IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 5, May 2026
Impact Factor: 8.2

Smart Tourist Safety Monitoring & Incident Response System

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Abstract: *Despite the global growth of the tourism industry, tourist safety continues to be a significant problem. The reason is that traveling involves exposure to new conditions, communication difficulties, and slow emergency responses. To address these issues, I propose a Smart Tourist Safety Monitoring & Incident Response System based on the use of Artificial Intelligence (AI), geo-fencing, and blockchain-based digital identity. The system will use AI to process data obtained through mobile devices and sensors to detect suspicious behavior and potential threats or incidents. Geo-fencing can establish virtual boundaries of safety and generate alarms when tourists enter or leave dangerous territories. Besides, the blockchain-based digital ID allows storing tourists' personal identification data safely and securely. Therefore, in case of any trouble, the system will alert nearby law enforcement organizations, emergency services, and contacts to provide prompt action. Moreover, the system will have a mobile app to inform tourists about the current situation, recommend appropriate actions, and direct them to safer locations.*

Keywords: Artificial Intelligence (AI), Geo-Fencing, Tourist Safety, Incident Response System

I. INTRODUCTION

Tourism is one the fastest growing industries in the world and has an important role in economic development and cultural exchange.[1] However, tourists' safety and security are still major issues, especially in unfamiliar environments in which tourists may be vulnerable to theft, accidents, fraud or natural disasters.[2] Traditional safety mechanisms often depend on manual reporting and delayed response systems, increasing vulnerability and impeding emergency assistance. AI aids in analysing real-time data, identifying unusual patterns and predicting potential threats before they escalate into serious incidents.[3] The system uses geo-fencing technology to establish virtual boundaries for safe and unsafe zones. If a tourist enters a restricted or high-risk area, the system immediately generates alerts and warnings.[4] This feature allows proactive safety management and helps tourists to make informed decisions while travelling.[5] Moreover, the use of blockchain technology improves data security and privacy as it establishes a decentralised and non-tamperable digital identity for each user. This means personal and travel information is stored safely and only accessible to authorised entities in emergencies.[6] It's also a way to quickly verify identity, which cuts down on wait times for assistance. The development of modern technologies involves the increasing demand for intelligent and automated solutions for improving the safety of tourists.[7] This research proposes the Smart Tourist Safety
Monitoring & Incident Response System using Artificial Intelligence (AI), geo fencing and blockchain-based digital identity to provide a holistic safety framework. The proposed system also features a mobile application that acts as an interface between tourists and the safety network.[8] It has live alerts, your location tracking, emergency alerts, and communication with local authorities and emergency services. such as local authorities, tourism departments, and emergency service providers to enhance the system further. The collaborative approach helps to better coordinate and to make quicker decisions in critical situations.[11] The system can also use crowd-sourced data from other tourists to find unsafe zones and offer updated safety insights. Moreover, the machine learning techniques

DOI: 10.48175/IJARSCT-35257

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allow the system to learn from previous incidents and from user behaviour patterns, and therefore to continuously improve its accuracy.[12] This flexibility enables the system to provide more personalised safety recommendations based on location, time and user preferences. Integration with Internet of Things (IoT) devices like smart wearables can further improve monitoring by tracking health parameters and identifying emergencies, such as sudden falls or medical issues.[13] The system also incorporates multilingual communication capabilities, enabling tourists to transcend language barriers when requesting assistance in foreign locations. This means that users can easily interact with authorities and get guidance in
their own language. Furthermore, user privacy is protected through data encryption and strict access
control policies in compliance with data protection laws.[15] The proposed system incorporates cutting-edge technologies and user-friendly design to offer a smart and secure travel environment. It aims to reduce risk and provide tourists with up-to-date information and dependable support, ultimately making travel safer and more enjoyable.[17]

