



2027 Signal Processing Cup

FaceVitals: Contactless, Bias-Robust Estimation of Heart Rate, SpO₂, Blood Pressure, from RGB Facial Videos

(Theme: Equitable, Edge-Deployable Camera-Based Vital Sign Monitoring)

The 2027 Signal Processing Cup is sponsored by:



1. Introduction

This challenge encourages young innovators to develop practical, technology-driven solutions that improve healthcare accessibility. One exciting development in this space is camera-based vital sign monitoring, which allows a smartphone's ordinary front or rear camera to estimate physiological parameters such as heart rate, blood oxygen saturation, blood pressure, simply by observing subtle changes in a person's facial skin over a short video. This capability is especially valuable in settings where clinical infrastructure is limited or unavailable remote villages, ambulances, disaster-response zones, telehealth consultations, and everyday home monitoring for the elderly or chronically ill.

Traditionally, measuring vital signs has required dedicated contact-based hardware: a pulse oximeter clipped to a finger, a cuff wrapped around the arm, a thermometer pressed to the skin. Each device solves one problem in isolation, and each requires the patient to be physically present with the right equipment on hand. But the human face already carries this information. Blood flow driven by each heartbeat produces imperceptible, rhythmic changes in skin color and reflected light; this signal, invisible to the naked eye, can be recovered computationally from ordinary RGB video through the science of remote photoplethysmography (rPPG). In principle, a single smartphone camera pointed at a person's face for under a minute could recover the same vital signs a nurse would otherwise take five separate instruments to collect.

The central challenge is achieving this reliably outside the laboratory. Existing camera-based vital sign systems, including several already available commercially, perform well under favorable conditions: good lighting, high-resolution cameras, a single cooperative subject facing the camera directly. Real-world deployment is far less forgiving. Lighting is often dim or uneven, skin tones and conditions vary enormously across a population, cameras in low-cost or remote-area devices offer limited resolution and unstable bandwidth for streaming, subjects may be elderly with wrinkled or aged skin, may have visible skin conditions such as vitiligo, may be partially masked, or may simply be one face among several in the frame. A system that only works in ideal conditions is of little use to the populations who would benefit from it most.

This problem matters because most current camera-based vital sign solutions either depend on heavy cloud-based computation, are validated only on narrow, curated datasets, or have not been tested for fairness across skin tone, gender, and age. Robust, edge-deployable, clinically validated extraction of vital signs from ordinary RGB video without thermal or contact sensors remains an open and consequential engineering problem, with direct implications for equitable, low-cost, remote healthcare access.

For more clarity: participants are encouraged to watch the following concept and demonstration videos of existing camera-based vital sign monitoring technologies made available for public viewing:

[1]. FaceHeart Vitals™ demonstration — contactless vital sign measurement through a single camera lens: <https://www.youtube.com/watch?v=S2u2fLW2fHI>

[2]. Binah.ai — video-based vital sign monitoring using only a smartphone camera: <https://www.youtube.com/shorts/GqcO0WK-hY8>

[3]. Binah.ai (Bvue) — CES demonstration of camera-based health checks: <https://www.youtube.com/watch?v=qDDGioLrNpU>

2. Competition Details

2.1 Task Description

Continuous physiological monitoring today largely depends on contact-based sensors (pulse oximeters, cuffs, thermometers, ECG leads), which are impractical for remote, continuous, or large-scale screening particularly in low-resource and remote settings where clinical infrastructure and trained personnel are limited.

This challenge asks participants to design a real-time system that extracts **three vital physiological parameters —Heart Rate (HR), Blood Oxygen Saturation (SpO2), Blood Pressure (BP) using only RGB facial video**, with no thermal, NIR, or contact-based sensing of any kind. The extraction must work directly from the subtle color and motion variations captured by a standard RGB camera (remote photoplethysmography, rPPG, and related signal-processing/deep-learning approaches).

The system must support:

- **Both offline (recorded video) and online (live-stream) inference**
- **Low-resolution video input**, reflecting real-world consumer and remote-area cameras
- **Clinical-grade validation**, benchmarked against standard reference datasets and ground-truth clinical devices

The solution must generalize independent of skin tone, gender, and facial orientation, and must remain functional under low-light conditions (illuminance ≤ 50 lux) — conditions under which most existing rPPG methods degrade sharply due to poor signal-to-noise ratio in the color channels.

Solutions may draw on classical signal processing (e.g., chrominance-based rPPG, ICA/PCA-based blind source separation), machine learning, deep learning, or hybrid approaches, and should be designed with eventual edge deployment in mind. To ensure fairness and reproducibility across teams, Raspberry Pi is recommended as an optional common target platform. MathWorks' Raspberry Pi Blockset supports deploying AI models and applications to it, giving all teams a consistent edge-computing environment. The feasibility of this platform will be evaluated further.

