HealthSonar: A System for Unobtrusive Monitoring of Elders and Patients with Movement Disorders

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The HealthSonar project¹

The HealthSonar project's aim was:

The development of an unobtrusive health monitoring system based on ultra-wideband (UWB) radar technology targeted towards elders and patients with sleep and movement disorders.

The system was designed to be (1) unobtrusive, (2) privacy-preserving and of course (3) accurate.





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The HealthSonar System



The prototype monitoring radar-based device of the HealthSonar system.





The System's Architecture

The HealthSonar system comprises the following three software components.

🖵 The web dashboard



🕫 The radar's web portal

HealthSonar Settings A Home 0 10000 Redar Settings Min X Banan L Schedule Max X Range A 1925 E Recordings Dark dark anoth Recording Bettings O FRE LOADER (m) w Debrador File Settings MD over the



The mobile application





The web dashboard

🖵 The web dashboard



The web dashboard is the main UI of the system used for:

- 1. Manually initiating and terminating recording sessions.
- 2. Manually selecting data for upload to the cloud storage.
- 3. Accessing telemetry data (logs) for connected devices.
- 4. Accessing system information (metadata) about each device.
- 5. Assigning users (e.g., elders, patients) to specific devices.
- 6. Viewing the connection status of each available device.
- 7. Managing the recorded stored data of all connected devices.
- 8. View reports and notifications for the health analytics.





The radar's web portal

🖵 The radar's web portal

HealthSonar		
	Settings	
	Rødar Settings	
L Scheduler	Min X Range	0.1
N 100	Max X Range	7
	FPS	60
erc	PPS	20
	Dorations	20
🗎 Recordings	DecluberLength	90
O File Londer		Recording Settings
	Elaboration	mi v
	Downsampling	1.0
		File Settings
	MB per file	2.4
	File upload	
		Save Settings

The web portal is a configuration and research tool used for:

- 1. Setting up the radar through Wi-Fi.
- 2. Configuring the settings of a device.
- 3. Initiating and terminating a recording.
- 4. Setting up a scheduler for a recording.
- 5. Accessing previously-stored radar data.





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The mobile application

🖵 The mobile application





The mobile application is meant for the end users in order to:

- 1. Facilitates the initial setup of the system.
- 2. Present to the user the generated health metrics.
- 3. Initiate a Timed Up and Go Test for gait evaluation.
- 4. User-friendly, uncluttered, targeted functionality.



The System's Functionality

The HealthSonar system is capable of...

C Nighttime monitoring

- 1. Sleep apnea detection
- 2. Slee staging classification

✤ Fall detection/alerting

- 1. Fall event detection
- 2. Fall event alerting

😵 Vital sign extraction

- 1. Heart rate extraction
- 2. Respiratory rate extraction

★ Mobility evaluation

- 1. iTUG¹ facilitation
- 2. Gait metrics generation

¹ An instrumented Timed Up And Go Test

Ortega-Bastidas, Paulina, et al. "Instrumented Timed Up and Go Test (iTUG)—More Than Assessing Time to Predict Falls: A Systematic Review." Sensors 23.7 (2023): 3426.





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Presence Detection

Most of the HealthSonar's functionality is based on presence detection which is run constantly.

It is a prerequisite for initiating the sleep monitoring or the fall detection pipeline.



A fall testing scenario in a living lab based on presence detection.





Data Storage and Processing

The HealthSonar system stores and processes data both locally and on the cloud based on the application.

🎎 Locally

- 1. Fall detection
- 2. Gait evaluation

🚹 Cloud

- 1. Nighttime monitoring
- 2. Vital sign exctraction





Intended Use Case



Green area: A falling detection scenario. Red area: A sleep monitoring scenario. Blue area: A suggested TUG scenario.





HealthSonar Publications



Kontaxis, S. et al. (2023a).

Contactless vital sign monitoring during sleep using spectral fusion of uwb radar range bins.



Kontaxis, S. et al. (2023b).

On the detection of indoor falls using an ultra-wideband radar.



Ntanis, A. et al. (2022).

Evaluating parameters of the tug test based on data from imu and uwb sensors.



Ntanis, A. et al. (2023).

Healthsonar: A system for unobtrusive monitoring of elders and patients with movement disorders.



Pentari, A. et al. (2023a).

Can the ir-uwb radar sensor substitute the psg-based primary vital signs' measurements?



Pentari, A. et al. (2023b).

Respiration and heartbeat rates estimation using ir-uwb non-contact radar sensor recordings: A pre-clinical study.





Thank you!

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