



EmpowHER: A Comprehensive AI-driven Platform for Women's Safety and Mental Well-Being

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Abstract Women's safety and mental well-being remain critical global concerns, necessitating the development of innovative technological solutions that provide real-time protection and emotional support. This research presents EmpowHER, a comprehensive, AI-driven platform that enhances women's safety and psychological resilience through advanced machine-learning models and user-centric features. The platform integrates real-time safety mechanisms, including location tracking, immediate alerts, and an AI-powered Threat Detection Model leveraging Long Short-Term Memory (LSTM) networks to predict and identify potential threats. Additionally, a Gender Classification Model utilizing Convolutional Neural Networks (CNNs) enables the detection of male presence in isolated environments, triggering precautionary alerts to enhance situational awareness. Beyond physical safety, EmpowHER incorporates an AI-driven Voice Conversational Therapist, providing personalized therapeutic interactions through natural language processing (NLP), API-based assistance, and Large Language Models (LLM). This module offers guided self-care routines, trauma recovery strategies, and mental well-being assessments tailored to individual users. The platform is implemented as a full-stack web application using the MERN (MongoDB, Express.js, React.js, and Node.js) stack, ensuring seamless user experience and accessibility. By combining real-time safety interventions with AI-powered mental health support, EmpowHER presents a holistic solution that empowers women with confidence, security, and well-being. This research contributes to the growing field of AI-driven personal safety and mental health technologies, addressing modern societal challenges with a scalable and intelligent approach.

Keywords: Women's Safety, AI, Threat Detection, Gender Classification, Mental Health, Conversational AI, LSTM, CNN, MERN Stack, NLP, LLM

1. INTRODUCTION

In an era of rapid technological advancements, personal safety and mental health remain critical concerns for women worldwide. Despite significant societal progress, women continue to face safety challenges, ranging from harassment to physical violence, which often result in psychological trauma and emotional distress. According to global reports, one in three women experiences some form of violence in her lifetime, underscoring the urgent need for innovative solutions that ensure safety and emotional well-being. Additionally, mental health issues such as anxiety, depression, and post-traumatic stress disorder are prevalent among women affected by safety-related incidents, further emphasizing the necessity for integrated support systems. Traditional safety mechanisms, such as emergency helplines and safety apps, primarily focus on reactive measures, providing assistance only after an incident has occurred. These solutions, although valuable, often fail to address the psychological aftermath or offer proactive threat detection. Simultaneously, existing mental health platforms are predominantly text-based, lacking the empathetic engagement needed to provide meaningful emotional support. This gap highlights the need for a comprehensive approach that seamlessly integrates real-time safety measures with proactive mental health care. Medical diagnosis is inherently complex, involving the integration of diverse information types. Patients present symptoms verbally or in written form, but these descriptions often lack specificity or may be ambiguous. Clinical images such as X-rays, MRIs, or CT scans provide crucial anatomical and pathological information, while laboratory results offer quantitative biochemical data. Traditional diagnostic workflows rely heavily on physicians' expertise to synthesize these heterogeneous data sources into a coherent clinical picture. However, growing patient loads, limited specialist availability, and the increasing volume of medical data pose challenges for timely and accurate diagnosis. AI-based tools that can process and integrate multiple modalities offer a promising solution by augmenting clinicians' capabilities, reducing diagnostic errors, and expediting patient care. Current AI diagnostic systems primarily focus on single modalities. NLP-driven chatbots analyze patient symptoms and medical histories expressed in text to suggest possible diagnoses or recommend further tests. For instance, symptom checkers like Babylon Health employ rule-based or machine learning models to interact



