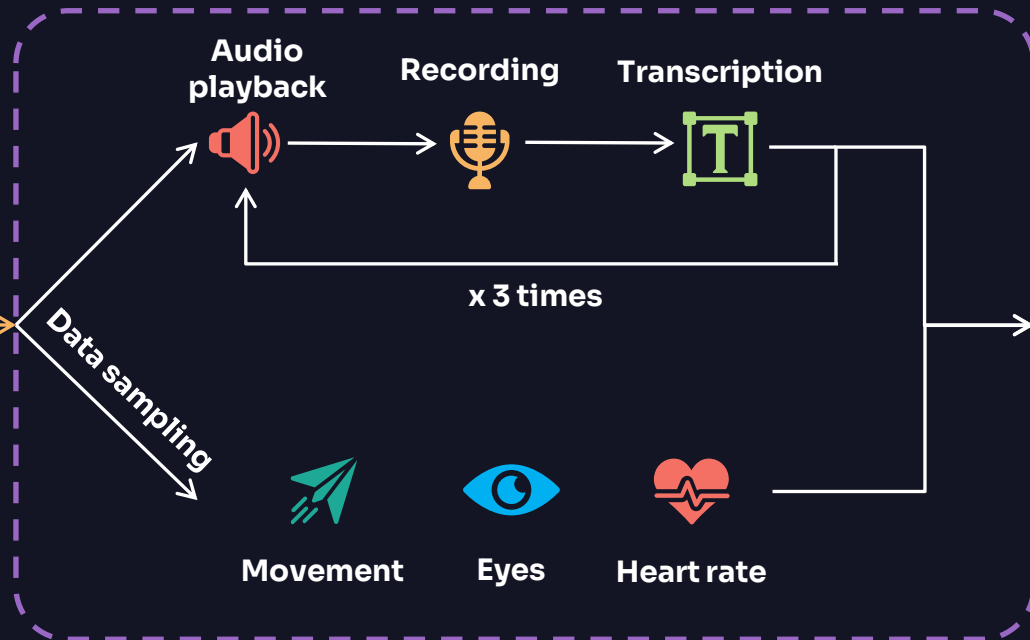
Protocol Description



Car
Crash

2

Protocol
Start



3

GCS
Computation

Estimated protocol duration \approx 20 seconds

GCS computation



Glasgow Coma Scale score is estimated based on:

1. The most frequent **eye state**:
 - **Open**: 5 points
 - **Slightly-Closed**: 3 points
 - **Closed**: 1 point
2. The most frequent **movement state**:
 - **Moving**: 5 points
 - **Stationary**: 2 point
3. The number of **affirmative** answers:
 - **3 affirmatives answers**: 5 points
 - **2 affirmatives answers**: 3 points
 - **1 affirmative answer**: 1 point

