

2026 START Program CFP Brief

THEME: **04. Advanced Sensors for Health**

SUB-THEME: **4.1. Multi-modal human state sensing technology on smart glasses: emotion, cognitive load, and beyond**

Context/ Overview

AI glasses or smart glasses are emerging to become the next major personal computing platform, bringing always-on sensing and intelligent assistance directly into the consumer's everyday life, providing a new and effortless human-machine-AI interaction. However, current glasses remain largely reactive because they rely largely on outsider cues (i.e., from environment camera and voice command) and currently lack the ability to understand a user's internal state—such as emotion, cognitive load, stress, or other physical, physiological and psychological conditions in real-world environments. Unlike existing mobile or wearable devices, glasses introduce unique form-factor and power, size, compute constraints. This creates a critical technology gap: without reliable human-state sensing, AI glasses cannot deliver truly personalized, adaptive, and proactive experiences.

Problem Statement

Achieving robust in-the-wild human-state sensing on glasses remains an open problem. 1) **Physiological sensor** that can infer emotion state, such as **EEG**, has **weak** signal and is highly **susceptible** to location, motion, sweat, and environmental noise, and exhibit large **variability** across users and contexts. Today's approaches on existing mobile and wearable rely on heterogeneous sensors, or a large sensor array that increase hardware complexity, cost, and power consumption, making them poorly suited for consumer glasses. EEG or other new sensors form factor, placement, and mechanical/electrical coupling on glass system remains a challenge. 2) Second, EEG (or new sensors) and multimodal signal processing must run under **extreme energy constraints** (e.g. <50 mW). Continuous EEG (or new sensors) perception and sampling may not be feasible in real-world scenarios due to these limitations. To enable practical deployment, a holistic system-level co-design approach is required to optimize energy efficiency while maintaining accuracy and reliability. 3) Thirdly, the field lacks **large-scale real-world datasets** and **generalizable models** capable of capturing emotional and cognitive states under everyday conditions. These challenges collectively represent a significant technical and scientific barrier, and addressing them is essential to deliver a reliable, consumer-friendly human-state monitoring. and enable further personalized, adaptive, and proactive AI assistant experiences.

Objectives & Scope

The objective of this CFP is to develop ExG or new sensors to accurately track the human mental cognitive and psychological state for a smooth human-device interaction, which is suitable for AI glasses or smart glasses. The long-term plan includes the sensor development, AI and signal processing algorithm development, human-device interaction, sensor foundation model, on-device optimization and agent in the loop design.

To solve the long-term problem above, please consider the following selected topics and focus areas. Feel free to come up new ideas to solve the problem.

Specific Topics & focus areas*

1. New sensor or sensing technology for emotion/cognitive/psychological state monitoring on wearable devices such as glasses, ring, watch and phone.
2. ExG electrode sensor configuration for optimal comfort and SNR
3. Definition of cognitive load and consumer friendly methods of evaluation (tasks, activities to passively gauge cognitive load). Intra-inter person variability study.
4. ExG artifact separation and analysis including jaw and eye movement analysis. Models for food logging, nutrition analysis, ocular health and cognitive insight derived from eye movement sensed through ExG.
5. AI glasses prototype with unobtrusive, miniaturized sensor integration and other system level optimization and innovation.
6. Develop brain foundation model including architecture, training methodology etc.
7. Develop other advanced AI technology for generalized human state monitoring across different user under everyday conditions.
8. Data curation methodology to create or synthesize large dataset.
9. On-device optimization for sensors and foundation models.
10. Multi-device sensor fusion to jointly utilize sensors on glasses, watch, ring and phones etc.
11. New ideas on enable multiple human state perception (emotion, cognitive, gaze, stress, respiration, and more) on AI glasses with minimal sensor suite.

※ The topics are not limited to the above examples and the participants are encouraged to propose other original ideas.

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