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Protego: An Innovative And Protective Badge Using Lilypad Arduino

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Abstract:
The paper aim is to design and develop a smart safety clip that can protect children, women and elderly people during any form of danger or emergency. The PROTEGO Safety Clip can be easily attached to ID cards, clothing, or bags and works independently through an inbuilt GSM module (SIM-based), GPS tracker, microphone, and buzzer alarm. This innovative system automatically detects clapping, hissing, screaming, or manual SOS button press, and immediately sends an SMS alert containing live GPS location to parents, guardians, or nearby authorities through the GSM network. The buzzer is simultaneously activated to attract public attention. Our project aims to develop an affordable, compact, and accessible safety solution using IoT and embedded systems, ensuring personal protection for every citizen. The PROTEGO Safety Clip can function without a smartphone, making it highly practical for school students, working women, and elderly individuals. This project merges technology and social safety to build a more secure environment for everyone.

Key Word: *GSM, SIM, Safety Clip, SoS.*

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I. Introduction

"Bringing together safety, innovation, and technology into a single clip." Today, public safety is a major concern for society. Incidents of kidnapping, harassment, and accidents often occur when the victim cannot seek help in time. While there are advanced wearable safety devices, they are either expensive or require constant connectivity with smartphones. The PROTEGO Safety Clip addresses this issue by introducing a low-cost, compact safety system that operates independently through GSM and GPS technologies. It is designed as a small electronic module attached to an ID card clip or badge holder, capable of detecting unusual sounds or manual triggers and sending instant alerts with location details to emergency contacts. It aims to ensure that help reaches in time, and that no individual is left without a voice during an emergency. Personal safety has become an important concern in modern society due to increasing Incidents of emergencies, accidents, and health problems. In many situations, individuals may not be able to manually call for help due to unconsciousness, panic or physical limitations. Wearable technology provides an effectives solution to address this issue's by continuously monitoring the user's condition and providing automatic emergency alerts. The PROTEGO system is designed as a smart wearable safety device that integrates health monitoring and emergency communication.

The device monitors the user's heart rate Using a pulse sensor and detects abnormal conditions such as tachycardia or bradycardia. Additionally, a clap detection mechanism using a sound sensor allows the user to activate an emergency alert through a simple clap gesture. This feature is particularly useful in situations where the user cannot access the SOS button. When this device detects the emergency event the Lilypad Arduino microcontroller process the sensor data and activates the GSM module to send an alert message and call at the same time GPS module retrieves the current location of the user and the coordinates are included in the emergency message. This device enables family members or authorities to locate the individuals quickly. The PROTEGO system is designed to be compact, low cost and energy efficient making suitable for wearable applications such as wrist bands or portable safety device.

II. Proposed Topology

The proposed system architecture integrates several sensor and communication module to provide real time monitoring and emergency alert functionality. The core component of the system is the lilypad Arduino microcontroller which acts as a processing unit. It receives input signal from multiple sensor's and controls the communication module accordingly. The pulse sensor continuously measures the user's heart rate and provides Analog signal to the microcontroller. If the measured heart rate exceeds predefined threshold the system identifies it as an abnormal condition triggers an emergency alert. In addition to physiological monitoring sound sensor is used to detect clap sound that may indicate distress. The system also includes a manual SOS push button that allows the user to activate the emergency alert manually. Once an emergency condition is detected the microcontroller retrieves the user's location from the GPS module. The GSM module then sends an SMS

alert and initiates a phone to predefined emergency contacts. To ensure data recording and monitoring the system includes a microSD card module that stores sensor readings and emergency event information. The entire system operates on a rechargeable Li-Po battery, marking it portable and suitable for wearable applications.

III. Components

Lilypad Arduino ATmega328P

The Lilypad Arduino is a microcontroller board specifically designed for wearable electronics. It uses the ATmega328P microcontroller and operates at low power consumption making it suitable for battery – powered wearable devices. The board acts as the main controller that processes sensor inputs and controls communication modules.

Pulse Sensor

It uses the ATmega328P microcontroller and operates at low power consumption making. The pulse sensor is used to measure the user's heart rate. It works based on photoplethysmography (PPG), which detects changes in blood volume in the fingertip. The sensor outputs Analog signals corresponding to the heart beat, which are processed by the microcontroller to calculate beats per minute (BPM).

Sound Sensor (KY-038)

The sound sensor detects acoustic signals in the environment. In the PROTEGO system it is configured to detect clap sound. When a clap is detected the sensor send a digital signal to the microcontroller which interprets it as a distress signal and activates the emergency alert mechanism.

GSM Module (SIM800L)

The GSM module enables wireless communication through the cellular network. It allows the system to send SMS alerts and initiate phone cells to predefined emergency contacts. The module operates on a 3.7V power supply provided by the Li-Po battery.

GPS Module (NEO-6M)

The GPS module is used to obtain the real–time geographic coordinates of the user. These coordinates are included in the emergency alert message so that the user's location can be tracked easily.