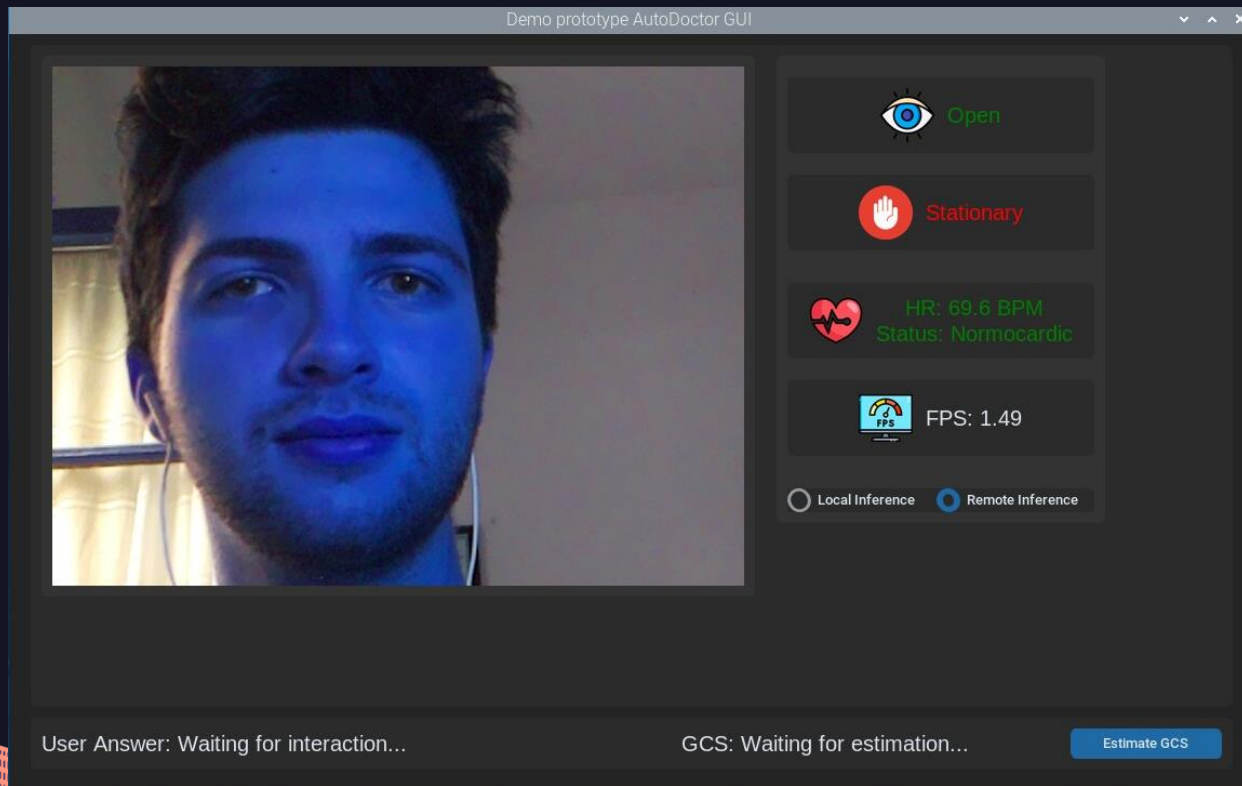


Total Score:
1 + 2 + 3

Maximum score: 15
Minimum score: 3



Prototype GUI



05

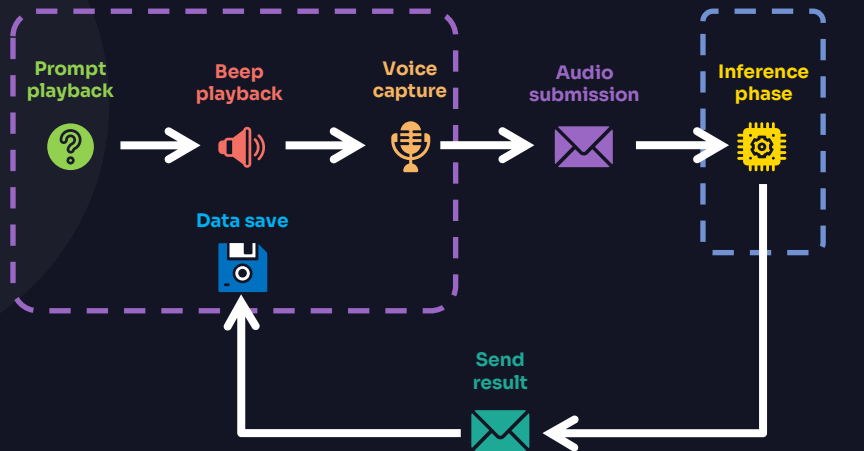
Performance Evaluation



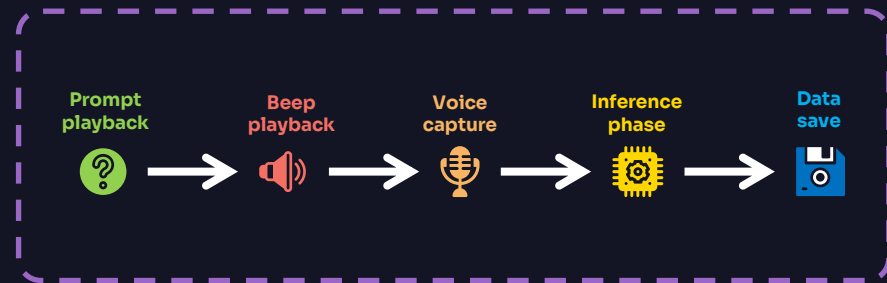
Local or Remote?

