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SafeMate: A Comprehensive Review and Emergency Response System for Enhanced Personal Safety

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Abstract—This project introduces a safety application designed to enhance real-time emergency response. Uti-lizing Android APIs and WebRTC/WebSocket technolo-gies, the app detects SOS signals via predefined power button taps, automatically activating the camera and microphone. The live video and audio data are streamed in real-time to a control room, ensuring situational awareness. Additionally, GPS tracking provides precise location updates for quick intervention.

Current safety applications often lack real-time re-sponsiveness, automated distress detection, or seamless integration of live data and GPS tracking, limiting their effectiveness. This project addresses these gaps by combining SOS detection, live streaming, and GPS tracking into a single, responsive system. By instantly transmitting live information, the app enhances surveil-lance, supports rapid decision-making, and improves the chances of timely assistance, offering a comprehensive security solution for urban environments.

Keywords- Real-time Emergency Response, SOS detec-tion, Live Streaming, GPS Tracking, Safety Applications.

I. INTRODUCTION

Personal safety and security, especially for women and vulnerable individuals, remains a growing global concern. Traditional safety measures often fail due to delayed response times, limited accessibility, and un-derreporting of incidents. To address these challenges, emerging technologies such as Artificial Intelligence (AI), Machine Learning (ML), the Internet of Things (IoT), and wearable devices provide real-time detec-tion, prevention, and intervention solutions. This re-view explores AI- and IoT-driven innovations in safety across multiple areas. AI-powered live event detection utilizes natural language processing (NLP) and deep learning to identify distress signals and trigger in-stant alerts. Smart navigation systems like SafeRoutes and SPaFE analyze crime data, clustering patterns, and crowdsourced information to suggest safer routes, while the LAW-U chatbot offers legal guidance to survivors using NLP-based case analysis. Wearable safety devices, such as Bindi, use biometric monitoring to detect distress, and IoT-enabled smart home systems help prevent domestic violence. Additionally, machine learning models assess crime patterns, socioeconomic conditions, and law enforcement efficiency to iden-tify high-risk areas. Comprehensive safety frameworks integrating GIS mapping, mobile applications, and community participation enhance crime prevention and emergency response efforts. This review evaluates the effectiveness, challenges, and future potential of AI-driven safety systems. While these innovations im-prove crime prevention and victim protection, they also present concerns regarding data privacy, ethical con-siderations, and system reliability. Overcoming these challenges requires continuous technological advance-ments and regulatory frameworks to ensure ethical, efficient, and scalable deployment. Future research should focus on enhancing AI accuracy, minimizing biases, and seamlessly integrating safety technologies into existing law enforcement and emergency response systems.

II. LITERATURE SURVEY

A. Live Event Detection for People's Safety Using NLP and Deep Learning [1]

This study introduces an AI-powered real-time threat detection system designed to protect individuals in isolated or high-risk environments. The system leverages Natural Language Processing (NLP) and Deep Learning models, including Convolutional Neu-ral Networks (CNNs) and Long Short-Term Memory (LSTM) networks, to analyze ambient sounds and identify potential threats such as screams, gunshots, or distress signals. Trained on a dataset of over 9,000 audio clips spanning 13 categories, the model achieves an accuracy of 96.6%. Upon detecting a threat, it auto-matically notifies emergency contacts via SMS, email, and WhatsApp, providing essential details along with a short audio recording for context. By eliminating the need for additional hardware, this solution offers a cost-effective and scalable approach to improving public safety.

B. SafeRoutes: Charting a Secure Path for Women's Safety Using GPS and Clustering. [2]

SafeRoutes introduces a holistic data-driven frame-work that integrates machine learning-based clustering algorithms with GPS technology to enhance women's safety in urban areas. By leveraging crime statistics, police presence, and infrastructure data, the system classifies different regions based on their relative safety levels. Using Gaussian Mixture Models and K-Means Clustering, the research builds a safety heatmap that continuously updates based on real-time data ingestion from public and government sources. The platform integrates with map APIs and ride-sharing services, ensuring that users are guided along the safest possible routes. It also features real-time safety alerts, notifying users and authorities about potential dangers. The study demonstrates how data analytics and AI can be effectively applied to urban planning and law enforce-ment, providing an innovative approach to proactive crime prevention.

