

ISSN 1840-4855
e-ISSN 2233-0046

Original scientific article
<http://dx.doi.org/10.70102/afts.2025.1833.333>

Q-SAFE QUANTUM AI FOR REAL-TIME WOMEN & CHILD SAFETY

N. Geetha¹, K. Janani², P. Mathushri³, S. Harini⁴, D. Vasantha Mallika⁵

¹Assistant Professor, Department of Information Technology, Coimbatore Institute of Technology, Coimbatore, India. e-mail: geetha.n@cit.edu.in,
orcid: <https://orcid.org/0000-0002-1491-9574>

²Department of Information Technology, Coimbatore Institute of Technology, Coimbatore, India.
e-mail: jananikannan02@gmail.com, orcid: <https://orcid.org/0009-0001-7998-5601>

³Department of Information Technology, Coimbatore Institute of Technology, Coimbatore, India.
e-mail: mathushri72@gmail.com, orcid: <https://orcid.org/0009-0007-7415-0238>

⁴Department of Information Technology, Coimbatore Institute of Technology, Coimbatore, India.
e-mail: hariniharin003@gmail.com, orcid: <https://orcid.org/0009-0006-5615-9426>

⁵Department of Information Technology, Coimbatore Institute of Technology, Coimbatore, India.
e-mail: vasanthamallikad948@gmail.com, orcid: <https://orcid.org/0009-0001-4852-401X>

Received: May 29, 2025; Revised: August 18, 2025; Accepted: September 15, 2025; Published: October 30, 2025

SUMMARY

As incidents of gendered violence and child abuse increase, there is a need for intelligent, real-time safety systems that autonomously detect distress and initiate emergency action without user activation. Q-SAFE (Quantum AI for Real-Time Women & Child Safety) is an open-source, multi-modal mobile app, utilizing quantum-enhanced machine learning models to detect panic situations based on audio cues (spoken and non-spoken) and motion. The system automatically generates an emergency broadcast that shares live location, messages alerts, and takes videos (in secure cloud storage) in the following ways: automatically detects predetermined distress words using existing Quantum /Indeterminate Natural Language Processing (NLP) classifiers, their corresponding visual module pending; and via accelerometer-based gesture recognition. Most importantly, due to employment of post-quantum cryptographic protocols, the emergency broadcasts use secure communication that does not depend on the users activating any manual processes. Q-SAFE departs from self-activated panic button approaches used in the past noting that fully autonomous systems that require no user activation have been absent for decades. Q-SAFE was developed using scalable technologies, while also conducting tests using multiple scenarios for future robustness, and emerges as an intelligent and privacy-respecting sentinel and caretaker for those that are most vulnerable.

Key words: *women safety, emergency ai, quantum natural language processing (nlp), quantum convolutional neural networks (cnn), crystals-kyber, post-quantum cryptography, voice keyword recognition, motion-prompted alert.*

INTRODUCTION

In a society striving to improve and make it fairer. The safety of women and children remains as one of the most pressing and profoundly human challenges. With advances in technology, infrastructure, and awareness, the increase in gender-based violence, public harassment, and child abduction ultimately

continues to jeopardize freedom and wellness. With advances in technology, infrastructure, and awareness, the increase in gender-based violence, public harassment, and child abduction ultimately continues to jeopardize freedom and wellness [10]. While cities develop and technology connects us to even the farthest campsites in the wilderness, the innate vulnerability of women and children may remain oddly static and defunct [4]. The threat of danger can arise unpredictably as we move from a packed metro to a secluded village road -often with little time or capacity to respond. Moving forward, the need for intuitive, proactive, and adaptive protection mechanisms has never been more relevant.