LOCAL ZONE

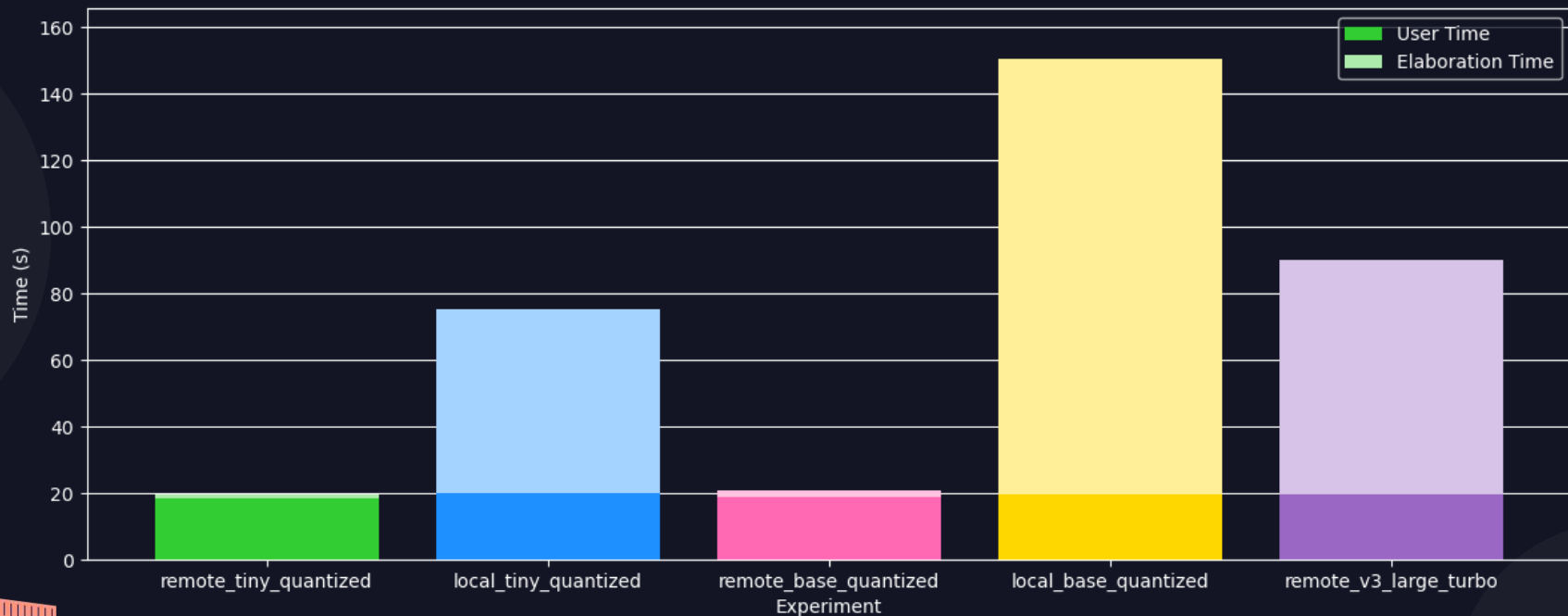
REMOTE ZONE



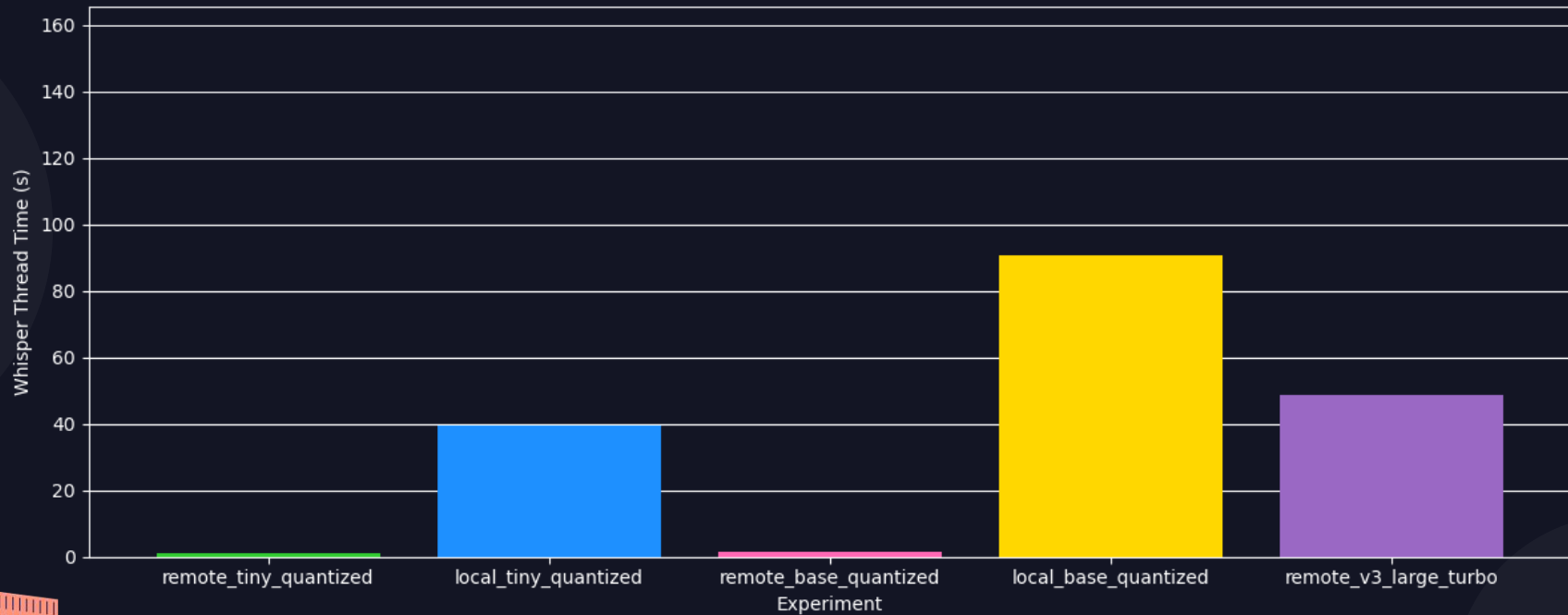
LOCAL ZONE



