

# **Hidden in Plain Speech: A Covert Safety System for Foreign Residents via Ambient Speech Recognition**

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# Motivation: Formative Study Findings

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## Formative Interviews

Interviews with three long-term Chinese female migrants revealed critical dimensions of vulnerability that standard safety tools fail to address.

### Vulnerability 1: Social Isolation

One participant, despite living in Korea for 20 years, faced deep social isolation and discrimination following a divorce.

### Vulnerability 2: Workplace Restrictions

Another participant experienced verbal harassment while working in **food processing** (intensive manual labor).

**Phone usage was strictly prohibited, leaving her defenseless.**

# Evolution of Research Focus

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Our research began with a narrow focus on domestic violence but expanded to address a broader systemic issue: the inability to access help under surveillance.

1

## Domestic Focus

Initial research focused on domestic violence intervention within multicultural families.

2

## The Constraint

Realized that in both abuse and workplace exploitation, victims cannot physically manipulate a phone.

3

## Ubiquitous Safety

Designed a hands-free, ambient system that acts as a discreet "witness" rather than just a panic button.

# Related Work & Gaps

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## Coercive Control in Smart Homes

Smart devices enable **Technology-Enabled Coercive Control (TECC)**. Solutions like *PrivacyCube* focus on transparency, but victims need opacity to operate safely.



## The Digital Safety Dilemma

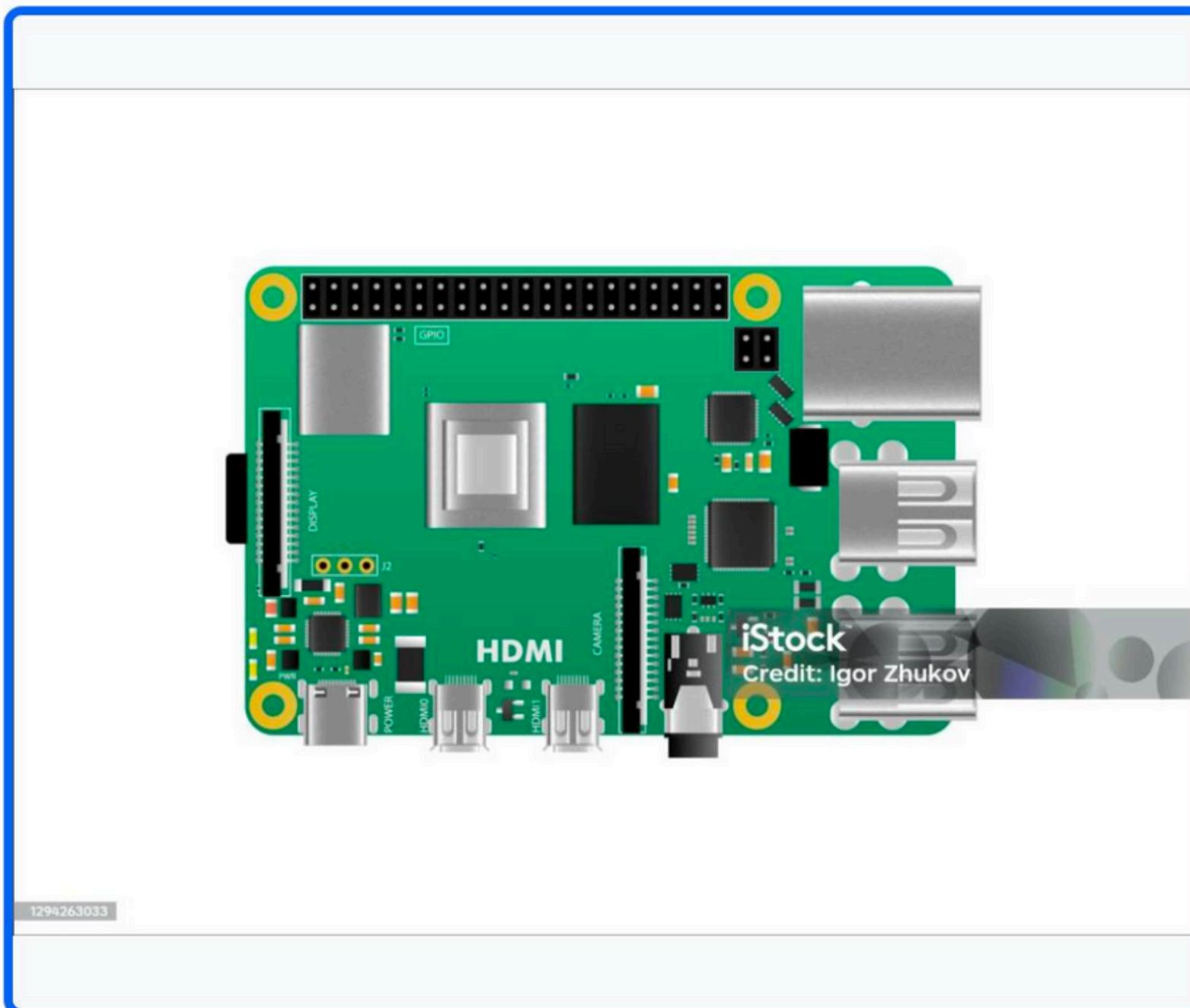
Most apps require GPS and touch interaction. This "digital safety dilemma" presumes private access to a device, which is often untrue for victims.