2.2. Constraints and Novelty Criteria

Objective: Beyond the core three-parameter extraction task, participants must design their solution to explicitly address **real-world deployment constraints**. Each constraint below is defined with a quantified operating specification, so that compliance can be objectively verified during evaluation rather than assessed qualitatively.

	Constraints
C1	Low-light operation: performance reported at illuminance ≤ 50 lux, well below typical indoor lighting.
C2	Diverse skin tones and dermatological conditions: robustness across the Fitzpatrick/Von Luschan skin-tone range, and explicit handling of conditions such as vitiligo that alter skin reflectance.
C3	Develop a multi-face tracking system that continuously isolates and monitors a designated target subject while rejecting signals from bystanders in multi-person scenarios.

C4	Low camera resolution: systems must degrade gracefully, not fail outright, on sub-HD, compressed, or low-frame-rate video typical of budget devices.
C5	Remote-area bandwidth and connectivity constraints: the pipeline must support an on-device or low-bandwidth offline mode, not assume continuous cloud connectivity.
C6	Aging skin (ages 60–70+): wrinkles and reduced skin elasticity change light scattering and must not degrade signal extraction disproportionately for older subjects.
C7	Partial occlusion / masked conditions: the system should identify and, where feasible, compensate for partial facial coverage (e.g., surgical masks) rather than failing silently.

Constraint specifications:

1. Room Setup

- Type: Low-illuminance facial capture (degraded SNR condition)
- Illuminance: ≤ 50 lux, measured at the subject's face using a calibrated lux meter
- Absorption/Reflectance: Standard indoor skin reflectance (no special surface treatment)
- Purpose: Baseline stress-test of rPPG signal extraction under poor lighting
- Camera setting: Fixed or auto-exposure, ISO capped at typical smartphone sensor limits
- Simulation in MATLAB (any one of the following):
 - Brightness attenuation: Scale pixel intensities of a well-lit baseline video using `im2double` followed by a multiplicative gain factor to emulate the target lux level.
 - Sensor noise injection: Use `imnoise(I,'poisson')` to emulate photon shot noise dominant at low illuminance, or
 - Combined degradation: Apply brightness attenuation followed by `imnoise(I,'gaussian',0,var)` to emulate combined shot and read noise at low light.
- Brightness attenuation: Scale pixel intensities of a well-lit baseline video using `im2double` followed by a multiplicative gain factor to emulate the target lux level.
- Sensor noise injection: Use `imnoise(I,'poisson')` to emulate photon shot noise dominant at low illuminance, or
- Combined degradation: Apply brightness attenuation followed by `imnoise(I,'gaussian',0,var)` to emulate combined shot and read noise at low light.

Resources:

- MATLAB Image Processing Toolbox – `imnoise` (Function): Add noise to image
<https://www.mathworks.com/help/images/ref/imnoise.html>
- MATLAB Image Processing Toolbox – `im2double` (Function): Convert image to double precision
<https://www.mathworks.com/help/images/ref/im2double.html>
- MATLAB Image Processing Toolbox – `imadjust` (Function): Adjust image intensity values
<https://www.mathworks.com/help/images/ref/imadjust.html>

2. Skin Tone Generalization

- Type: Multi-skin-tone evaluation set
- Classification standard: Fitzpatrick Skin Type I–VI
- Purpose: Ensure extraction accuracy does not systematically degrade for darker skin tones
- Acceptance criterion: Per-type error must not deviate beyond a pre-specified tolerance from the population mean across all six types
- Simulation/Quantification in MATLAB:

- Convert facial ROI pixels from RGB to L*a*b* color space and compute the Individual Typology Angle (ITA) to objectively classify/verify skin tone category, using rgb2lab
- Use ITA-based stratification to report per-stratum accuracy rather than a single pooled metric

Resources:

- MATLAB Image Processing Toolbox – rgb2lab (Function): Convert RGB to CIE 1976 L*a*b*
<https://www.mathworks.com/help/images/ref/rgb2lab.html>

3. Multi-Person Frame Isolation

- Type: Multi-subject frame condition
- Requirement: When more than one face is present, the system must automatically identify and continuously track one designated target subject, rejecting signal contributions from bystanders.
- Purpose: Reflect realistic deployment scenarios (e.g., family telehealth calls, group screening).
- **Simulation in MATLAB:**
 - Detect all faces per frame using faceDetector (the newer face detection functionality in Computer Vision Toolbox, in place of the legacy vision.CascadeObjectDetector).
 - Assign a persistent identity to the designated target across frames using Kalman filter-based tracking (vision.KalmanFilter) combined with assignDetectionsToTracks for multi-face association.
 - Track facial key points over time using vision.PointTracker.
 - Optionally capture subtle pixel-level motion across video frames using RAFT optical flow (opticalFlowRAFT).
 - Alternatively, use the newer tracking workflows in Computer Vision Toolbox, such as videoTracker and other feature-tracking objects.