Voice Protocol Average Time

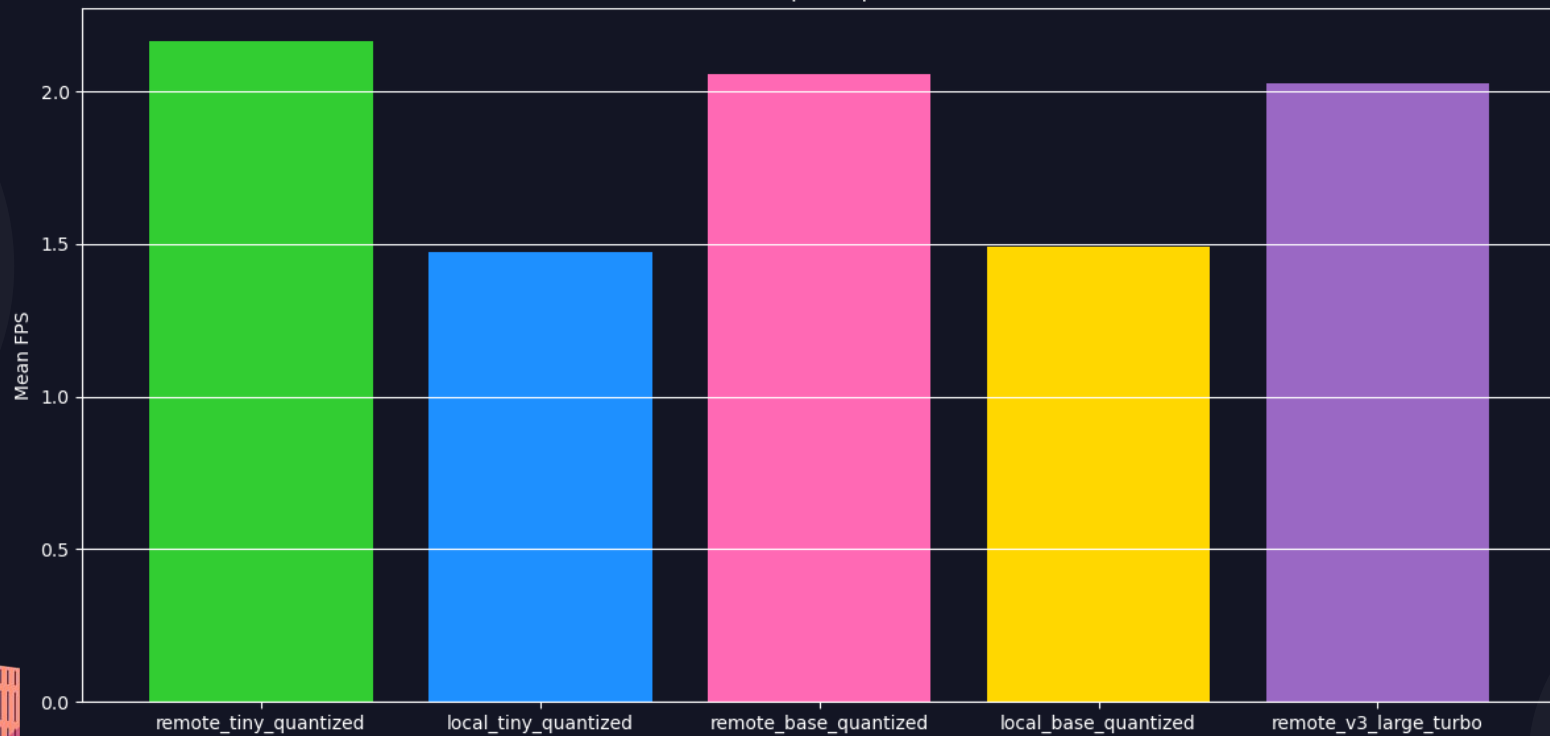


Whisper thread time



Framerate

Mean FPS per Experiment