C. SPaFE: A Crowdsourcing and Multimodal Recom-mender System for Travel Safety. [3]

The Safe Path for Everyone (SPaFE) system en-hances commuter safety by integrating historical safety data with real-time crowdsourced reports. Unlike con-ventional navigation tools like Google Maps, which prioritize speed and distance, SPaFE focuses on se-curity by incorporating factors such as crime rates, accident reports, lighting conditions, and pedestrian feedback. The system follows a two-step algorithmic approach: first, the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) ranks routes based on historical safety data. Then, Ant Colony Optimization (ACO) dynamically adjusts route recom-mendations in response to live crowdsourced reports. This research highlights how machine learning and real-time data aggregation can power an adaptive, personalized safety navigation tool, enabling SPaFE to continuously update its safety recommendations and respond to emerging threats and conditions.

D. Technological Innovations for Tackling Domestic Violence. [4]

This review examines recent technological advance-ments in combating domestic violence and intimate partner abuse, focusing on eight key interventions. AI-powered Natural Language Processing (NLP) fa-cilitates social media monitoring to detect distress signals from victims. Wearable technology, such as smart bracelets and panic buttons, provides discreet emergency alerts. IoT-based ambient sensing leverages smart home devices for audio and motion detection to identify signs of violence. Smartphone-based solutions incorporate hidden contacts, AI chatbots, and loca-tion tracking, while AI-driven virtual reality therapy supports trauma recovery for survivors. Additionally, the study explores privacy concerns, legal challenges, and ethical considerations, offering recommendations for future research. While these technologies serve as powerful intervention tools, ensuring data security and mitigating the risk of digital surveillance by abusers is essential to maintaining their safety and effectiveness.

E. LAW-U: Legal Guidance Through Artificial In-telligence Chatbot for Sexual Violence Victims and Survivors. [5]

Sexual violence remains a serious issue, often in-tensified by stigma and barriers to justice. LAW-U, an AI-driven chatbot, is designed to support survivors in Thailand by providing legal guidance and recom-mending relevant Supreme Court decisions. Utilizing Natural Language Processing (NLP), it analyzes user queries and matches them with 182 sexual offense cases under the Thai Criminal Code, achieving 88.89% precision through similarity scores and keyword tech-niques. Trained with expert-curated dialogues, LAW-U ensures accurate and relevant legal assistance. Ac-cessible via the LINE app, it offers free and confi-dential support, making legal guidance more available to those who may feel intimidated by the traditional legal system. By bridging this gap, LAW-U empowers survivors with essential legal knowledge, helping them navigate complex legal processes and seek justice more effectively.

F. Bindi Affective Internet of Things to Combat Gender-Based Violence. [6]

Gender-based violence (GBV) is a critical global issue, with many individuals, particularly women,

experiencing various forms of violence. Traditional safety measures like panic buttons require manual activation, which may not be feasible in high-risk situations. Bindi is an AI-powered wearable system designed to autonomously detect distress and potential GBV using physiological and auditory data. It consists of a bracelet and pendant that monitor heart rate, skin conductance, temperature, and voice signals, processed in real-time through edge-fog-cloud computing. By detecting fear-related emotions, Bindi can trigger an alert to emergency services without user intervention, reducing response times and minimizing the risk of revictimization. Unlike traditional devices, Bindi's dis-creet and continuous monitoring offers a proactive solution to combat GBV, marking an important step forward in personal security technology.

G. The Role of IoT in Women's Safety: A systematic review of the literature. [7]

This paper reviews the role of Internet of Things (IoT)-based devices in enhancing women's safety, fo-cusing on the integration of sensors, wearable tech-nologies, and machine learning algorithms to detect and prevent threats. It categorizes IoT-based safety solutions based on technologies such as GPS tracking, GSM-based communication, and Raspberry Pi integra-tion, evaluating their effectiveness in improving safety response.Key machine learning algorithms, including logistic regression, decision trees, and hidden Markov models, are discussed for their ability to analyze sensor data and identify potential threats automatically. The paper identifies gaps in current systems, such as the lack of automatic alert activation and the need for better accuracy in threat detection.To address these challenges, a novel IoT-based safety solution is pro-posed, combining multi-sensor fusion with AI-driven predictive analysis. This model enhances real-time threat detection and response, offering a more effec-tive, autonomous system to improve women's security.