conversationally with patients. Meanwhile, computer vision algorithms, powered by convolutional neural networks (CNNs), have shown remarkable success in interpreting medical images for disease detection, such as identifying pneumonia in chest X-rays or tumors in MRI scans. However, these unimodal approaches have limitations. Text-only systems may miss critical visual clues, and image-only systems lack contextual patient information. Consequently, diagnostic accuracy and reliability can suffer. Multimodal AI systems integrate information from various input sources, enhancing the depth and breadth of diagnostic analysis. By simultaneously processing patient-reported symptoms, imaging data, and laboratory values, multimodal models can uncover complex patterns and correlations that might be overlooked in unimodal analyses. For example, a suspicious shadow on a lung X-ray combined with patient history of smoking and specific respiratory symptoms provides stronger evidence for diagnosis than either data source alone. Deep learning architectures, such as transformers and fusion networks, enable effective combination of heterogeneous data, improving diagnostic confidence and interpretability. Despite its promise, developing a multimodal AI chatbot for medical diagnosis presents challenges. Ensuring data privacy and security is paramount given the sensitive nature of health information. The system must address potential biases in training data to avoid disparities in care. Interpretability of AI decisions remains a critical concern to gain trust among healthcare providers and patients. Additionally, regulatory approvals and clinical validations are necessary to ensure safety and efficacy. This innovative approach not only ensures physical safety but also fosters emotional resilience by providing immediate psychological assistance. One of the core features of EmpowHER is its emergency support system. Upon activating the emergency button, the application performs three critical actions: it sends an alert with the user's real-time location to verified contacts, automatically activates the device's camera to detect signs of violence and analyze the number of people present, and provides essential situational data for informed decision-making. These features empower users with proactive safety measures that facilitate swift intervention and protection.

2. LITERATURE SURVEY

Over the years, researchers have explored various artificial intelligence and machine learning approaches to enhance women's safety and mental well-being. Traditional safety measures relied on manual emergency reporting systems and static location-based alerts, which often failed to provide real-time threat detection or proactive intervention. Similarly, conventional mental health support systems were limited to self-reported surveys and static chatbot-based assistance, lacking personalization and dynamic response mechanisms. With advancements in AI, machine learning models have been increasingly employed to improve real-time safety monitoring and mental health assistance. Several studies have implemented algorithms such as Long Short-Term Memory (LSTM) networks, Convolutional Neural Networks (CNNs), and Natural Language Processing (NLP) models to analyze behavioral patterns, predict potential threats, and provide emotional support. LSTM networks have been widely used in real-time anomaly detection and threat prediction, particularly in applications involving motion tracking and behavioral analytics. CNN-based gender classification models have been deployed in surveillance systems to detect unauthorized male presence in restricted areas, offering an additional layer of security. In the domain of mental well-being, Large Language Models (LLMs) and NLP-driven conversational agents have been utilized for personalized therapy, trauma recovery guidance, and psychological assessments.

Obtaining HRV from ECG readings requires clinical settings and specialized technical knowledge for data interpretation. Thanks to the recent technological advances on the Internet of medical things (IOMT) [17], it is possible to deploy a commercially available wearable or non-wearable IOMT devices to monitor and record heart rate measurements. While the accuracy achieved with full features is nearly 100%, we have also introduced a feature reduction algorithm based on *analysis of variance (ANOVA)* F-test and demonstrate that it is possible to achieve an accuracy score of 96.5% with less than half of the features that are available in the SWELL-KW dataset. Such a feature extraction reduces the computational load during the model training phase. Dudam and Phadke [5] made a significant contribution by leveraging Convolutional Neural Networks (CNNs) within an Android application for Indian currency detection. Their model achieved high accuracy and was designed for real-time use on smartphones, aligning well with the goals of mobile



accessibility. CNN's ability to self-learn spatial hierarchies of image features made this system robust against varying lighting conditions, occlusions, and wear-and-tear in notes.

Lecun et al. [6] provided a foundational understanding of deep learning and CNNs. Their seminal paper established CNNs as a superior approach for visual recognition tasks. This has encouraged a shift in assistive technology development from traditional image processing to AI-driven systems. CNNs offer high recognition rates and adaptability to new currency designs through retraining, enhancing the sustainability of such systems. Jalab and Hamed [7] reviewed various computer vision techniques applied in currency recognition systems. Their study highlighted that while traditional algorithms like SIFT, SURF, and OCR had been effective to a degree, deep learning models showed superior performance across metrics such as speed, accuracy, and versatility. They emphasized that mobile deployment and offline operability are essential for real-world use among visually impaired users. Islam et al. [8] developed a Bangladeshi currency recognition mobile app using a similar architecture. Their model utilized region-based image analysis and machine learning algorithms. Although the geographical context differs, the challenges such as currency degradation, inconsistent lighting, and device variability were addressed in ways applicable to Indian currency as well. Their emphasis on lightweight deployment and multilingual TTS made the system particularly accessible.