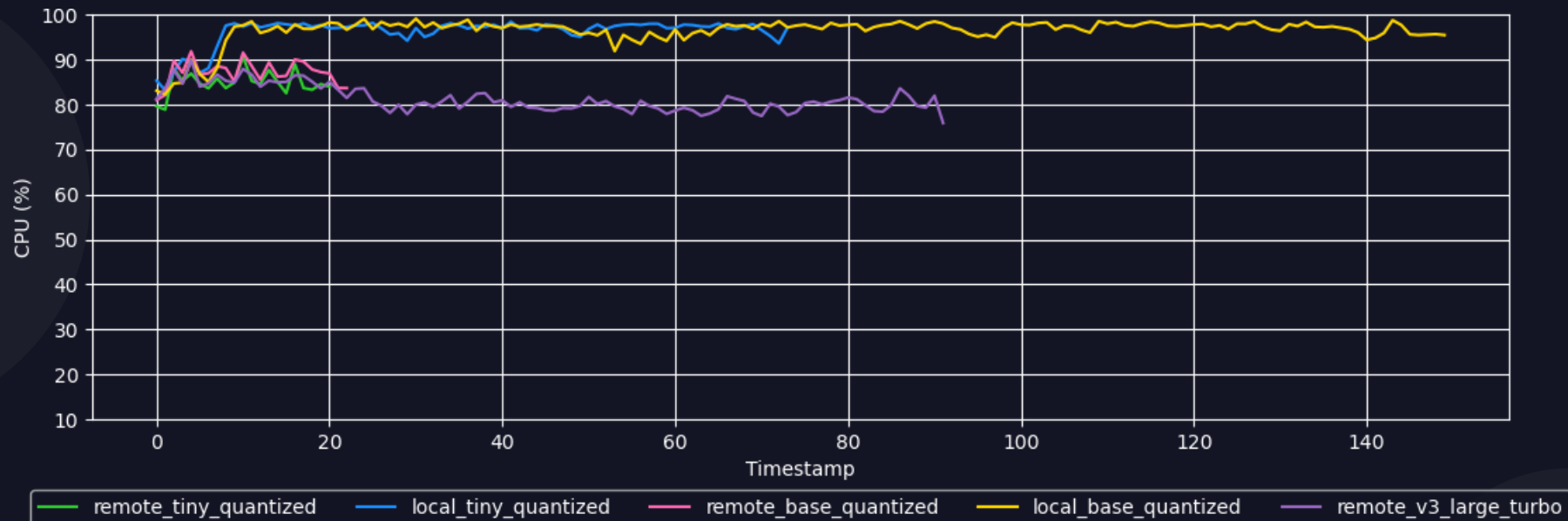
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CPU usage in depth