Resources:

- MATLAB Computer Vision Toolbox – faceDetector: Detect faces in images and video:
<https://www.mathworks.com/help/vision/ref/facedetector.html>
- MATLAB Computer Vision Toolbox – assignDetectionsToTracks (Function): Assign detections to tracks for multi-object tracking: <https://www.mathworks.com/help/vision/ref/assigndetectionstotacks.html>
- MATLAB Computer Vision Toolbox – vision.PointTracker (System Object): Track points in video using the Kanade-Lucas-Tomasi (KLT) algorithm: <https://www.mathworks.com/help/vision/ref/vision.pointtracker-system-object.html>
- MATLAB Computer Vision Toolbox – opticalFlowRAFT: Estimate optical flow using the RAFT deep learning algorithm: <https://www.mathworks.com/help/vision/ref/opticalflowraft.html>
- MATLAB Sensor Fusion and Tracking Toolbox – videoTracker: Video-based object tracking workflow: <https://www.mathworks.com/help/fusion/ref/videotracker.html>

4. Low Camera Resolution

- Type: Reduced spatial-resolution capture condition
- Resolution: $\leq 640 \times 480$ (VGA), with a stress case at $\leq 320 \times 240$ (QVGA)
- Purpose: Reflect real-world consumer/remote-area camera hardware limits
- Baseline for comparison: 1280×720 (HD), as specified in Task 1
- Simulation in MATLAB:
 - Downsample baseline HD video frame-by-frame to VGA/QVGA using imresize with bicubic interpolation, then re-run the extraction pipeline on the downsampled stream

Resources:

- MATLAB Image Processing Toolbox – `imresize` (Function): Resize image
<https://www.mathworks.com/help/images/ref/imresize.html>

5. Low-Bandwidth / Remote-Area Operation

- Type: Bandwidth- and frame-rate-constrained transmission condition
- Bitrate: ≤ 500 kbps
- Frame rate: ≤ 10 fps (reduced from the ≥ 30 fps baseline specified in Task 1)
- Purpose: Emulate streaming/inference conditions in low-connectivity remote areas
- Note: This relates to the Nyquist criterion for physiological signal sampling — the HR frequency band ($\approx 0.7\text{--}3$ Hz, covering 42–180 bpm) requires a sampling (frame) rate $\geq 2 \times F_{\text{max}} \approx 6$ fps as an absolute floor. The 10 fps constraint stress-tests performance close to this theoretical limit.
- Simulation in MATLAB:
 - Frame-rate decimation: Sub-sample the baseline video's frame sequence to the target fps using `VideoReader/VideoWriter` with a specified frame-skip interval
 - Bitrate-limited compression: Re-encode the video using `VideoWriter` with the 'MPEG-4' profile and a constrained `VideoCompressionQuality`/target bitrate to emulate compression artifacts

Resources:

- MATLAB – `VideoWriter` (Function): Write video frames to file
<https://www.mathworks.com/help/matlab/ref/videowriter.html>
- MATLAB – `VideoReader` (Function): Read video file
<https://www.mathworks.com/help/matlab/ref/videreader.html>

6. Aging-Skin Robustness (60–70+ years)

- Type: Elderly-subject evaluation condition
- Age range: 60–70+ years
- Purpose: Ensure robustness to wrinkle-induced micro-shadowing and reduced skin elasticity, which alter reflectance independent of blood perfusion
- Requirement: Evaluation set must include subjects in this age bracket; accuracy must be reported separately for this subgroup
- Simulation in MATLAB (for supplementary synthetic stress-testing only; real subject data from the provided dataset, Section 4, remains the primary evaluation source):
 - Apply localized micro-texture/shadow perturbation via `imfilter` with edge-emphasizing kernels to approximate wrinkle-induced reflectance variation on a baseline face video

Resources:

- MATLAB Image Processing Toolbox – `imfilter` (Function): Filter 2-D/3-D image
<https://www.mathworks.com/help/images/ref/imfilter.html>

7. Masked-Face Operation

- Type: Partial facial occlusion condition
- Occlusion extent: $\geq 40\%$ of the lower face occluded (e.g., surgical/cloth mask)
- Purpose: Reflect post-pandemic and clinical settings where subjects are frequently masked; system must degrade gracefully by relying on exposed regions (periocular, forehead)
- Simulation in MATLAB:

- o Overlay a synthetic occlusion patch on the lower face region of a baseline video using insertShape with a filled rectangle/polygon aligned to facial landmarks, then verify that the extraction pipeline correctly re-weights toward the forehead/periorcular ROI

Resources:

- MATLAB Computer Vision Toolbox – insertShape (Function): Insert shapes into image or video
<https://www.mathworks.com/help/vision/ref/insertshape.html>

2.3. Challenge phases:

(Structured across three rounds, progressively increasing in scope — from single-parameter proof of concept to full three-parameter, clinically validated, real-time deployment.)

