EDP23[draft]- A Worspace Accident Detection and Reporting System Aimed at Archieving a Zero-Accident Workplace

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1. Motive: Workplace Accidents?

- Accidents do happen in workpaces, especially in the manual labor sector.
    - In **Sri Lanka**, approximately **2,000** non-fatal occupational accidents occur annually, while the number of fatal accidents ranges between **60** and **80**.
    - In **2023**, the **USA** experienced **226,698** preventable deaths and **62 million** injuries.
    - In **France**, there are **2 deaths daily** and **600,000 injuries** due to workplace accidents.
- Most accidents happen due to **human error**, but some occur due to **technical issues and cost-cutting measures**. Despite this, many companies and countries aim for **“zero accidents.”**
- Here is quick list of some recents workspace accidents happened in **Sri Lanka**.
    1. 5 deaths due to Ammonia gas poisoning in a rubber factory in Horana.
    2. Sri Lankan sewage maintenance workers killed due to lack of basic safety measure.
    3. A study that goes about high tension electric trauma at workplaces in Sri Lanka.
    4. Missing Dematagoda railway employee found dead in well.
    5. Electrocuted construction worker falls to his death.
    6. And many more unfortunately like workplace violence, etc.

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2. Types of Workplace Accidents?

- What kind of accidents could happen in workplaces? Do they depend on the type of work being done?
    - Leading workspace-related injuries in **Sri Lanka**, according to the Directorate of Non-Communicable Diseases, are as follows:
        1. Struck/hit by object - 25.4%

2. Stab/cut - 22.1%
3. Fall - 18.6%

- The most common accident in the **construction sector** in **Sri Lanka** is **falling** followed by **being struck-by something**, acording to both paper 1, and paper 2.

- According to **American Insurance**, the three most common accidents are:

  1. Overexertion involving external sources.
  2. Falling.
  3. Being struck by an object.
  4. Exposure to hazardous substances.

- According to **Makrosafe**, the top causes are:

  1. Repetitive motion injury.
  2. Slips, trips, and falls.
  3. Workplace violence.
  4. Vehicle accidents.

- **OSHA (Occupational Safety and Health Administration)** Fatal Four: Most prominent accidents in construction:

  - Fall (36%)
  - Struck-by (10%)
  - Caught-in/between (9%)
  - Electrocution (2%)

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3. Prevention or Response?

Some workplace accidents are **preventable**, while others require a **rapid response** to minimize harm. Unfortunately, many incidents go **unnoticed** and **unattended**, leading to unnecessary loss of life.

Should anyone lose their life while working? **Absolutely not.**
That's why we must focus on both **prevention** and **rapid action** to ensure workplace safety.

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4. Proposed Solution?

Introducing _____ , a compact wearable **device** designed to:

4.1. Accident Detection & Reporting

- **Early Detection (Manual/Automatic) to Base Station:**
  - Report **workspace violence** with a **discreet button press**.
  - Monitor **live location** using **GPS**.
  - Geofencing using **GPS**.
  - ‘No-motion for a long-time’ detection, and ask for a confirmation from the worker through the device’s simple UI.
  - (*optional) Detect **live wires** using an **induction sensor**. (e.g., **High tension lines**)
  - (*optional) Detect **toxic gases** that are otherwise unnoticed (e.g., **CO**, **Ammonia**, **H2S**).
- **Automated Reporting Post-Accident:**
  - **Falling/Unconsciousness** detection using **IMU sensors**.
  - **Struck by an object (e.g., vehicle impact)** using the same **IMU sensors**.
  - **Loud scream detection** using a **microphone**.
  - (*optional) **Drowning detection**.

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[*] The exact configuration of the sensor array for a particular device is decided at the **point of purchase**, as it is costly, and not all sensors may be beneficial for every user, industry, or work setting.

4.2. User Interface (UI)

- **Worker Side:** Minimalist, **screen-less** UI with a **single push button**.
- **Monitoring/Base Station:** Software that **reports/alarms** for potential or actual accidents for every employee using the device.
- **Device Features:**
  - Small, **wearable** (attachable to a **belt/helmet/etc.**)
  - Runs on **battery**, for a considerably long time without recharging/replacing.
  - **Customizable configuration** based on industry needs. (E.g., fall detection is included in every configuration, gas detection is an optional add-on.)