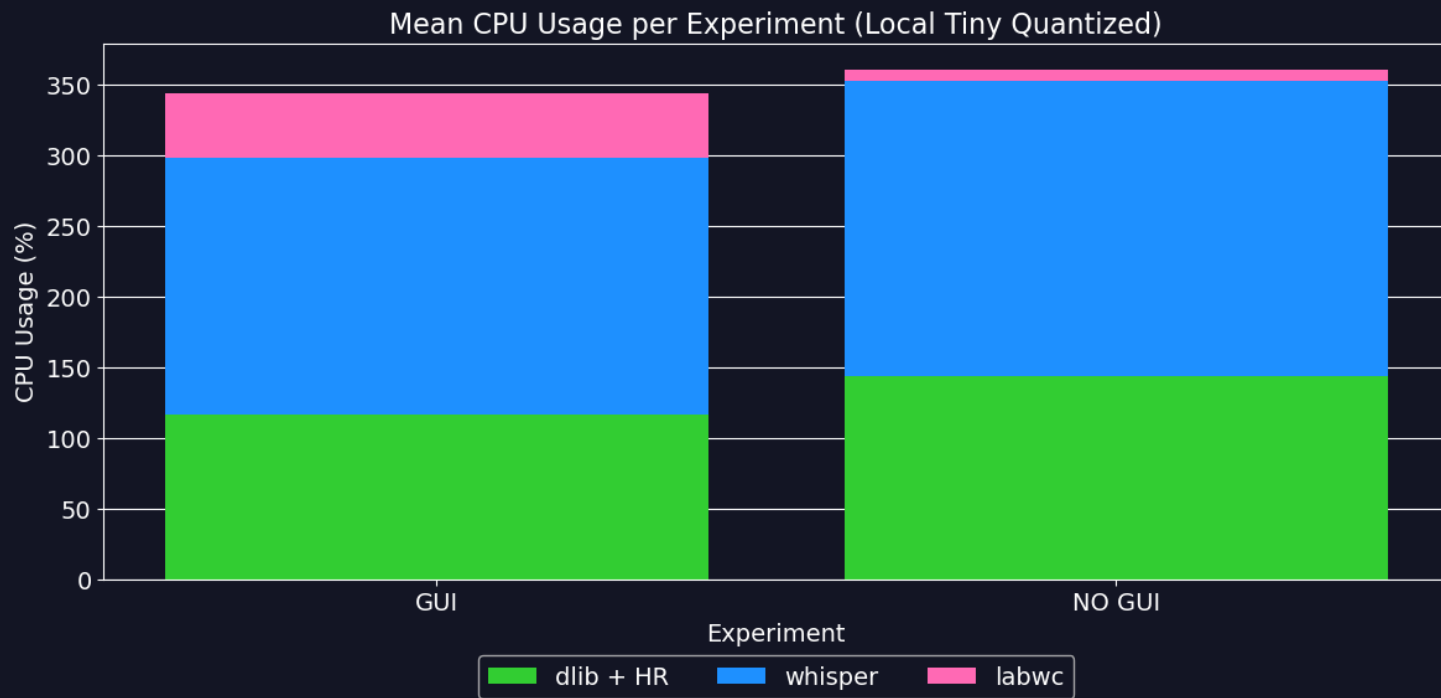


CPU usage



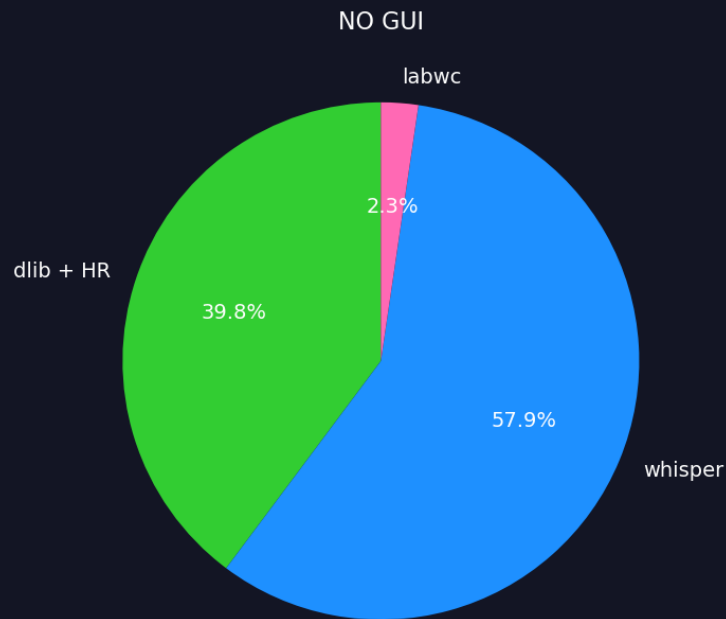
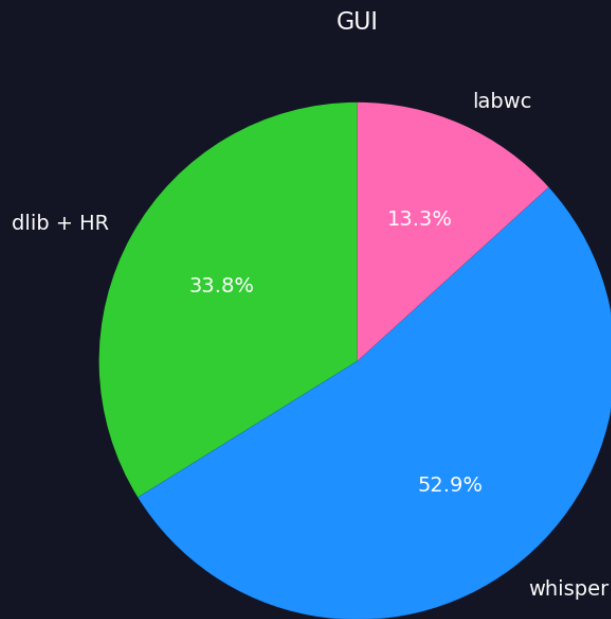