Task 1: Controlled-Environment Heart Rate Extraction (Ideal Baseline Case)

Objective: Establish baseline feasibility of extracting Heart Rate (HR) from RGB facial video under controlled, near-ideal conditions, using MATLAB- or Python-based rPPG pipelines, before constraint-driven degradation is introduced in later tasks.

Specifications:

1. Recording Environment

- Type: Indoor, controlled lighting (unconstrained baseline case)
- Illuminance: ≥ 300 lux (standard indoor ambient lighting)
- Background: Static, non-reflective, minimal subject motion
- Purpose: Baseline signal-quality reference against which all constrained rounds (Section 2, C1–C7) are compared

2. Camera / Recording Setup

- Device: Smartphone-grade RGB camera or equivalent USB webcam
- Resolution: 1280×720 (HD) minimum for this baseline task
- Frame Rate: ≥ 30 fps
- o *Note:* This follows the Nyquist sampling criterion applied to physiological signals: required frame rate $\geq 2 \times F_{\text{max}}$, where F_{max} is the upper bound of the HR frequency band (≈ 3 Hz, corresponding to 180 bpm). A rate of 6 fps satisfies the theoretical minimum; ≥ 30 fps is specified here to ensure adequate SNR margin at baseline.
- Subject-to-camera distance: 40–60 cm
- Subject pose: Frontal face, within $\pm 10^\circ$ yaw/pitch/roll
- Video encoding: Uncompressed or high-bitrate H.264 (≥ 5 Mbps) to avoid compression artifacts at baseline

3. Subject and Facial Region of Interest (ROI)

- Subject count: 1 (single-subject baseline; multi-person handling is deferred to the constrained rounds, C3)
- ROI selection: Facial landmark-based (e.g., 68-point or 468-point dense facial mesh), targeting forehead and bilateral cheek regions
- Skin exposure: Unobstructed — no mask, minimal glare/reflection, no facial hair covering ROI

4. Ground-Truth Reference

- Reference device: Clinical-grade pulse oximeter or ECG, time-synchronized with video capture
- Reference sampling rate: ≥ 100 Hz (ECG) or per manufacturer specification (pulse oximeter)
- Synchronization: Timestamp-aligned recording between video and reference device.

5. Dataset

- Dataset Requirement: Participants can follow any one of the dataset procedures as mentioned in section 4.

FAQ:

1) Does the organizer have any datasets?

Yes. Ethical clearance for the data has been obtained from Sri Ramachandra Hospital, Tamil Nadu, India, and the associated dataset is available for use by participants in this challenge. Participants who wish to use this dataset must execute a copyright and legal agreement with the organizers before the dataset is shared. To avail the dataset, approach the primary organizer.

2) Should participants consider all the constraints as listed under section 2.2?

Participants may consider any of the listed constraints. If they incorporate and successfully address additional constraints from the list, the total number of constraints considered will be taken into account during the assessment and grading. Participants are also encouraged to create their own supplementary dataset that incorporates the listed constraint conditions.

3) Can Students use any other relevant publicly available dataset?

Yes, students may use any similar publicly available dataset. Some example datasets are listed in Annexure - 1.

4) Can students generate their own datasets for this challenge?

Yes, participants may work on their own dataset. However, the dataset must be generated with appropriate Institutional Review Board (IRB) ethical clearance. All datasets used whether a provided clinical dataset or participant collected data must be clearly documented. In addition, any participant-collected data must be supported by appropriate informed consent and ethical approval. These ethical documents will be verified during the evaluation process.

6. Evaluation Metrics

- Mean Absolute Error (MAE), in BPM
- Root Mean Square Error (RMSE), in BPM
- Pearson correlation coefficient (r) between estimated and reference HR
- Bland–Altman limits of agreement

Resources:

- MATLAB Computer Vision Toolbox — Face Detection (vision.CascadeObjectDetector): <https://www.mathworks.com/help/vision/ref/vision.cascadeobjectdetector-system-object.html>
- MATLAB — Face Detection and Tracking example: <https://www.mathworks.com/help/vision/ug/face-detection-and-tracking-using-camshift.html>
- MATLAB Signal Processing Toolbox — designfilt for bandpass filtering of the rPPG signal to the HR band: <https://www.mathworks.com/help/signal/ref/designfilt.html>

7. Submission requirement:

A technical report describing the proposed pipeline (face detection/ROI selection, signal extraction, filtering, HR estimation), evaluated against the metrics, at least two constraints (C1–C7) must additionally be addressed and justified, even at this baseline stage, as a demonstration of the team's intended robustness

strategy for later rounds.

Evaluated on: innovation, technical feasibility, clarity of documentation.

Round 1: One Parameter Extraction (HR)

Objective: Extraction of Heart Rate (HR) from the Participants video images with various constraints. Must demonstrate heart rate (HR) extraction from RGB videos acquired under both controlled and uncontrolled environmental conditions.

Solutions demonstrating the least deviation from standard medical equipment measurements will be given higher consideration during the selection process.