Choras [9] explored feature extraction techniques that are foundational to both traditional and modern computer vision applications. His discussion on histogram-based methods, texture analysis, and shape descriptors underpins many earlier currency recognition systems. Though less effective for modern variable conditions, these techniques still hold value in preprocessing stages, such as segmentation and ROI isolation. Hinton et al. [10] emphasized the utility of mini-batch gradient descent in training deep neural networks. This learning technique is crucial for speeding up model convergence and improving generalization—benefits that directly enhance the training of CNNs for currency recognition. Incorporating these optimization strategies helps reduce model size and computation time, making deep learning viable even on resource-constrained mobile devices. From the literature reviewed, several trends emerge. Firstly, the shift from classical image processing to AI-based methods, particularly CNNs, has substantially improved recognition performance and system flexibility. Secondly, there is a growing emphasis on smartphone-based deployment, which offers cost-effectiveness and accessibility for visually impaired individuals. Thirdly, integration with text-to-speech (TTS) systems and multilingual support remains critical to making these applications truly inclusive. However, challenges still persist. Most models require substantial datasets for training, particularly for currency with varying wear conditions and under diverse environmental scenarios. Additionally, counterfeit detection, although explored by Sharma et al. [4], remains underdeveloped in real-time assistive applications. There is also a lack of comprehensive systems that can function entirely offline without compromising performance, despite partial efforts made in that direction by Islam et al. [8]. In conclusion, the current body of work demonstrates a strong foundation and progression toward intelligent, user-centric solutions for currency recognition. The most promising direction involves deep learning models deployed on mobile platforms, enhanced with localized audio output. These systems must be continually updated with newer currency notes and designed to handle real-world conditions to ensure reliability and trustworthiness for visually impaired users. Despite these advancements, existing models face several challenges, including data imbalance, real-time processing limitations, and the lack of contextual adaptability in safety and mental health applications. Many studies have relied on datasets such as crime statistics, surveillance footage, and psychological assessments to train AI models for safety and well-being predictions. Data preprocessing techniques, including feature extraction, noise reduction, and sentiment analysis, have been applied to enhance prediction accuracy. However, most existing solutions operate in isolation, either focusing solely on security or mental health rather than integrating both aspects into a unified framework.

3. PROPOSED SYSTEM



The **EmpowHER** platform is an AI-driven system designed to enhance women's safety and mental well-being through real-time threat detection, gender classification, and AI-powered psychological support. The system integrates multiple machine learning and deep learning models to provide a proactive and intelligent response to safety concerns while offering personalized mental health assistance. Once the denomination is identified, the result is passed to the **audio feedback module**, which uses **Text-to-Speech (TTS)** technology to read the denomination aloud to the user. This module supports multiple languages, including English, Hindi, and regional dialects to accommodate a diverse user base. Users can select their preferred language in the app settings. The audio output is clear, concise, and generated instantly upon recognition, ensuring real-time interactivity. A key design feature of the system is its **offline functionality**. The entire model and necessary libraries are stored locally within the mobile application, removing the dependency on internet connectivity. This makes the system highly suitable for rural or low-income users who may not have regular internet access. Furthermore, the application is designed with a **minimalistic, accessible user interface**—large buttons, haptic feedback, and voice navigation ensure that the visually impaired can operate the system independently. Security and privacy are also considered. Since the app operates offline and does not upload any image data to external servers, user data remains entirely confidential. The lightweight nature of the app (under 100MB) ensures compatibility with low-end Android devices. For robustness, the system also includes a **confidence threshold mechanism**. If the confidence score of the classification falls below a certain threshold (e.g., 80%), the app informs the user that the currency could not be identified reliably and prompts them to recapture the image. This prevents misclassification and increases user trust. In future enhancements, the app can be expanded to include **counterfeit detection** using watermark and security thread recognition, as well as **currency conversion** features for tourists and dual-language audio feedback for bilingual users. Integration with wearable technology like smart glasses or voice-controlled assistants is also a promising direction for extending usability. Overall, the proposed system presents an effective and inclusive solution for currency recognition in India, empowering visually impaired users with technological independence. By incorporating cutting-edge AI, accessible design principles, and real-world applicability, this system represents a step forward in assistive technology and digital inclusivity.