## From Digital to Physical Defense

We adapt "Quick Exit" web principles to the physical world, creating an ambient defense that is non-provocative and discreet.

# System Approach: "Mother Tongue"



## Stationary IoT & Offline Privacy

Our solution is a stationary IoT system designed for environments where phones are restricted.

- ✓ **Hardware:** Raspberry Pi (Compact & concealable).
- ✓ **Core Tech:** VOSK Offline Speech Recognition (50MB model).
- ✓ **Mechanism:** Uses ALSA for recording and SMTP for MIME-multipart email delivery.
- ✓ **Privacy:** All processing is local. No data leaves the device until a trigger event.

# Evaluation Methodology

Single-session evaluation in a controlled environment with **8 participants**

(International students & researchers).



## 1. Configuration

User sets rescue keyword & recording duration.



## 2. Testing

User speaks keyword in natural sentences.



## 3. Confirmation

Verify email receipt of audio evidence.

Slack status bar: slacker, bash, SafeWord - Chromium

Top right icons: download, battery, signal, volume, microphone

Terminal 1 (bash):

```
127.0.0.1 - - [24/Nov/2025 12:51:13] "GET /status HTTP/1.1" 200 -
127.0.0.1 - - [24/Nov/2025 12:51:15] "GET /status HTTP/1.1" 200 -
127.0.0.1 - - [24/Nov/2025 12:51:15] "GET /status HTTP/1.1" 200 -
127.0.0.1 - - [24/Nov/2025 12:51:15] "GET /list-samples HTTP/1.1" 200 -
=====
✓ Vosk Wake Word Detector Starting
Target phrase: 'yordam'
Sample rate: 16000 Hz
=====
[✓] Audio processing thread started
[✓] Listening for wake word successfully!
127.0.0.1 - - [24/Nov/2025 12:51:17] "POST /start-detection HTTP/1.1" 200 -
127.0.0.1 - - [24/Nov/2025 12:51:19] "GET /status HTTP/1.1" 200 -
127.0.0.1 - - [24/Nov/2025 12:51:19] "GET /detection-events HTTP/1.1" 200 -
[✓] Recognized: "qaramasdan takshil"
127.0.0.1 - - [24/Nov/2025 12:51:20] "GET /status HTTP/1.1" 200 -
127.0.0.1 - - [24/Nov/2025 12:51:20] "GET /list-samples HTTP/1.1" 200 -
127.0.0.1 - - [24/Nov/2025 12:51:21] "GET /detection-events HTTP/1.1" 200 -
127.0.0.1 - - [24/Nov/2025 12:51:21] "GET /status HTTP/1.1" 200
```

Terminal 2 (bash):

```
✓ RECOGNIZED: "salom"
✓ RECOGNIZED: "sekin o'tmaydimi"
✓ RECOGNIZED: "go'yo kulardi"nglayini
✓ RECOGNIZED: "jamila"
✓ RECOGNIZED: "haqiqat"
✓ RECOGNIZED: "yashovchilar lekin zirvak da yuza ga tinch qo'y adibimiz nima deysan"
✓ RECOGNIZED: "yordam"
✓ RECOGNIZED: "va yangilanib"
✓ RECOGNIZED: "a a a"
✓ RECOGNIZED: "undan desa"
✓ RECOGNIZED: "shuvayx kuvayt respublikaning"ga
✓ RECOGNIZED: "laylaki sezadi"
✓ RECOGNIZED: "tuvalu"umani
✓ RECOGNIZED: "nima edi"
✓ RECOGNIZED: "dengiz birinchi tartibli"erenzial
✓ RECOGNIZED: "o'zbek qilib ayt"
✓ RECOGNIZED: "toki"
✓ RECOGNIZED: "na emas"
✓ RECOGNIZED: "sen esa edi"
✓ RECOGNIZED: "da'vo begimga faqat noyob hamisha emas"
✓ RECOGNIZED: "qayda"
✓ RECOGNIZED: "mixail paleolognning nikohsiz bekorga olg'a"
```