CPU usage





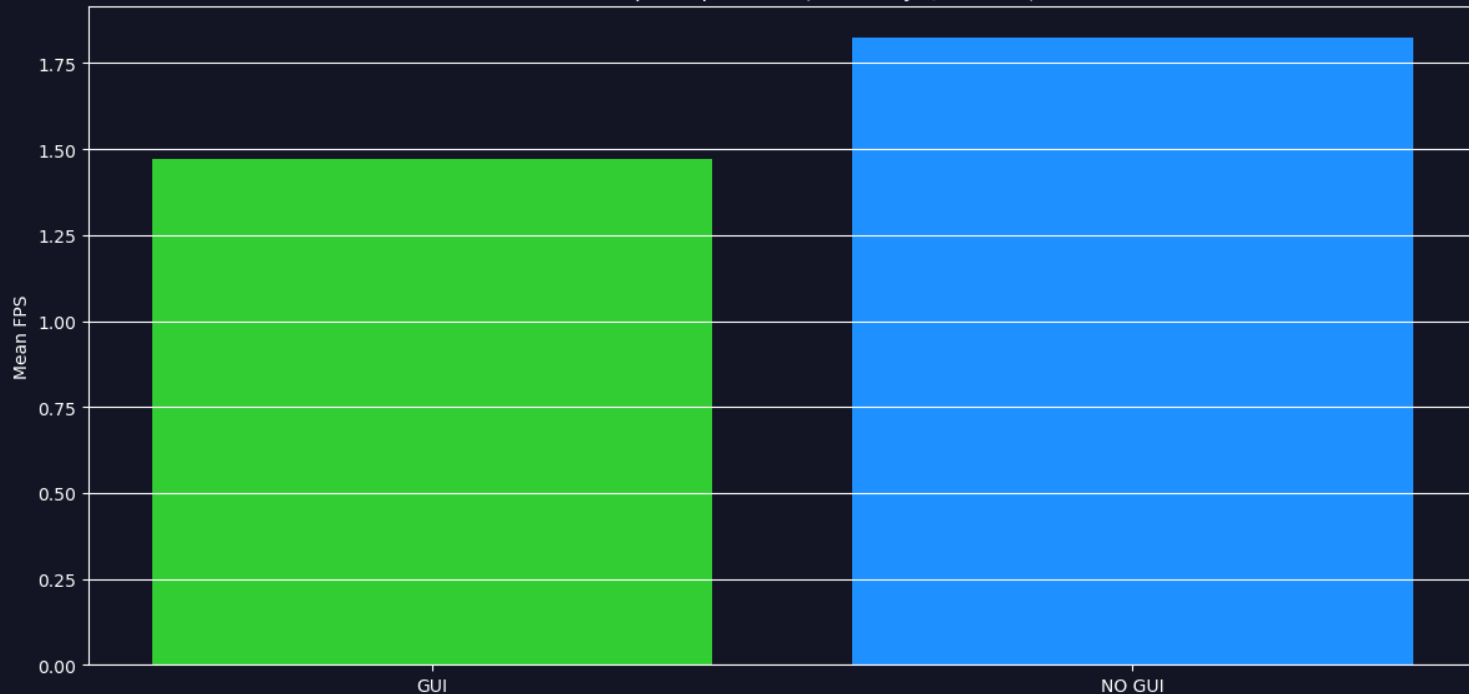
CPU usage



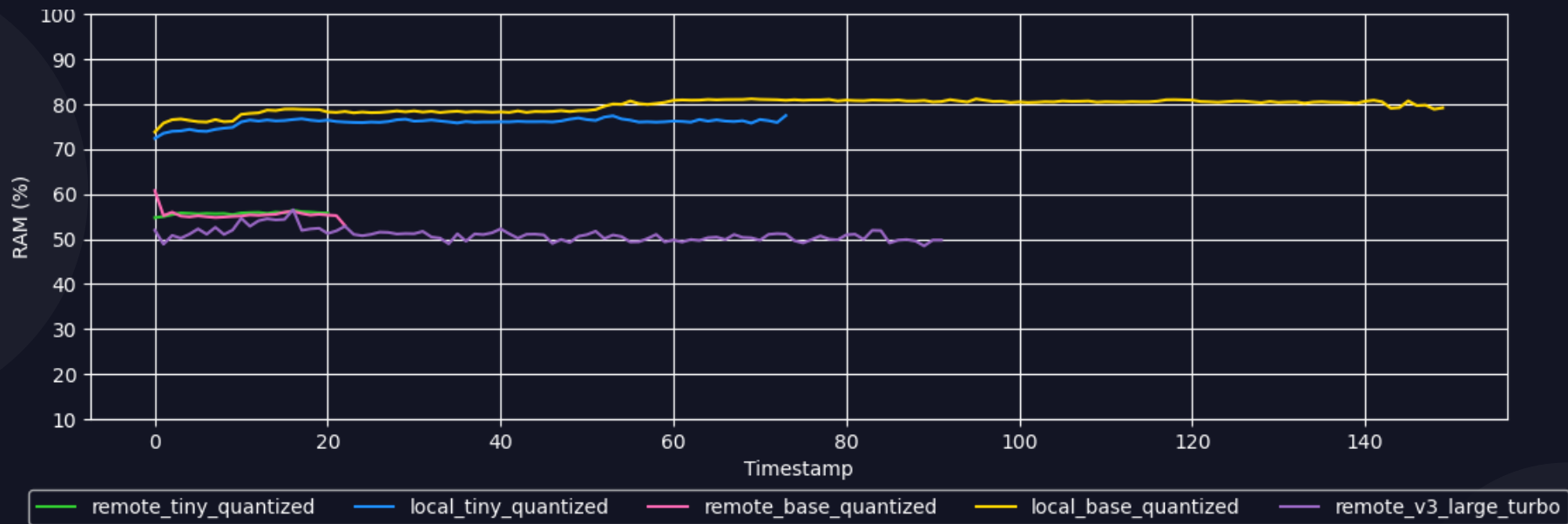


Framerate

Mean FPS per Experiment (Local Tiny Quantized)



RAM usage



Thanks!

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