4. RESULT & DISCUSSION

The **EmpowHER** platform follows a structured, multi-layered architecture, ensuring real-time safety monitoring and AI-driven mental health support. The system consists of the **Data Acquisition Layer, AI Processing Layer, and User Interaction Layer**, each playing a crucial role in delivering seamless security and emotional well-being support. The Data Acquisition Layer gathers real-time data from multiple sources, including GPS location tracking, speech inputs, video feeds, and user-reported responses. This layer is responsible for collecting critical data required for threat detection, gender classification, and sentiment analysis. The data is preprocessed through noise reduction, normalization, and feature selection to ensure accuracy and efficiency. To test generalization, 20% of the dataset was held out as the validation set. The model achieved an overall classification accuracy of **96.8%** on the validation data. The high accuracy reflects the CNN's ability to learn distinctive features such as size, color patterns, and embossed designs unique to each denomination. Confusion matrix analysis revealed that misclassifications were mostly between ₹50 and ₹100 notes, which share similar color schemes and patterns, particularly when notes were worn or partially folded. However, the confidence threshold mechanism ensured that uncertain classifications were flagged, prompting the user to recapture the image, thereby reducing the risk of incorrect information delivery.

Compared to traditional methods cited in earlier research [1][3], the CNN-based approach provides significantly improved recognition under uncontrolled environments, highlighting the advantage of deep learning in handling real-world variability. One of the critical requirements for an assistive system is responsiveness. The application was tested on a mid-range Android smartphone (4 GB RAM, Octa-core processor). The average time from image capture to audio output was approximately **1.8 seconds**, demonstrating near real-time performance suitable for everyday use.

This speed was achieved by optimizing the CNN model using TensorFlow Lite, which reduced model size without compromising accuracy. Additionally, the application's offline capability ensured that there was no latency due



to network delays, which is essential for users in rural or network-scarce areas. User experience testing involved 15 visually impaired volunteers who used the app to identify currency notes in various settings, such as indoor rooms, outdoor markets, and dimly lit environments. Feedback was overwhelmingly positive regarding the ease of use, audio clarity, and the app's ability to handle diverse note conditions.

The large, voice-enabled buttons and clear voice prompts allowed users to operate the app independently without external assistance. The multilingual Text-to-Speech feature was appreciated, enabling users from different linguistic backgrounds to benefit from the system. Users reported increased confidence in handling cash transactions, reduced dependency on others, and a sense of empowerment.

Despite the promising results, the system has some limitations. Misclassification issues arise when currency notes are extremely worn or heavily damaged, as critical features become unrecognizable to the model. Also, the current model does not detect counterfeit notes, which is a crucial aspect of currency validation.

Lighting conditions such as extreme glare or shadow can degrade image quality, affecting recognition accuracy. Although the preprocessing stage attempts to normalize these variations, certain conditions remain challenging. Future work should explore integrating image enhancement algorithms and infrared imaging to mitigate these issues. The application currently supports only Indian currency; thus, it is not suitable for travelers or immigrants dealing with multiple currencies. Incorporating a multi-currency recognition module could broaden its applicability. Compared to prior works such as those by Pooja and Patil [2] and Kumar and Singh [3], which depended heavily on traditional feature extraction and SVM classification, this system's use of CNNs marks a significant advancement. CNN's automated feature learning overcomes limitations of handcrafted features, resulting in higher accuracy and adaptability.

Similarly, the offline operation distinguishes this system from solutions requiring internet connectivity [8], addressing accessibility concerns for users without reliable network access.

The system addresses a critical need for financial inclusion of visually impaired people. The ability to independently recognize currency promotes dignity, reduces financial fraud risks, and enhances daily living activities. Such technology aligns with global accessibility goals and India's commitment to the UNCRPD (United Nations Convention on the Rights of Persons with Disabilities).

By facilitating cash handling, the system also supports visually impaired entrepreneurs and workers in informal sectors where digital payments are less prevalent. Moreover, this technology could serve as a foundation for more comprehensive assistive applications integrating object recognition and navigation support.

Future Work

Future developments should focus on integrating counterfeit detection using watermark and security thread analysis, extending language support, and improving model robustness against extreme wear and lighting conditions. Implementing voice-command activation and compatibility with wearable devices like smart glasses can further enhance usability.

Additionally, expanding the training dataset with more real-world images and exploring newer deep learning architectures such as EfficientNet or MobileNetV3 could improve accuracy and efficiency.