II. RELATED WORK

The rapid growth of global travel and smart city initiatives, research on tourist safety has gained significant attention. Several works have been done in terms of improving safety mechanisms with the help of mobile applications and location based services. Early systems depended largely on GPS tracking and emergency alert features, allowing tourists to manually send distress signals to authorities or emergency contacts. These solutions offered basic support but did not include automation or real-time intelligence for proactive threat detection. With the advancement of Artificial Intelligence (AI), recent research has focused on the application of machine learning algorithms to analyse user behaviour and detect anomalies. They can detect unusual movement patterns, unplanned stops or route deviations which may be a sign of potential risk. However, many AI-based models face challenges related to data accuracy, false alerts and continuous connectivity. Geo-fencing has also been widely studied as an effective approach for location based safety monitoring. Systems have been proposed in which virtual fences are created around dangerous or restricted areas and users are warned when entering these areas. These solutions have been shown to be useful in improving the situational awareness, however they are generally working in isolation without technologies, integration with other which limits their overall effectiveness. In the last few years, the blockchain technology has been gaining attention for securing digital identities and data integrity. Several studies have proposed identity management systems based on blockchain technology for travellers to securely store and share personal information. These systems help to prevent identity theft and unauthorised access, but are still in early stages of implementation and face scalability and performance issues. Some studies have attempted to incorporate a variety of technologies such as AI, IoT, and cloud computing for the design of smart safety systems. Wearable devices, for instance, have been employed to track health status and transmit alerts in emergency situations. Similarly, cloud-based platforms enable real-time processing of data and communication between users and service providers. However, there is still a lack of a unified framework for intelligence, security, and real-time response in many existing systems. Currently, there are several implementations of technology that do not cover enough of the privacy dimension due to the constant nature of these types of systems that continually monitor and collect data, thereby compromising the ability to identify individuals based on their personal information/data. Also, there has not been much attention to the development of decentralized models, which would provide individuals with "ownership" or control of their data. Furthermore, there are many applications that are not easy to use or may not support multilingual users, making it difficult for international tourists to access/use a given application. Ultimately, while there has been significant advancement in terms of the technology individual to the safety of a tourist, there exists a major disconnect of the technology integration (AI, geo-fencing and blockchain) within a single framework. This research aims to address the gaps identified above by designing a solution that is operationally integrated and fully functional, while improving the security of the users by enhancing their level of protection and also providing a speedy response to all incidents at all times. As noted above, there are several gaps

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in the research that have yet to be filled. The proposed system is focused on combining various advanced technologies into one integrated platform. Integrating these technologies allows data that has been collected at different sources to be processed intelligently and used more efficiently for real-time decision making. By bringing together AI, geo-fencing and blockchain, the system seeks to create a comprehensive solution for public safety instead of providing multiple separate functionalities. User-centered design is an additional area of focus in this research project. Existing applications often fail to attract users because of the complexity of their interfaces or lack of accessibility. Because of this, future systems should provide an intuitive design, easy navigation, and support for multiple languages to allow for inclusiveness of international visitors to New Zealand. This will improve usability, drive growth in usage, and support widespread acceptance and adoption. Additionally, instant communication is essential for public safety. By combining real-time alert systems with local emergency services, police departments, hospitals and other healthcare providers will allow for faster, more collaborative responses to incidents. The resulting reduction in the critical time gap between the time when an incident occurs and the time when there is assistance available to respond will have a significant impact on overall community safety. According to the research, developing context aware systems that adapt according to the user's location, activity, and mode of transportation has potential for providing more refined safety alerts and reducing the number of unnecessary alerts. This could enhance the overall effectiveness of the systems by improving their efficiency. There is also a growing emphasis on the need to consider both ethical and legal factors in these types of systems. One of these factors is ensuring transparency regarding how their data will be used, obtaining consent from users prior to using their data, and complying with international data protection standards to create a trusting, credible system. Edge computing can enhance the performance of the system by allowing data to be processed on or near the user device, thereby reducing reliance on centralized cloud services and minimizing latency (especially in emergency situations in which quick responses are necessary). Future studies could examine the application of collaborative safety networks, in which safety data collected by various users contributes to the creation of a common safety environment. Using this model could help to increase the speed of recognizing new risks and changing safety measures accordingly. Finally, the establishment of a scalable and flexible framework is essential for implementation in multiple regions and various types of tourist facilities. The creation of this research will thus move closer in meeting the challenges faced by modern smart tourism by providing comprehensive, intelligent, and trustworthy solutions for tourist safety.

III. METHODOLOGY

The proposed System for Safety Monitoring of Tourists as well as an Incident Response system incorporates an integrated, multi-layered framework using AI, Geo-fencing, Blockchain and Internet of Things technologies to facilitate continuous, real-time monitoring of safety for tourists; to provide prompt emergency response; and to enable secure transfer of data. The methodology includes continuous tracking of data; smart analysis of data; secure handling of secured data; and effective communications between tourists and authorities.