Round 2: Two-Parameter Extraction (HR + SpO2)

Objective: Extend the pipeline to jointly estimate Heart Rate and SpO2 from RGB video, without thermal or contact sensors. Quantitative comparison against ground-truth pulse oximeter readings required.

Round 3: Full three-Parameter System with Clinical Validation

Objective: Final, integrated system estimating all three parameters HR, SpO2, Blood Pressure simultaneously from RGB facial video.

- Clinical validation is mandatory: results must be benchmarked against a recognized standard dataset (e.g., established rPPG/vitals benchmark datasets) and/or clinical-grade reference device measurements.
- Live/real-time demonstration required, under at least two or more constraints from Section 2.
- Judged on accuracy (per-parameter error against ground truth), robustness across constraint conditions, and real-time performance where a Raspberry Pi is used.

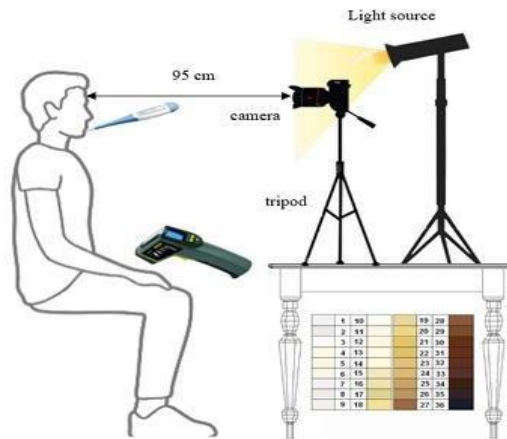


Figure 1. Experimental Setup overview for the challenge

2.4. Reference Instruments and Ground Truth

Parameters	Reference / Ground-Truth Instrument
Heart rate	Pulse oximeter or ECG-derived HR

SpO ₂	Clinical pulse oximeter
Blood pressure (systolic/diastolic)	Calibrated oscillometric or auscultatory sphygmomanometer

Useful References

- Jeyakumar, V., Nirmala, K. & Sarate, S. Chapter 5- Non-contact measurement system for COVID-19 vital signs to aid mass screening—An alternate approach. Cyber-Physical Systems. pp. 75-92 (2022)
- M, R., Jeyakumar, V., K, G., V, K. & S, V. Non-Contact Pulse Rate Measurement Using Facial Videos. 2020 IEEE International Conference On Advances And Developments In Electrical And Electronics Engineering (ICADEE). pp. 1-6 (2020)
- Arulselvi, R., Jeyakumar, V., Vidya, N. & Yuvaraj, V. A Study on Impacts of Ambient Lights and Skin Tone for Contactless Blood Oxygen Measurement using Visible Spectrum Facial Videosaper. 2023 2nd Edition Of IEEE Delhi Section Flagship Conference.pp. 1-7(2023)
- F. Von Luschan, Voelker, Rassen, Sprachen, Walter de Gruyter & Co, Berlin, (1927). [12] Altman, D. & Bland, J. Measurement in Medicine: The Analysis of Method Comparison Studies. Journal Of The Royal Statistical Society. Series D (The Statistician). 32, 307-317 (1983)

1.1 Evaluation Protocols

The evaluation of the competition will be conducted across three rounds by a jury panel comprising: Members & Professionals holding a **PhD/Doctorate** with demonstrated research expertise in physiological signal processing, biomedical imaging, or related fields & Representatives from the **IEEE Technical Committee**.

1.2 Data organization

All data used in this competition follow a structured organization to ensure consistency, reproducibility, and clarity across all rounds.

File Naming Convention: RoundX_Condition_Constraint.mat RoundX: Indicates the round number

Round 1 – Controlled/Uncontrolled-Environment Heart Rate Extraction (HR)

Round 2 – Two-Parameter Extraction (HR + SpO₂)

Round 3 – Full three-Parameter System with Clinical Validation (HR + SpO₂+ Blood Pressure)

Condition: Recording condition (e.g., Baseline, LowLight, LowResolution, LowBandwidth)

Constraint: Applicable constraint tag from Section 2 (e.g., C1, C4, C7), or "None" for the unconstrained baseline.

Files to be Submitted:

Round 1 – Baseline Heart Rate

- Round1_Baseline_None.mat – Facial video and reference HR at baseline conditions
- process_round1.m – MATLAB/Python script implementing the processing pipeline
- Corresponding files: target_video.mp4 – Raw facial video; reference_signal.csv – Synchronized ground-truth HR (pulse oximeter/ECG); processed_output.csv – Estimated HR output from the implemented algorithm

Round 2 – HR + SpO₂

- Round2_[Condition]_[Constraint].mat – Facial video and reference HR/SpO2 under the tested condition
- process_round2.m – Processing script
- Corresponding files as above, extended with SpO2 reference and output channels