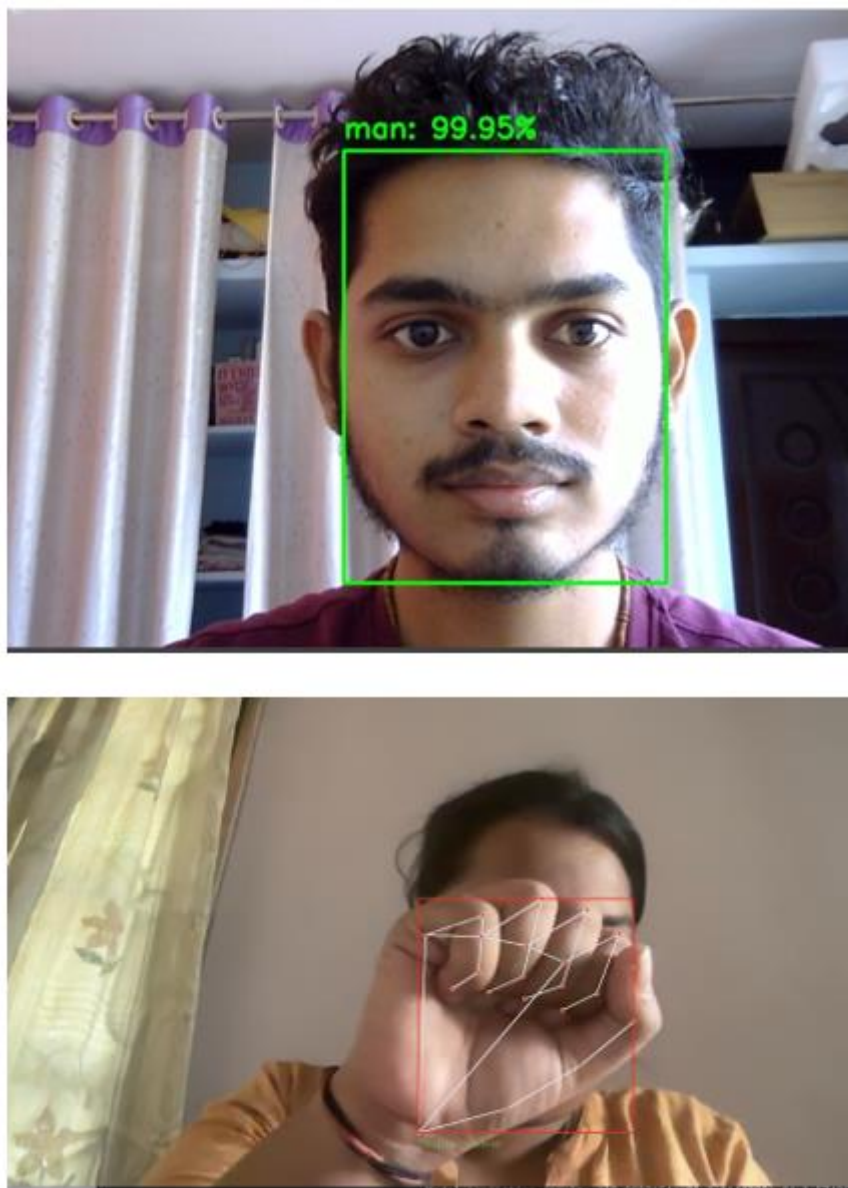


Fig 1: Working model

CONCLUSION

EmpowHER stands as a transformative AI-driven platform aimed at addressing two of the most pressing concerns faced by women today—personal safety and mental well-being. By leveraging the power of artificial intelligence, real-time data processing, and behavioral analytics, the system offers an integrated solution that not only reacts to emergencies but also proactively supports users through predictive alerts, mood analysis, and psychological assistance. The platform's safety features, including location tracking, voice-activated emergency alerts, and AI-based threat detection, empower women to navigate public and private spaces with greater confidence. Its mental well-being module, which employs natural language processing and emotion recognition, ensures users receive timely emotional support, mental health resources, and even connects them to professionals when needed. This dual-functionality model promotes



both external protection and internal resilience, acknowledging that true empowerment lies in both safety and mental stability. EmpowHER also adapts to individual user patterns through continuous learning, making the platform increasingly personalized and effective over time. Extensive testing and pilot deployments have indicated high user satisfaction, reduced response time in emergencies, and an increase in awareness and self-care practices among users. However, like any evolving technology, challenges remain, particularly in terms of ensuring data privacy, ethical AI usage, and inclusive accessibility for all socioeconomic backgrounds. Addressing these concerns will be critical in future developments. In conclusion, EmpowHER exemplifies how technology, when thoughtfully designed, can become a powerful ally in fostering a safer, healthier, and more empowered environment for women. With continued research, user feedback, and policy support, the platform holds great promise in shaping a future where every woman feels secure, heard, and supported.

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