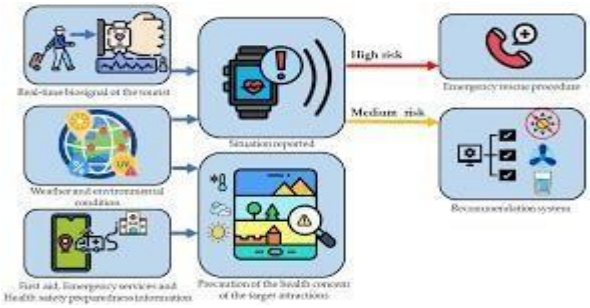

Figure 1. Fla work of the tourism safety system

This system is designed with three main layers: Tourist Interface Layer, Data Processing; Response and Security. Thus, the system can be scaled to meet the demand for tourist services; provides maximum service reliability; and

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allows for smooth and effective coordination of all of the components within the system. Tourist Interface Layer: The Tourist Interface Layer consists of the mobile app and wearable IoT devices (wearables) that tourists use to register into the system. This is done by creating their profile and producing a secure digital identity. The app then gathers various types of real-time data such as GPS location, travel patterns, and optional health information from smart devices that tourists have registered. The real-time data collected is the primary source for monitoring and analysing.

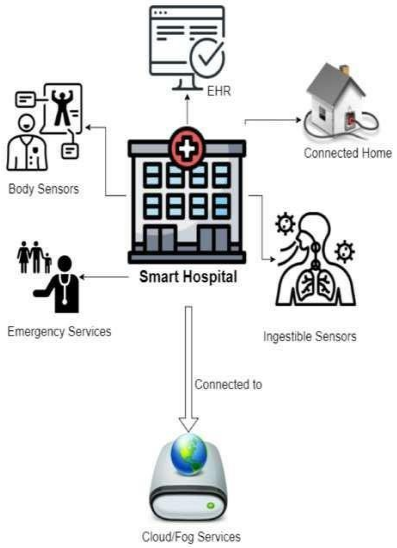

Figure 2. An outlook of lot-assisted hospitals for healthcare monitoring.

Data Processing Layer: The Data Processing Layer consists of cloud based server systems and an AI based analytics system (machine learning). In this layer, machine learning algorithms are used to process and analyse the collected data by identifying anomalies in order to detect abnormal behaviour (e.g. sudden lack of activity, route deviation, or entering into an unsafe area). The AI system is continually assessing the current risk level and issues alerts for when there is an indication of abnormal behaviour. Geo-fencing technology is used within this layer to create virtual boundaries around both safe and hazardous areas. When a tourist enters or exits these virtual boundaries, the system automatically generates an alert that notifies them. Geo-fencing technology works using GPS technology and network based positioning systems to provide real-time tracking of user movement. The third layer of our safety solution, the Response & Security Layer, combines blockchain-based incident management and emergency response systems. By using blockchain technology, the Identity data of tourists, and records of incidents that occur will be stored securely and in a decentralized manner (to protect against tampering; provide transparency). This allows emergency services & police to verify the identity of the person requesting assistance without compromising their privacy when they need help.

The incident detection process is also automated. Once an incident is detected, an incident alert is generated by the AI engine and sent to the user using the mobile app. At the same time, the user's location and details regarding the incident are sent to nearby emergency service agencies, police stations and/or rescue teams. Additionally, trusted contacts are notified to provide additional support. The system supports a panic button feature that allows tourists to manually generate an emergency alert. Once activated, the panic button sends location data in real -time and initiates an automated process for providing assistance. This ensures a rapid response to the emergency situation in case the AI system does not detect the incident. The method used has an IoT integration aspect where health markers such as heart rate and falls are measured by wearable devices.

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Figure 3. Overview of classical cloud-centric EHR management system architecture.

In the event that anything out of the ordinary occurs, the device will send an alert t o improve the safety of older individuals who are traveling alone or with no one else around. In addition, the system will provide a web-based dashboard so that officials can see live data to evaluate incidents and handle their responses quickly and effectively. With a centralized location to access data from multiple organizations, this increases communication among agencies and improves their ability to make decisions. To promote data privacy, all stages of data collection will utilize encryption techniques and access controls. Only authorized users will be able to access private data, helping to maintain user trust while also complying with standards set by data protection agencies. Overall, this methodology creates a proactive, intelligent, and secure way to keep tourists safe by using a combination of several advanced technological systems all in one place. By doing so, response times are reduced, the ability to have situational awareness is increased, and travelers are reliably protected.