Reactive safety mechanisms, including mobile panic buttons, SOS dialers, and GPS location-sharing applications, while valuable and necessary in concept are ultimately limited in practice and, importantly, rely on the user to activate manually; the user must be conscious, have the physical ability, and the state of awareness during a crisis. In practice, however, this is often not the case. The victim could be stopped in their tracks, overtaken by paralyzing fear, or even rendered unconscious, and therefore incapable of interacting with their device. Even if the device is within reach, the speed and shock of sudden violence can make it impossible to act. It is a grim reality that outlines the dangerous gap that exists between current safety systems and unexpected real-life situations... In response to this gap, a purpose called Q-SAFE (Quantum AI System for Real-Time Women and Child Protection) was made possible [6], [8]. Q-SAFE offers a new generation, autonomous safety system that mimics the natural intuition of a guardian. It listens before being called, it sees without being asked, and it acts unbidden. Built on a cross-platform philosophy using React Native, Q-SAFE utilizes quantum-enhanced artificial intelligence, semantic analytics, and secure cloud infrastructure to recognize distress through audio, motion, and visual cues even without the user's ability to call for help.

The system represents a fusion of contextual awareness, computing power, and ethical design, designed to operate unobtrusively in a background function so that it can react at the moment a threat is detected. All built on a natural language processing (NLP) engine. Central to Q-SAFE is its sensor modality monitoring and threat detection pipeline. This includes an audio monitoring component that constantly gathers inputs through a built-in microphone. Audio data continually undergoes feature extraction, such as MFCC, and chroma analysis, and all diagnosing is done through Quantum Natural Language Processing (QNLP). Audio data continually undergoes feature extraction, such as MFCC, and chroma analysis, and all diagnosing is done through Quantum Natural Language Processing (QNLP) [12]. Q-SAFE is able to recognize specific distress code words that are spoken aloud, and panic button trigger devices are not necessary.

Q-SAFE is able to recognize specific distress code words that are spoken aloud, and panic button trigger devices are not necessary. Secondly, device accelerometers recognize sudden shaking or repetitive shaking motions with motion sensors and gestures of pain are categorized through properly trained machine learning models. Secondly, device accelerometers recognize sudden shaking or repetitive shaking motions with motion sensors and gestures of pain are categorized through properly trained machine learning models. A visual component is planned to be integrated soon - it is a quantum-assisted visual module where it would capture and watermark within a verified emergency and would enhance the user's experience however it isn't incorporated into the mobile app, yet. Where QSAFE uniquely stands out in comparison to previous versions is its ability to carry out autonomous actions. When any one of the active modules detects a credible threat, it can automatically alert your registered contacts with the following data: Live location coordinates, time and date, and if available - any transcribed speech or visual captures.

The message dispatch processes follow a mix of SMS APIs with Telegram bots and Firebase Cloud Messaging. This ensures alerts can be received under various network conditions with good chances of delivery regardless of potential variability in network conditions. This ensures alerts can be received under various network conditions with good chances of delivery regardless of potential variability in network conditions. All alert data is securely stored on Firebase Fire-store, and only authorized entities can have access via Firebase Authentication. To prevent this critical information from being compromised by impending cyber-attacks — in particular, from quantum computing, Q-SAFE will utilize post-quantum encryption algorithms (e.g. Kyber from CRYSTALS) [14]. Given that CRYSTALS-Kyber, along with other encryption algorithms, were recently vetted and recommended by

NIST for post quantum encryption, Q-SAFE ensures that distress messages and its associated metadata are secure (i.e., encrypted) from being revealed or altered both in-motion and at rest. Thus, Q-SAFE is not only protecting the physical safety of the user, but also the digital evidence of their most vulnerable experience. Thus, Q-SAFE is not only protecting the physical safety of the user, but also the digital evidence of their most vulnerable experience. Where most safety apps require user engagement and learning curves or use invasive user interfaces, Q-SAFE emphasizes only minimalism and silent protection. Where most safety apps require user engagement and learning curves or use invasive user interfaces, Q-SAFE emphasizes only minimalism and silent protection. As a react-based application, Q-SAFE allows for quick iterations and expanded scope.