Round 3 – Full three-Parameter System

- Real-time processing code (deployable pipeline)
- Corresponding files: target_video.mp4 (or live stream log); reference_signal.csv – HR, SpO2, BP, ground truth; processed_output.csv – Real-time estimated output for all three parameters; benchmark_comparison.csv – Comparison against the standard dataset/clinical reference device

Folder Contents (for Tasks 1 and 2):

Each .mat file must contain the following variables:

- facial_video -Raw RGB video frames of the subject;
- roi_data – Extracted facial ROI coordinates/masks (forehead, cheeks);
- reference_signal – Ground-truth physiological signal(s) for the round;
- processed_signal – Output of the participant's extraction algorithm;
- metrics – Evaluation results (MAE, RMSE, Pearson r, Bland–Altman limits);
- params – Metadata including camera resolution, frame rate, illuminance (lux), camera-to-subject distance, subject Fitzpatrick skin type, subject age, and which constraint(s) from Section 2 were applied

Directory Structure

```
/Round1_Baseline/
/Round2_HR_SpO2/
/Round3_Constrained/
/Round4_FullSystem_Clinical/
```

Notes:

- Video files must exactly match the signals/subject IDs stored in the corresponding .mat files.
- Strict adherence to the naming and folder structure is required for automated and subjective evaluation.
- All submitted data must comply with the ethical clearance conditions for participant-collected / own data, including documented consent and institutional ethical approval.
- This organization ensures reproducibility and facilitates both quantitative and qualitative assessment by the judges.

3. Dataset Strategy and Data Organization

Consistent with the 2027 Call for Proposals, the team can proceed the challenge for the chosen constraints by effectively utilizing any one of the following dataset procedures:

1. The team may prepare their own dataset for their constraints by strictly adopting Institutional review board (IRB) procedures / any medical legal procedures of their own country. The IRB ethical clearance is mandatory if any human participation is involved. IRB ethical clearance documents must be submitted in the initial round of judging.
2. Certain publicly available datasets are available without any restrictions. The team may approach them. The

database lists are available in Annexure – I.

3. The team can obtain the reference dataset from the organizers. Our pilot study's ethical clearance (Sri Ramachandra IEC/23/FEB/177/08) and data-collection protocol will be published as a reference protocol that participating teams may adapt, including the recording setup, participant preparation steps (avoiding anti-pyretic medication, intense activity, or eating/drinking before capture), and skin-tone classification procedure.

Recommended File Naming and Folder Structure

Convention: Subject{ID}_{SkinTone}_{Condition}_{Parameter}.ext — e.g., Subject014_TypeV_LowLight_HR.csv

Condition tags: Controlled, Hospital, LowLight, LowRes, as applicable to the constraints addressed.

Suggested top-level folders: /Dataset/Controlled/, /Dataset/Hospital/, /Dataset/LowLight/, mirroring the controlled-vs-hospital split used in our pilot study.

Each subject record should log: raw video, extracted ROI frames, reference-instrument readings for all three parameters, ambient illuminance (lux), Von Luschan/Fitzpatrick skin-tone classification, and self-reported age band.

4. Participant Submissions

All work submitted for evaluation must go through the official SPS team registration and submission platform. Each submission must include a technical report in IEEE conference paper format, covering methodology and results, together with the programs/code developed. Team scores and rankings for each round will not be shared publicly; only the final ranking is released after the competition concludes.

5. SPS Competition Details

5.1 Team Eligibility and Composition

5.1.a. Team Composition

- Each team MUST be composed of: (i) One faculty member (the Supervisor) and (ii) At least 3 but no more than 10 undergraduates; *Optionally* (iii) At most one graduate student (the Tutor).
 - At least three of the undergraduate team members must be SPS student members at time of team registration, and maintain this status until the end of the competition
- Further definitions of each team position are as follows:
 - Faculty (Supervisor): A faculty member or someone with a PhD degree employed by the university. Postdocs and research associates are not considered as faculty members.
 - Graduate Student (Tutor): A graduate student is a student having earned at least a 4-year University degree at the time of submission. *Please note: Tutors are not eligible to receive travel grants or prize money.*
 - Undergraduate: An undergraduate student is a student without a 4-year degree.
- Team members cannot be changed after the team registration deadline.

- At least one undergraduate team member must be in attendance (in-person) of the final round of the competition held at the respective conference (ICASSP or ICIP) to present the team's work.*

***Important notice:** Upon registering a team for the competition, the team must commit to at least one undergraduate team member representing the team by attending the physical competition and participating in the final round of the competition at the physical conference. Should a team not be able to participate physically (in-person) in the final round of the competition held at the respective conference (ICASSP or ICIP) for any reason, at any point in the competition, then the team must notify SPS Staff and organizers immediately. This will likely result in the team being ineligible to continue in the competition, therefore forfeiting their position in the competition. Teams must make every effort to attend the final round at the conference; visa issues *may* be an exception. *If all team members are unable to obtain visas, please be prepared to present proof of visa process, communication to obtain visa, as well as a visa denial. All eligibility decisions are at the discretion of the SPS Student Services Committee and competition organizers.*

Should a team be disqualified or forfeit their finalist position for any reason, the next team selected by the organizers may be contacted to compete in the final round, following the same guidelines as above.

