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關鍵詞	<u>GSM, GPS, Gyroscope, Microcontroller, Accident, Emergency Service, Third Life, Trishuli bus accident</u>
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THIRD-LIFE: Real Life Accident Alerting, Live Locations and Notifications to Emergency Service

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Abstract:

The country of Nepal, although beautiful, is facing many challenges due to its geography, lying between the towering Himalayas and the vast plains of Terai. The narrow mountain roads, prone to landslides and poor infrastructure, often result in frequent accidents. This situation is worsened by the delayed emergency response, as accidents are often reported much later than the time they occur. In the past ten years, over 15 major bus accidents have killed hundreds of people, and in 2024 alone, more than 80 deaths were reported. In response, the "Third Life" project was developed to improve emergency response time and save lives. The project has two main components: first, a device equipped with GSM (Global System for Mobile Communications), a GPS module (Global Positioning System), a gyroscopic sensor, and a microcontroller to detect accidents in real-time within seconds of the incident. Second, once an accident is detected, live coordinates are sent directly to emergency services and police stations for immediate assistance. This project is not only vital for Nepal but also for countries with similar terrain and infrastructure challenges. The "Third Life" project aims to save many lives that are lost due to delayed reporting, ensuring quicker emergency responses. A tragic example of this was the 2024 Trishuli bus accident, where many lives were lost when the bus plunged into the river. To date, the bus has not been recovered. Our project aims to create a waterproof device that, when connected to a satellite, will send live coordinates to emergency services, ensuring 100% reliability. This device could help locate the bus, which is still missing, within seconds. Ultimately, this initiative offers more than just safety it restores peace of mind and hope for the families of victims, providing them with a chance for a better future despite the tragedy.

Keywords: GSM, GPS, Gyroscope, Microcontroller, Accident, Emergency Service, Third Life, [Trishuli bus accident](#)

1. Introduction

Nepal, which is a landlocked country surrounded by the Himalayas, experiences special challenges regarding transportation. This has to do with not only the rugged, mountainous terrain but also very badly maintained roads, alongside common incidents of landslides, making the transportation system highly accident-prone. In bad weather conditions like that of the monsoon season, the situation worsens further. As a result, the road network is generally unsafe and accidents frequent and serious in rural and mountainous areas.

The road infrastructure currently in place in Nepal is generally inadequate to meet the demands of modern transportation, especially in rural areas. Many roads are narrow, winding, and in poor condition; traveling on them is hazardous, particularly for buses and trucks. In this scenario, the absence of real-time communication infrastructure to report accidents greatly hampers effective accident reporting. Thus, it is common that whenever road accidents occur, help always arrives late, which escalates the chances of fatalities and severe injuries. The critical problems that are leading to loss of life, which can be prevented, include poor emergency response times and identification of locations.

In the past decade, Nepal has witnessed several tragic accidents, particularly fatal bus crashes, that have resulted in hundreds of deaths. A tragic example is the 2024 Trishuli bus accident, where a bus plunged into a river, and the wreckage was not recovered for several days. It also created much delay in response due to the lack of immediate location reporting and poor communication between the accident site and emergency services. The immediate need for an effective system to handle emergencies was felt more than ever.

The concept of the Third Life project was born from these very issues, with a specific focus on real-time accident detection and the immediate sharing of location data with emergency responders. Thus, this system aims at not only reducing the sluggish movement of emergency services to many mishaps in Nepal but also aims for better rescue operations so people's lives can be salvaged. With this work done, integrating advanced gyroscopic sensors, GPS technology, and GSM networks, there promises to

be significant betterments in emergency response, mostly in areas with complex topography like Nepal with its Third Life project.

This system's focus is on two key objectives:

Real-time Accident Detection: The system detects accidents almost immediately after they occur using advanced gyroscopic sensors, GPS modules, and microcontrollers.

Immediate Live Location Sharing: Once the accident is detected, the system shares the real-time coordinates with emergency services and local police stations, enabling faster response times and more effective rescue operations.

The relevance of this project goes beyond Nepal. The solution is highly relevant for other countries with similar geographical challenges, such as those with mountainous terrain, poor infrastructure, and underdeveloped emergency response systems. The ability to detect accidents in real-time and share accurate location data can have a profound impact on road safety and emergency response efforts in these regions.

2. Literature Review

In this section, we shall review existing research on issues identified with accident response time, emergency alert technologies, and accident detection sensors, forming the base on which the Third Life project was built.

Time Delay in Accident Response Challenges

Different studies from various regions have pointed out considerable times taken in emergency responses across the globe, especially for those countries with challenging geographical characteristics. The WHO and other organizations have identified that delays in response result in increased mortality rates in accidents. Inaccessibility to accident sites, lack of communication networks, and uncertainties about the exact location of accidents contribute to such delays. For example, most emergencies in many rural and remote parts of Nepal are either not informed on time or due to poor mobile connectivity, a lack of GPS infrastructure, or because reporting is usually late.