SafeWord - Chromium:

Getting Started Help Projects Safety Info Vosk Model vosk-model-small-uz-0.22

## Safeword

Personal Safety Keyword Detection System

### Configure Wake Word

Wake Word / Phrase:  (2)

Sensitivity: 0.5 Higher = more sensitive

Save Configuration (3)

✓ Wake word configured: "yordam"

### Detection Control

Listening

Detection Threshold: 0.5 Higher = More Sensitive

Stop Detection (6) Test Trigger

✓ Listening for wake word: "yordam"

### Recent Events:

12:51:17: Started listening for: "yordam"

### How it works:

- Click "Start Detection" to begin listening

### Actions Configuration

Recording Duration (seconds):  (4)

How long to record audio after detection

Encrypt recordings

Encrypts saved audio files for privacy

Attach recording to email

Send the audio recording with the email alert

Grace Period (seconds):  (5)

Delay before triggering actions (0 = instant)

Email Subject: input your email

Red annotations and arrows:

- A red circle with a question mark (2) points to the "yordam" input field.
- A red arrow points from the "yordam" input field in the configuration window to the "yordam" entry in the recent events log.
- A red circle with a number (3) points to the "Save Configuration" button.
- A red circle with a number (4) points to the "Recording Duration (seconds)" input field.
- A red circle with a number (5) points to the "Grace Period (seconds)" input field.
- A red circle with a number (6) points to the "Stop Detection" button.
- A large red circle highlights the "yordam" entry in the recent events log.

ALERT: Safe word detected! ➤ Inbox ✕

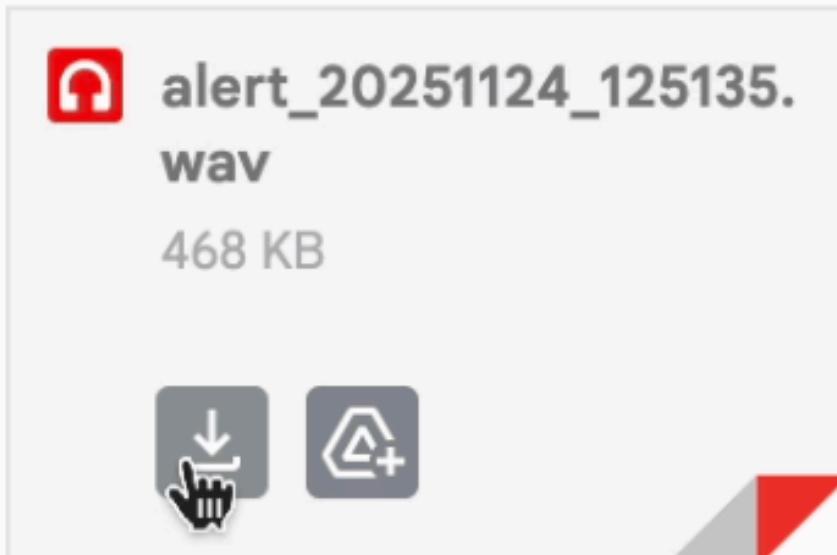
→ Summarize this email

animuscodec@gmail.com

to me ▾

Safe word was detected. Alert triggered.

One attachment • Scanned by Gmail ⓘ  Add to Drive



# Email confirmation of recording

# Quantitative Results



# User Strategies for Keyword Selection

Participants adopted two distinct strategies for choosing their "Rescue Keyword" based on the threat model.

## Strategy A: "Secret Code"

**Language:** Native Language

Participants chose a word in their native tongue that the abuser wouldn't understand.

*Example: "**Bachao**" (Help in Hindi) – "It's like a magic word they can't decode."*

## Strategy B: "Contextual Fit"

**Language:** Context Specific

Participants embedded the keyword in a natural sentence to avoid the suspicion caused by anxiety or language switching.

*Example: "I think the **oven** is still on."*

# Qualitative Insights & Future Work

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## Granularity & Cancel

Need for "critical levels" (multiple keywords for severity) and a "double confirm" or cancel option to prevent false alarms.



## Multi-Modal Feedback

Suggestions for secondary actions like a "Fake Call" to provide an excuse to leave the room, or real-time location sharing.



## Wearability

Participants suggested integrating the technology into wearable items like "sticky patches" to ensure protection extends beyond the home.

# Conclusion

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## A New Paradigm for Safety

### "From Panic Button to Ambient Witness"

Our study confirms that in environments of power asymmetry and surveillance, **hands-free, linguistic camouflage** is not just a feature—it is a requirement.

By leveraging the "Mother Tongue" as a secure channel, we provide a safety net that empowers vulnerable populations without escalating their risk.

# Questions?

Thank you for your attention.

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