Micro SD Card Module

The SD card module is used to store system logs such as heart rate data and emergency events. The data can be used later for analysis and monitoring.

Micro SD Card

It is used with SD module for data storage

Power supply

The system is powered using a rechargeable 3.7V Li-Po battery. A TP4056 charging module is used to safely charge the battery and regulate the power supply to the system.

IV. Problem And Objective

Problem

Many schools and public institutions have no efficient or real-time safety system to protect students and staff. Women and elderly citizens are also vulnerable when alone in public places.The main problem is the lack of instant communication and tracking during emergencies.

Objective

- To build a smart, low-cost, and portable safety clip using IoT-based technology that can detect sound-based emergency cues (clapping, hissing, screaming).
- Allow manual SOS trigger via button.
- Send SMS alert with GPS coordinates to parents or authorities.
- Activate a buzzer/vibration alarm for immediate attention.
- Operate independently through a GSM SIM module without mobile dependency.
- The system's goal is to make safety accessible to everyone, especially in schools, colleges, and public environments.

V. Working

IoT and GSM Integration:

The PROTEGO clip is powered by an lilypad Arduino microcontroller, SIM800L GSM module, NEO-6M GPS module, and a sound detection microphone. When an emergency trigger (sound or button) is detected:
1. The Lilypad Arduino collects GPS coordinates from the GPS module.
2. The GSM module sends SMS alerts with location link to pre-registered phone numbers.
3. The buzzer alarm activates to alert people nearby.

System Flow

❖**Normal Mode:** Monitors sound environment; remains on standby.
❖**Trigger Mode**: On clap/hiss/SOS button press, system activates alert sequence.
❖**Alert Mode:** Sends SMS or Call (user option) → GPS location → Activates buzzer → Enters standby again.

Technology Used

❖Microcontroller: lilypad Arduino
❖GSM Module: SIM800L (with SIM card)
❖GPS Module: NEO-6M
❖Sound Detection: MAX9814 microphone
❖Power: Rechargeable Li-Po battery (500 mAh)
❖Software: Arduino IDE (C/C++)
The system operates in real-time and can function in any environment with GSM coverage.

VI. Experimental Demo

❖Demo 1: Press SOS button or automatic trigger → SMS alert sent to parent's mobile with GPS link.
❖Demo 2: Clap or hiss sound detected → Triggers alert sequence
❖Demo 3: Buzzer activation test for public attention.
❖Demo 4: GPS accuracy check via live tracking on Google Maps.
❖Demo 5: Battery life and power management test using TP4056 charger.

VII. Frame Work

➢ Hardware Layer: Lilypad Arduino, GSM, GPS, Mic, Pulse sensor, Micro SD card, Buzzer, Battery
➢ Software Layer: Arduino code for sound detection, GPS integration, GSM SMS communication.
➢ Communication Layer: GSM network for SMS transmission, GPS satellite for location data.
➢ Output Layer: Call and SMS alert with location.

VIII. Hardware Results

The hardware implementation of the PROTEGO system demonstrates the successful integration of sensors and communication modules for emergency monitoring. The pulse sensor continuously monitors the heart rate and sends data to the Lilypad Arduino. When abnormal heart rate conditions are detected, the system automatically activates the GSM module to send an emergency alert. Similarly, when a clap sound is detected by the sound sensor, the system interprets it is a distress signal and immediately initiates a phone call and sends an SMS alert containing the user's location. The GPS module provides accurate latitude and longitude coordinates, which are embedded in the alert message. All sensor readings and emergency events are recorded in the microSD card module for monitoring purposes. The hardware system is compact and energy efficient, making it suitable for wearable safety devices.

IX. Advantages Of Protego Safety Clip

❖Cost-effective and easy to assemble.
❖Independent operation (works even without smartphone).
❖Detects emergencies automatically or manually.
❖Portable and lightweight; fits inside an ID card clip.
❖Supports instant GPS and SMS or call alerts.
❖Encourages safer educational and public environments.
❖Can be expanded to include camera or BLE app connection.

X. Importance

The PROTEGO Safety Clip will have a major social impact, especially in educational and public institutions. It ensures safety and peace of mind for parents and guardians, while empowering individuals with technology-driven protection. Schools, colleges, and workplaces can implement this innovation to improve

emergency preparedness. This device aligns with the government's Digital India and Women Safety initiatives, while also inspiring students to understand and apply IoT and embedded system technologies for real-world challenges.

XI. Conclusion

The PROTEGO Smart Wearable Badge provides an effective solution for personal safety and emergency communication. The integration of heart rate monitoring, clap detection, and manual SOS activation ensures that the system can detect multiple type of distress situations. The GSM and GPS modules enable rapid communication and locating tracking, ensuring quick response during emergencies. The system is compact, low cost, and energy efficient, making it suitable for wearable safety applications. Future Improvements may include integrating additional sensors such as fall detection and cloud-based health monitoring to further enhances the system's capabilities

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