Sensing Meets Mobile Social Networks: The Design, Implementation and Evaluation of the CenceMe Application

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Summary

Main idea:

- A people-centric sensing application using mobile phones

Design:

- Limitations: OS, API, and energy management
- Split level classification for scalability

Core features:

- Automated Presence Sharing
- ClickStatus Interface
- Privacy Controls

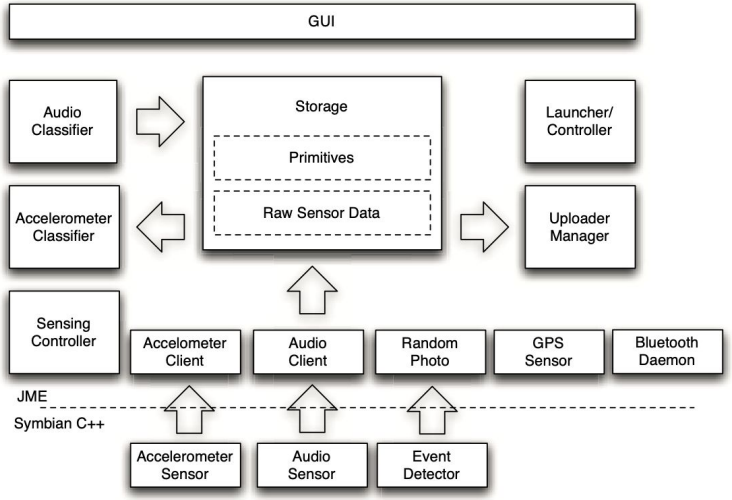

Figure 1: Architecture of the CenceMe phone software.

Market Segmentation

- On-device smartphone sensing & social apps
- Smart wearable devices
- Backend analytics
- Privacy/Consent management tools

Key Goods and Services

- **Smartphone OEMs/sOc vendors**
  Apple, Samsung, Google (Pixel),
  Nokia (historical relevance)
- **Wearable/sensor makers**
  Fitbit, Garmin, Apple (Watch),
  other startups
- **Cloud/backend providers**
  Amazon Web Services,
  Google Cloud, Microsoft Azure
- **Analytics/ML platforms and tools**
  On-device or cloud ML toolchains
  TensorFlow Lite, Core ML, Edge ML

Business Model

Freemium consumer apps

- free core app with paid premium features
- Costs: mobile engineering, backend hosting, ML model maintenance

Subscription / SaaS for enterprises

- recurring revenue for analytics, dashboards, SLAs
- Costs: cloud infrastructure, data storage, compliance.

Wearable vendors

- sell hardware and cloud services
- costs: manufacturing, customer support

Data Monetization

- aggregate or anonymized behavioral data sold to advertisers or used to target content
- privacy issues involved

Major Standards

The ones highlighted in orange are **de facto standards**, and the rest are **official standards**.

Category	Standards / Bodies
Sensor Interface & Calibration	IEEE 2700; ISO/IEC
Communication & Data Acquisition Protocols	Bluetooth LE, IEEE 802, MQTT, CoAP
Health and Biometric Data Schemas	HL7 FHIR; Apple HealthKit / Google Fit
Privacy & Data Protection Laws	GDPR (EU), CCPA (California), HIPAA (US health privacy)
User Consent & Data Governance	IAB TCF, W3C Privacy Sandbox, OneTrust models

Practice Gap

CenceMe research	Market Implementation Today	Commercial Reality
Automatic user state inference (e.g., walking, talking, listening to music)	Smartphones and wearables detect motion and sleep but rarely infer *social interactions* (e.g., “in conversation”, “in a meeting”).	Partially implemented
Multimodal fusion (audio + motion + GPS)	Technically feasible but constrained by permission models and cross-platform data silos.	Feasible but impractical
Continuous background sensing (always-on)	Modern OSes (iOS/Android) restrict microphone, accelerometer, and Bluetooth scanning in the background for privacy and battery reasons.	Severely limited

Why Does This Gap Exist?

1. Privacy and Ethical Constraints
2. Platform Restrictions (OS-Level Policies)
3. Technical and Resource Constraints

Unaddressed Research Topics

1. Longitudinal Behavior Modeling & Personalization

2. Social Implications & Human–AI Coexistence

Unmet Needs

1. Trustworthy, Transparent Sensing Systems

2. Fine-Grained Consent and Contextual Privacy Controls

Why These Needs Remain Unmet

1. Regulatory & Legal Fragmentation

2. Technical Complexity

3. Lack of Interdisciplinary Capacity