Research conducted by Jasanoff et al. (2015) on accident response in rural regions of South Asia reveals that over 40% of accidents go unreported in the first 30 minutes, and help often arrives more than an hour late, worsening the severity of injuries or fatalities. Delayed responses are even more detrimental in remote areas where geographical isolation or severe weather can hinder road access, further complicating the rescue efforts.

Real-Time Emergency Alert Technologies:

Over the years, different technologies have been thrown up to address these critical challenges in emergency response. The use of GPS, GSM, and sensor-based systems has proven to be effective in improving the timeliness and accuracy of emergency alerts.

For example, studies on accident vehicle tracking systems prove that the integration of GPS modules in vehicles facilitates real-time tracking of the location of accidents. By embedding GSM technology, such a system can send instant notifications to emergency responders. A similar type of real-time data sharing can reduce response time and increase the rate of survival for victims of road accidents.

For example, studies by Khatri et al. (2016) showed that up to 30% of reduction in the emergency response time was realized when real-time tracking systems integrated with GSM communication networks were used. In countries where roads are badly marked with access points difficult to manage, real-time location provided through GPS makes all the difference.

Accident Detection Sensors:

In modern vehicle safety systems, the use of gyroscopic sensors, accelerometers, and impact sensors is commonplace to detect accidents. These sensors identify sharp deceleration, rollovers, or impacts as indications of an accident.

For instance, a gyroscopic sensor would show the change in orientation-for example, when a vehicle rolls over or overturns-and instantly deploys the airbag. This is very important in mountainous areas where the road is full of sharp turns and elevation changes that could lead to rollovers and collisions. Accelerometers can detect rapid

changes in velocity, helping to trigger the system's alert function at the moment of impact.

Studies on impact sensors have shown their ability to detect even minor crashes, allowing emergency services to be alerted promptly. In addition, sensor-based accident detection is highly accurate, with detection rates exceeding 90% in many systems.

Waterproof Devices for Emergency Situations:

The ability to maintain communication capabilities during extreme conditions is essential, particularly in accident scenarios involving submersion, such as the Trishuli bus accident. In these cases, vehicles that fall into rivers or are trapped by landslides may be difficult to locate, and communication systems may fail if not properly protected.

In that regard, the Third Life system design is waterproof for all its key components. This ensures that even if the device is submerged, the GSM module and GPS sensor will continue to function by sending vital data to emergency services.

Zha et al. (2019) point out that waterproof technologies are an important part of making sure emergency communication systems work under extreme conditions. Such devices are designed to withstand both water submersion and harsh weather conditions, ensuring that the device continues to provide location data and emergency alerts in the aftermath of accidents.

3. Methodology

The Third Life project uses a combination of hardware sensors and software algorithms to detect accidents in real time and share live location data with emergency responders. The following is a detailed description of the methodology used to achieve this:

Device Components:

GSM Module: The GSM module provides the means for communication by sending real-time alerts about the accident. A mobile network is used to send alerts to pre-defined contacts, including emergency services and local police stations. This

ensures that the accident is reported immediately, even in remote areas where other forms of communication may be unavailable.

GPS Module: The GPS module detects the exact location of the accident site. The module receives signals from satellites and pinpoints the location of the vehicle, which it sends to the emergency handlers so that they can locate the site as soon as possible.

Gyroscopic Sensor: It detects sudden movement or orientation, like sharp turns, collisions, or rollovers, through the gyroscopic sensor. The sensor is capable of identifying a vehicle's sudden deceleration or impact; it will trigger the system with immediate action to send the alert to emergency services in no time.

Microcontroller: The microcontroller processes data from sensors and manages the operation of the system. It coordinates the triggering of alerts, the activation of the GPS and GSM modules, and the transmission of data to emergency responders.

System Workflow:

Accident Detection: The system constantly detects the movement of a vehicle with the help of the gyroscopic sensor. This sudden impact or change in orientation, for instance, collision or rollover, sends a signal from the sensor to the microcontroller.

Location Capture: Once the accident is detected, the system activates the GPS module to capture the real-time coordinates of the accident site. This information is vital for emergency services to locate the accident quickly, especially in remote regions where roads are unmarked or poorly signposted.

Alert Transmission: The microcontroller further triggers the GSM module, which sends a real-time alert with the precise coordinates of the accident site to emergency services and the nearest police stations. It makes use of the mobile network for this purpose to provide fast and reliable communication even in places where there is less infrastructure.

Waterproof Design: The system is designed to be waterproof to ensure functionality in extreme conditions, such as being submerged in a river or affected by a landslide. The sensors and communication modules are designed in a waterproof casing for proper functionality in providing key location data in challenging terrain.

【評語】 100057

1. Authors are advised to present the actual product made in this project and the results obtained by this system. In addition to the anticipated responses, the ratio of false alarms is also a very important factor.
2. In comparison to existing commercial products, such as the fall detection feature in Apple Watch Series 4 and subsequent models, the crash detection feature with satellite connectivity in Apple iPhone 14 and subsequent models, what are the advancements of this system?
3. Please highlight the unique needs, specifications, and limitations for the applications in Nepal.