H. A Systematic Review of Computer Science Solu-tions for Addressing Violence Against Women and Children. [8]

This paper reviews computer science solutions for detecting and preventing violence against women and children, categorizing them into four main areas: on-line detection, offline detection, safety mechanisms, and educational tools. It explores technologies such as AI, IoT, machine learning, and cloud computing in identifying abusive behavior, with a focus on AI-powered natural language processing (NLP) and image recognition for detecting cyberbullying, child groom-ing, and online harassment. Additionally, it examines safety mechanisms, including wearable devices, mo-bile apps, and emergency alert systems that provide real-time protection and notify authorities or trusted contacts in distress situations. The paper also discusses key challenges such as data privacy, biases in AI models, and the need for real-time threat assessment. It concludes by proposing future research directions to enhance AI fairness, strengthen data security, and de-velop adaptive real-time solutions for better protecting vulnerable individuals.

I. A Hybrid Machine Learning and Regression Ap-proach for Validating a Multi-Dimensional Crime In-dex in the Context of Crime Against Women. [9]

This study presents a multi-dimensional crime index to assess and predict crimes against women, incorpo-rating factors such as socioeconomic conditions, ju-dicial effectiveness, healthcare access, and education. Using multiple regression techniques and machine learning models like random forest and stochastic gradient descent (SGD), the index ensures high predic-tive accuracy. The research identifies key risk factors, including low literacy rates, high unemployment, weak law enforcement, and societal norms, which contribute to gender-based violence. The proposed hybrid en-semble model outperforms traditional crime prediction methods, offering more precise forecasts. Findings re-veal strong correlations between crime rates, economic conditions, law enforcement efficiency, and healthcare access. Emphasizing the role of predictive analytics in law enforcement strategies, the study provides pol-icy recommendations aimed at improving education, strengthening legal enforcement, and enhancing social support systems to reduce gender-based violence.

J. A Holistic Framework for Crime Prevention, Re-sponse, and Analysis With Emphasis on Women Safety Using Technology and Societal Participation. [10]

This paper proposes a comprehensive framework to enhance women's safety by integrating crime preven-tion, real-time response, and crime pattern analysis. Utilizing Geographic Information Systems (GIS), the system identifies crime hotspots based on historical data, social factors, and law enforcement reports. It features a wearable emergency alert device and a mobile app that enable women to signal distress in real time, ensuring immediate assistance. Unlike tra-ditional approaches, this framework prioritizes com-munity participation by alerting nearby volunteers and law enforcement for a coordinated response. A web-based crime analytics dashboard provides real-time monitoring, predictive crime mapping, and improved law enforcement coordination. Demonstrated in Pilani, Rajasthan, India, the system is scalable for smart city implementations worldwide. By incorporating real-time data sharing between users, volunteers, and au-thorities, the framework enhances collaboration and accelerates response times, emphasizing the need for technology-driven, community-supported safety solu-tions for women.