Only one team from a given institution may place as a finalist in the competition. If more than one team from the same institution placed in the top three ranking teams based on the phase one evaluation results, then only the team with the highest ranking will be considered as a finalist team. All other teams from the same institution will be considered ineligible to compete as a finalist team. *Please note, there is no limit for how many teams from the same institution can register for the competition and compete in the first phase of the competition.*

5.1.b Team ineligibility (Further clarification)

Specific team **ineligibility** in addition to the above. *Any of these criteria will result in the team being disqualified/ineligible to continue in the competition:*

- Teams that are composed with 50% or more of its undergraduate members being students who have previously participated on a finalist team within the last year are not eligible. *For example, if two of four undergraduate team members participated as a member of a finalist team during the 2023 SP Cup will not be eligible to participate on a team for the 2023 VIP Cup.*
- Any team members who have placed in the top three teams of any SPS competition held during the previous conference, i.e. a member from one of the 3 finalist teams of the 2023 SP Cup (at ICASSP) will not be eligible to participate in the 2023 VIP Cup (at ICIP). any team member that has previously received travel support would not be eligible to receive travel support again (calendar year)
- Team members cannot simultaneously participate in more than one competition at the same time. Team members cannot participate on more than one team at the same time.

5.2 Final Round Judging Criteria

The final round held live at the conference is judged on six equally weighted criteria. Each of the three finalist teams will be scored on the five criteria and the team with the highest score will place 1st, the team with the second highest score will place 2nd, and the team with the third highest score will place 3rd in the competition. The six equally weighted criteria are:

No.	Criterion
1	Innovation of the proposed approach and thoroughness of experiments
2	Performance on the validation set
3	Performance on the test set
4	Model and time complexity
5	Quality and clarity of the final report
6	Quality and clarity of the presentation

The final winning rankings will be based on the highest points awarded from the six criteria during judge deliberations at the end of the competition. Final rankings are ultimately decided by the Society, at their discretion. All ranking decisions are final.

5.3 Judge Participation and Conflict of Interest

All judges and team supervisors must complete the IEEE Conflict-of-Interest form before participating in evaluation, in accordance with IEEE Policies 9.9(A–C) and 4.4.H. Any judge with a disclosed or perceived conflict including current or recent (within five years) supervisory, employment, collaboration, or shared-institution relationships with a team must recuse themselves from discussion and voting on that team's ranking.

5.4 Prizes for Finalists

The [eligible] three teams with the highest performance in the open competition based on the judging criteria will be selected as finalists and invited to participate in the final competition at ICASSP or ICIP. The champion team will receive a Grand Prize of \$5,000. The first and the second runner-up teams will receive a prize of \$2,500 and \$1,500, respectively, in addition to travel grants and complimentary conference registrations for up to three team members.

- Up to three student members from each finalist team will be provided travel support to attend the conference in-person. In-person attendance of the physical conference is required for reimbursement.
 - Travel grant funds are offered on a reimbursement basis of up to \$1,200 for continental travel and \$1,700 for intercontinental travel. There are no exceptions.
 - Funds will be issued by way of a bank transfer after the competition via Concur.
 - Receipts for reimbursement must be uploaded into Concur
 - Prior to claiming your travel grant award, you must submit receipts of your travel expenses that are equal to or exceed the grant amount in order to receive the full travel grant payment. Travel expenses include: air fare, train tickets, hotel, visa fees, transit, meals, and conference registration. Receipts are required for all items and must equal to or exceed the total reimbursement amount. **The receipts must show** form of payment used, name, date, and amount paid. Hotel reservation confirmations or bookings, invoices, or quotes for airfare are not acceptable receipts unless the proof of payment is also provided with the document.
 - All travel expenses should be submitted through IEEE's NextGen Expense Reimbursement (Concur) tool. Detailed instructions will be shared with the (up to) 3 undergraduate members receiving travel support as part of one of the finalist teams.

- Complimentary conference registration for up to three team members.
 - These complimentary conference registrations cannot be used to cover any papers accepted by the conference.
 - You must notify Jaqueline Rash, Jaqueline.rash@ieee.org, via email of the three team members who have been chosen to receive complimentary registration.
 - **VISA information:** Once registered for the conference, each individual will have the opportunity to request an invitation letter through the conference website to be used for the visa application process. This is the only way to receive a letter for visa purposes.
- The finalist teams will also be invited to join the Conference Banquet and the SPS Student Job Fair, so that they can meet and talk to SPS leaders and global experts. Please note registration for the Conference Banquet and Student Job Fair is limited and based on availability. You must add this event to your registration. If you are unable to add these events, then maximum capacity has been reached. *There may be additional availability for the Student Job Fair, but not the Conference Banquet. You can inquire by emailing Jaqueline.Rash@ieee.org.*
- Please note that IEEE may not be able to provide certain services to certain designated countries, entities, or individuals from those countries or entities per OFAC. [View a list of these countries](#).