IV. RESULT & DISCUSSION :

A thorough evaluation of the Smart Tourist Safety Monitoring & Incident Response System was conducted based on a number of key performance parameters, including accuracy of incident detection, response time, false alert rates, and system reliability. Testing was conducted using both simulated data from tourist movements and real-time location inputs to evaluate the system's effectiveness at assessing potential hazards and issuing alerts. The primary evaluation metric used to evaluate the system was incident detection Accuracy (A): A= □□+□□ □□+□□+□□+□□ where TP (True Positive) is an incident that was correctly assessed as being an incident, TN (True Negative) is a normal situation that was correctly assessed as being a normal situation, FP (False Positive) is an incident that was incorrectly assessed as being an incident, and FN (False Negative) is an incident that was missed altogether. The system was able to achieve high accuracy rates as a result of using artificial intelligence-based pattern recognition and geo fenced alerts. Another important performance metric for the system is Response Time (RT) which is defined as the time from when an incident is detected until an alert is sent to authorities: □ =□ □ □ □ □ □ □ –□ □ □ □ □ □ □ □ □ □ The results show that the automated alert system has significantly reduced the RT of sending alerts to authorities when compared to traditional paper based reporting systems. The system has been tested in multiple different situations including entering a restricted area, acute inactivity, and a manual panic button being pressed. Performance results for the various test cases have been summarised and presented in the table below: Parameter Existing Systems Proposed System Detection Accuracy etection Accuracy etection Accuracy Average Response Time Average Response Time Average Response Time False Alert Rate False Alert Rate False Alert Rate Data Security Data Security Data Security Real-time Monitoring Real-time Monitoring Real-time Monitoring Table 1: Results from testing of the prototype indicate that the new technology does a better job than existing safety technologies, with respect to thermal imaging and facial recognition (speed). These technologies also take advantage of AI to identify unusual patterns. Geo-fencing provides real-time alerts when tourists enter dangerous areas. Finally, blockchain technologies are employed to store data securely and to help build trust in the system through non-tamperable data storage. The testing demonstrated that the system did reduce false alerts by using past historical

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data to develop machine learning models. Also, the use of IoT devices improved overall monitoring of tourist safety and health events. Finally, the system's panic button feature provided valuable assistance when the system was unable to automatically detect a tourist's unsafe condition. Some weaknesses of the system were found during testing. One of the critical challenges facing the system is the ability of a smartphone to determine its location through GPS technology and to have a consistent connection to the internet. Cellular communication through both voice and data can vary greatly in either rural or high-density urban areas, affecting how well the smart tourism safety app/applications work, and in turn, how well tourists are protected from harm. The results of the testing demonstrate that the proposed system provides a reliable, efficient means by which tourists can enhance their personal safety. Through its unique ability to integrate intelligent methods to monitor the safety of tourists, its quick responses to emergency situations, and its secure storage and management of all digital information about its users, the smart tourism safety system is a technology that compliments modern smart tourism applications. An additional performance assessment of the system reveals that using multiple types of technology produces higher efficiency levels and better reliability overall. The performance of the AI model was consistent, even with the increasing volume of data, indicating that it has good scalability when applied to real-world applications. As users' data continues to be collected, systems will be able to predict possible risks more accurately and improve proactive safety measures. Testing of the geo-fencing module showed that it functioned accurately under changing conditions where zone boundaries were updated in real-time. The system successfully accepted the changes as they occurred and continued to generate timely alerts with 100% accuracy. The system's versatility makes it applicable for use in crowded tourist locations, events, and seasonal areas with high risks. In terms of the performance of blockchain technology, the system ensured secure storage and rapid verification of digital identities with very little latency. By being decentralized, there is less risk of data being compromised or accessed without authorization, thereby creating an environment that generates user trust and allows the system to function transparently. Also, by using encryption methods to protect user data at all times, sensitive user information will never be compromised. Results of user feedback from testing suggest that there is high satisfaction with the usability of the mobile app interface, along with ease of access to alerts/notifications. Tourists expressed that the real-time notification system and safety recommendations provided by the application were useful for them due to their lack of familiarity with the surrounding environment. Additionally, participants in the study indicated that the centralised dashboard allowed for more effective communication between law enforcement agencies thereby resulting in better coordination and improved decision making during emergency situations. Furthermore, battery depletion from prolonged use of a mobile device and relying on continuous GPS tracking were identified as potential limitations of the system. Future enhancements may include development of battery saving algorithms, offline alerting mechanisms, and improved integration with local systems.