Reference	Description	Advantages	Disadvantages
[1]	Uses AI-driven sound classification to detect threats like screams, gunshots, and distress signals, triggering real-time emergency alerts via SMS, email, and WhatsApp.	• High accuracy in real-world threat detection • Does not require additional hardware. Instant alert system enhances emergency response times	• False positives in noisy environments (e.g., concerts, crowded areas) • False positives in noisy environments (e.g., concerts, crowded areas) Limited ability to distinguish between real threats and non-threatening loud noise.
[2]	AI-based navigation system that analyzes crime data, infrastructure quality, and police presence to recommend safer travel routes.	• Improves travel safety with AI-driven recommendations. • Real-time updates enhance reliability law enforcement and urban planning	• Dependent on the availability of crime data. • Might not be accurate in locations with limited law enforcement reports. Potential biases in clustering models affecting risk assessmen.
[3]	Combines historical crime reports and real-time crowdsourced user data to suggest secure commuting paths based on dynamic risk factors.	• Adapts to live conditions, making recommendations more relevant. • Uses community-driven insights for increased accuracy. Accounts for pedestrian feedback and localized safety concerns.	• Heavily reliant on user participation for crowdsourced data. • Potential for misinformation or bias in user-submitted reports.Data quality may vary, affecting prediction accuracy.
[4]	Explores AI, IoT, and virtual reality (VR) solutions for domestic violence detection, prevention, and victim recovery.	• Covers multiple safety and recovery approaches. • Integrates AI with IoT for automated threat detection. Helps survivors with therapy and legal guidance.	• Privacy concerns regarding IoT and surveillance tools. • Risk of misuse by abusers for controlling victims. High cost of VR-based recovery solutions.
[5]	LAW-U is an AI-powered chatbot designed to provide legal guidance to survivors of sexual violence in Thailand. Using Natural Language Processing (NLP), it analyzes user queries and recommends relevant Supreme Court cases, making legal information more accessible. Integrated with the LINE messaging app, it ensures confidentiality and ease of use, empowering survivors with legal knowledge.	• Provides free and confidential legal guidance. • High accuracy (88.89 percentage) in case-matching for legal advice. Accessible via the LINE app, making it easy to use.	• Automatically detects distress without requiring manual activation. • Uses multimodal data (heart rate, voice, skin conductance) for improved accuracy. Can trigger emergency alerts, enhancing user safety.
[6]	Bindi is a smart wearable system that detects and responds to gender-based violence using AI and physiological sensors. The device autonomously recognizes fear-related emotions based on heart rate, skin conductance, and voice analysis. If a threat is detected, it automatically triggers an alert, enhancing user safety without requiring manual activation.	• Limited to Thai legal system and cannot be used internationally. • Does not offer emergency response, only legal guidance. Cannot replace human legal professionals for complex cases.	• Requires users to wear the device consistently for effectiveness. • Fear detection accuracy is only 63.61 percentage, which may lead to false alerts. Potential privacy concerns due to continuous monitoring of physiological data.
[7]	This paper explores IoT-based safety devices for women, focusing on sensors, wearables, and machine learning algorithms. It highlights the importance of auto-activation alert systems and improving threat detection accuracy. Additionally, it proposes an architectural model for developing more effective IoT-based safety solutions.	• Reviews IoT-based devices for women's safety,analyzing sensors, wearables and ML algorithms	• Focuses only on IoT-based devices, lacks discussion on boraders societal aspects.
[8]	This paper explores computer science-driven approaches for detecting and preventing violence against women and children. It categorizes solutions into online detection, offline detection, safety, and education, emphasizing artificial intelligence, IoT, and digital gaming technologies.	• Comprehensive classification of technological solutions; highlights Al applications.	• Primarily theoretical, lacks in-depth evaluation of implementation challenges.
[9]	This study presents a crime index based on social factors like health, education, and judiciary effectiveness. Validated through hybrid machine learning and regression techniques, it identifies key social determinants of crimes against women. The findings suggest that improving socio-economic conditions can help reduce gender-based violence.	• Identifies key social indicators influencing crimes against women; offers predictive insights.	• Does not propose direct interventions, focuses more on statistical analysis.
[10]	This paper proposes a comprehensive system integrating crime analysis, prevention, and emergency response using Geographic Information Systems (GIS) and community participation.	• Combines crime prediction, prevention, and response; scalable for smart cities.	• Requires significant infrastructure and public participation for effectiveness.

TABLE I
COMPARISON TABLE

III. Conclusion

The rapid advancements in AI, IoT, and data-driven technologies have significantly transformed the landscape of personal safety and crime prevention. The reviewed studies highlight various innovative ap-proaches, ranging from real-time threat detection and legal assistance to predictive crime mapping and smart wearable security solutions. These technologies have demonstrated significant potential in reducing response times, improving navigation safety, assisting victims, and proactively preventing crime. By integrating real-time data and predictive analytics, these solutions offer more timely and efficient responses to emerg-ing threats, enhancing both individual and community safety.

AI-powered systems such as Live Event Detection, SafeRoutes, and SPaFE showcase how real-time ana-lytics, machine learning, and crowdsourced data can help individuals avoid dangerous situations, navigate more safely, and respond to threats effectively. Simi-larly, LAW-U and Bindi highlight the transformative impact of AI-driven legal and physical safety assis-tance, providing survivors with crucial support, from legal guidance to distress detection. Additionally, IoT-based monitoring systems and predictive crime analyt-ics play a vital role in reinforcing law enforcement and policymaking efforts, enabling smarter urban planning and safer communities. These innovations demonstrate the increasing synergy between technology and safety, helping to design proactive security systems that an-ticipate and mitigate risks before they escalate.

IV. Future Scope

To maximize the impact of AI and IoT-based safety solutions, future research should focus on enhancing AI model precision through more diverse training datasets, improving data privacy with secure encryp-tion and user-controlled measures, and increasing pub-lic awareness to ensure communities feel empowered rather than surveilled. Additionally, integrating AI with law enforcement and policy through cross-sector col-laborations, including predictive crime analytics and smart city initiatives, is essential.

In conclusion, AI, IoT, and machine learning are re-shaping safety technologies, offering automated, data-driven solutions to prevent crime, support victims, and enhance law enforcement. Addressing challenges and ensuring ethical deployment will be crucial in creating safer societies. Ongoing research and collaboration between AI developers, governments, and advocacy groups are key to building more accessible and in-clusive security systems.

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