6. Important Dates

Milestone	Date
Call for Participation of teams	From 11 September 2026
Team registration deadline	25 October 2026
Training & starter code – Brainstorming session	TBD
Round 1 submission deadline	30 November 2026
Round 1 result declaration	05 December 2026
Round 2 submission deadline	16 January 2027
Round 2 result declaration	21 January 2027
Selection of 3 finalist teams	21 January – 1 February 2027
Announcement of 3 finalist teams	9 February 2027
Presentation soft-skills training for finalists	TBD
Final competition at ICASSP	16–21 May 2027

7. Registration and Resources

7.1 Official SP Cup Team Registration

All teams must be registered through the official competition by the deadline in order to be considered as a participating team. Official team registration can be submitted via:

<https://www2.securecms.com/SPCup/SPCRegistration.asp>

All work that is being submitted for evaluation in the competition must be submitted to the official registration system using the above link. Only the work submitted to the official registration system can be considered for the competition.

All team members MUST also acknowledge and agree to the 'SP and VIP Cup Terms & Conditions' prior to the team registration deadline to be eligible for the competition. [Submit your signed Terms & Conditions form here](#)

7.2 Complimentary MATLAB License

MathWorks, Inc. continues to support the IEEE SP Cup. Participating students are encouraged to download the complimentary MathWorks Student Competitions Software for use in the competition

Instructions on how to apply for the complimentary MATLAB License can be found in the following DropBox folder:

[DropBox Folder: SP Cup - Complimentary MATLAB License \(MathWorks\)](#)

7.3 Resource Links

- SPS Competition Terms & Conditions: Located on both [SP Cup](#) and [VIP Cup](#) pages of [SPS website](#)
- [IEEE Conflict of Interest form](#)
- [Submit your signed Terms & Conditions form and Conflict of Interest confirmation here](#)
- [Complimentary MATLAB License instructions](#)
- [Official Team Registration and Work Submission System](#)

8. Contacts

Competition Organizers (technical, competition challenge-specific inquiries):

Dr. Vijay Jeyakumar, IEEE SPS Madras Chapter - Secretary

Email: vijayjeyakumar@ieee.org

SPS Staff (Terms & Conditions, Travel Grants, Prizes):

Jaqueline Rash, SPS Membership Program and Events Manager

Email: Jaqueline.Rash@ieee.org

SPS Student Services Committee

Lucas Thomaz, Chair

Email: lucas.thomaz@ieee.org

sp-competitions@listserv.ieee.org must be copied on ALL email communications regarding the competition

9. Organizing Committee and Technical Committee Endorsement

Dr Vijay Jeyakumar, Secretary - IEEE SPS MAS (Primary Organizer)

Dr Lucas Thomaz IEEE SPS Director-Student Services

Dr. Venkateswaran N, Chair - IEEE SPS MAS

Dr. Brindha Swaminathan - Board of Governors - IEEE SSIT

Ms T Abirami - Vice Chair - IEEE SPS SSN Student Branch

Ms. Leelasri B - Chair - IEEE SPS SSN Student Branch

Dr. Mita C. Paunwala – IEEE SPS Student Services Committee

10. Annexure - 1

S.No	Dataset Name	Description	Access	Link for Datasets
1.	UBFC-RPPG Dataset	Dataset 1- 8 videos Ground truth is stored in gtdump.xmp files: Column 1: Timestep (ms) Column 2: Heart rate (HR) Column 3: SpO2 Column 4: PPG signal Dataset 2- 42 videos Line 1: PPG signal Line 2: Heart rate (HR) Line 3: Timestep (seconds, scientific notation)	Open	https://sites.google.com/view/ybenezeth/ubfcrppg
4.	RPPG Dataset	The 'Data' folder contains the 88 video data of subjects from India and Sierra Leone. The videos generated for each subject are described below and the corresponding regions (R1: Forehead, R2: Left Cheek, R3: Right Cheek) on the face are shown in the accompanying figure.	Open	https://github.com/AiPEX-Lab/rppg_biases/blob/main/README.md

		Rectangular region of 60 x 30 pixels of the forehead Rectangular region of 25 x 25 pixels of the left cheek (the left of the viewer) Rectangular region of 25 x 25 pixels of the right cheek (the right of the viewer) The ground truth mean heart rate for each video is provided in the respective '.csv' files contained in the 'Ground_Truth' folder.		
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Sponsor

We gratefully acknowledge MathWorks, Inc. for their continued support of IEEE Signal Processing Cup. Participating students are encouraged to download the complimentary MathWorks Student Competitions Software for use in the competition.



Please note, any work submitted during this competition may be made available to MathWorks for commercial use.