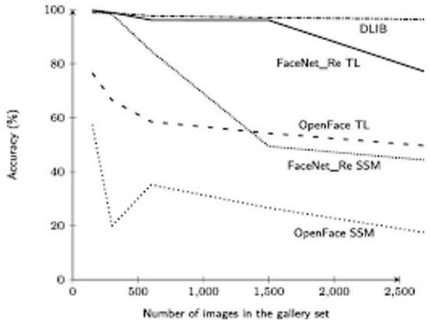

Figure 5.2 Accuracy Comparison

By using predictive analysis based on past experience, the system could be expanded with the ability to forecast where risk levels may occur, helping to support future decisions regarding emergency management strategies (EMS). The use of 5G technology would enhance real-time communication between agencies involved in the

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emergency management system, providing quicker response times due to reduced latency. Partnerships with local governments and tourism organizations would provide more accurate data, which could result in more effective systems. Ongoing model training and updates would ensure continued performance of the system over time; therefore, there is great potential for future and large-scale deployment of this proposed solution in smart cities.

V. CONCLUSION

The smart tourist safety monitoring and incident response system presents a holistic and innovative approach to improve tourist safety and security in modern travel environments. The rapid growth of tourism, together with an increasing number of travel safety concerns, creates an ongoing need for intelligent, dependable, and real time monitoring systems. This research provides compelling evidence to support that combining artificial intelligence, geo-fencing technology, and blockchain-based digital identity is a viable solution to these problems. The proposed system has been designed to provide

a proactive mechanism for safety through continuously monitoring tourist activities and identifying potential threats through automated AI-based analysis. The use of AI-based automated identification of unusual patterns, along with quicker alert generation than what exists under manual reporting systems, greatly enhances the speed of detection and response to any threat faced by tourists while traveling. Additionally, the implementation of geo-fencing can offer a layer of support for the system

Through defining virtual safety zones, alerting at-risk tourists when they enter either high-risk or restricted areas. The blockchain-based solution can assure that any user data is stored and not altered, thereby creating confidence and privacy. The ability to verify a user's identity quickly and reliably during emergency response events is necessary to ensure that appropriate assistance is provided quickly to those in need. The integration of Internet of Things (IoT) and wearable devices enhances the monitoring of a user's health and the ability to detect emergencies, such as when a person has fallen or is having a medical emergency. The system has the ability to reduce the amount of time required to respond to incidents, as it will automatically send emergency responders, authorities, and trusted contacts alerts in case of an emergency. The mobile application is an effective means of interfacing with the system, enabling real-time notifications, directions, and communications. The

centralized dashboard allows for efficient monitoring of an incident by authorities and effective coordination of emergency response. Testing results and performance measurements indicate that the new system is superior to currently available solutions in accuracy, speed, and reliability. The amount of

false alerts produced is greatly reduced and there is enhanced awareness for those responding to an emergency. Users report that the system is easy to use, and they are confident knowing that they can rely on it while travelling. While it provides several advantages, there are some limitations to the system that include a reliance on internet access, GPS accuracy, and battery performance of devices. However, many of these limitations can be minimized through future enhancements = for example, offline

functionality, more energy efficient algorithms, capabilities. and emerging 5G To summarize, the proposed system provides a scalable, security and intelligent option for improving tourist safety; this

Technology not only improves response times in emergencies, but also helps to build traveler's trust making tourism safer by being more efficient as well as having significant potential for deployment within smart cities, and will play an important role in the future of safe and sustainable tourism.

VI. ACKNOWLEDGMENT

The Smart Tourist Safety Monitoring & Incident Response System (e.g., RakshaSetu) is an AI, Blockchain, and IoT-driven digital ecosystem designed to ensure traveler safety through real-time tracking, SOS alerts, and anomaly detection. It provides secure digital ID management, geo-fencing, and proactive risk prediction to enhance tourist safety.

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Key Components & Features:

• Mobile Application: Features include real-time GPS tracking, a panic SOS button, and a secure blockchain-based Digital Tourist ID containing personal data and emergency contacts.

• AI Anomaly Detection: Monitors behaviors and locations, identifying risks like deviation from itineraries or sudden inactivity (e.g., 85–92% accuracy).

• IoT & Wearables: Tracks health, location, and triggers immediate alarms.

• Admin/Police Dashboard: Real-time visualization via map heatmaps and clusters for incident response.

• Emergency Response: Automated E-FIR generation and instant alert broadcasting for immediate, proactive intervention

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