Todo: Design a website snapshot to guide users through configuration…

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5. Market Analysis

- **Existing Solutions:** Some devices and services already provide similar functionalities, proving that this is not an abstract concept.

- **Why This Over Others?**
  - **Cost:**
    - Most competitors exceed **$500** and often require a **subscription** (which alone can exceed a manual worker's salary in **Sri Lanka**).
    - **Safety should be accessible** for **everyone**, from individual workers to employees in large corporations.
  - **Flexible Deployment:**
    - Can be used with a **base station for businesses** or as a **standalone device** communicating with a **loved one's phone**.
  - **Compared to Smartphones:**
    1. While smartphones offer some similar functions, many features require **subscriptions** and are **limited by hardware capabilities**.
    2. **Better battery life**—no one wants a dead battery in an emergency.
    3. **Simple, foolproof UI**—emergencies require quick, effortless actions.
    4. **Specialized hardware**—smartphones lack **gas sensors** and other critical features.

6. Target Users? Other Possibilities?

1. **Individual workers** (e.g., **drivers, local construction workers**).
2. **Large corporations**.
3. **Elderly individuals** who may stay home alone unattended.
4. **Adventurers** (e.g., **bikers**, **hikers, campers**) who may face risks in remote areas.

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7. Implementation [Draft]

7.1. The wearable device:

1. A low powered **microcontroller** polls sensory data.
2. In case of an event, it uses **GSM/GPS communication** to alert the base station and vice versa.

7.2. The base station:

1. Connects to a PC or a security system using USB.
2. Uses a microcontroller and GSM/GPS communication.
3. For individual workers the base station is simply replaced with an simple mobile app (or a text messages based implementation) on some other party's cellcular device(e.g., a loved one).

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8. Hardware & Cost Estimation [Draft]

Component	Cost (LKR)
LP Microcontroller x2	TBD
GSM Module x2	~1150 x2
Small Buzzer	~90
Enclosure	TBD
PCB	TBD
IMU Sensor (Mandatory)	~650
Microphone (Mandatory)	~160
Gas Sensors (Optional)	~900
Other Optional Sensors	TBD
Push Button	~100

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9. Next Steps [Draft]

- **Refine the implementation** and **expand UI details**.
- **Develop a prototype**.
- **Develop a GUI for base station**.
- **Gather user feedback** for iterative improvements.

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10. References

- **Competitors:**
  1. Black Line Safety
  2. Solo Protect
  3. People Safe
- **Data Local:**
  1. Occupational injuries in Sri Lanka [Pages 77-83]

2. Poor Occupational Safety in Sri Lanka - a study
3. Workplace accidents in Sri Lanka - Ticking time bomb
4. Ammonia gas poisoning in Horana
5. Two deaths from lack of safety measures in Sri Lanka
6. Ministry of Labor Sri Lanka
7. National Occupational Safety Policy Sri Lanka
8. Workspace Accidents in Sri Lanka
9. Construction accidents Sri Lanka
10. Workspace violence in Sri Lanka
11. Sri Lankan sewage maintenance workers killed
12. High tension electric trauma in Sri Lanka
13. Missing Dematagoda railway employee found dead
14. Electrocuted construction worker falls to his death
15. Workplace violence and harassment costs Sri Lankan businesses millions

- **Data Global:**
  1. NSC - National Safety Council USA
  2. RADIOFRANCE - Workplace accidents in France
  3. AMERICANINSURANCE - Causes of workplace injuries
  4. OSHA - Fatal Four in construction
  5. OSHA - Workplace violence
- **Similar Ideas:**
  1. Smart Helmet for adventurers
  2. Fall Detection for Elderly
  3. Lone Worker Safety Devices
  4. High Tension Electric Trauma in Sri Lanka
  5. Ammonia Gas Poisoning Incident in Sri Lanka
  6. Workplace Accidents in Sri Lanka - Ticking Time Bomb