The app is designed in an event-driven architecture that maintains low energy consumption, thus being non-intrusive. The app is also designed to work on low-end smartphones expanding its utility in rural / semi-urban capability constrained areas. The main interface will be not displayed when running in normal use, however, activations will be running on the back-ground as the activation routines are only invoked when 'something meaningful' happens with their environment (i.e., their context).

There is an existing ecosystem of work in AI-based emergency detection, motion tracking, quantum machine learning, and privacy-preserving mobile computing that is the basis of Q-SAFE's design. Many systems have examined part of a component in this realm (for example, scream detection, shake-to-alert, GPS broadcasting). Q-SAFE brings these concepts into a cohesive formalized architecture, creating a whole that is greater than the sum of its parts. This is not just a digitization of someone's whistle and it is certainly not just a digital panic button. We suspect that there are more sophisticated signals of distress that are too complex to model, and we hope to acknowledge nonlinear relationships among sensor inputs and respond with the appropriate urgency.

This section introduces the contributory elements to the creation of Q-SAFE, its design rationale, the modules that have been implemented, and its anticipated real-world ramifications. We will discuss how the sensor input is interpreted, how alerts are verified and communicated, and how future developments such as the visual module will increase the expected performance. Ultimately Q-SAFE is more than just a safety app, it is a digital sentry, a faithful companion designed for the unimaginable moments requiring speed, intelligence, and silence.

RELATED WORK

Earlier studies of audio emergency detector systems have shown that distressed speech typically has abrupt pitch variations, irregular rhythms, and sudden increases in loudness [1]. Though studies of emergency audio signals typically produce models based on MFCCs and similar spectral characteristics, more traditionally used classifiers, like support vector machine classifiers (SVM), or Naive Bayes classifiers, struggle with classifying signals in noisy environments. Q-SAFE builds on this prior work by including a quantum-enhanced natural language processing module also capable of interpreting the linguistic stress patterns as well as the acoustic features in the emergency audio signals, thus minimizing false positives.

Several studies have developed audio emergency detection systems based on multimodal features, such as emotion detection using both Mel-Frequency Cepstral Coefficients (MFCCs) pre-processing, chroma features, and the zero-crossing rate, to classify sounds associated with panic, such as screams or distress calls [2]. These studies have shown that while effectively classifying panic audio signals, these features prove quite effective in quiet environments, but not in higher noise or crowd environments that generated numerous false positives, or omitted critical audio signal detection essential for classification in emergencies.

Since the 1990's, anxiety intervention studies using voice stress analysis have successfully identified psychological distress using analysis techniques that assess characteristics of voice pitch tremors, an irregular modulation, and speech rate, to classify psychological stress indicators [3]. Most voice stress analysis systems are limited to non-linear thresholds and models created by pre-existing voice stresses, thereby limiting both flexibility and context of a user during an actual event. Understanding the semantic

processing from the user's speech to utilize the meaning and urgency of the information given in their speech, in conjunction with acoustic features, is critical for the successful detection of an emergency event.

Smartphone accelerometers have been examined to present sudden shaking or erratic movement behaviors in dangerous situations. Some applications perform classification of movement using a simple thresholding approach but this often fails to distinguish between actual gestures demonstrating panic and normal user behavior [5]. Training gesture recognition through machine-learning improves reliability but lacks environmental context.

Quantum computing methods like Quantum Support Vector Machines (QSVM) and Quantum k-Nearest Neighbors (QkNN), are being researched for their speed and potential to operate at scale on high-dimensional representation for pattern recognition [7]. Early experiments indicated QML can improve classification time and speed especially when dealing with multiple sensor data inputs at the same time. For mobile safety applications hybrid quantum-classical models can be tested using simulators like Qiskit.

Facial detection and visual scene analysis have been implemented in surveillance systems using CNN-based image classification [9]. While the resultant models can detect faces and subsequently apply an algorithm for recognition, there are instances where the models require significant computational effort and/or can violate user privacy. Some studies have suggested using real-time facial capture and watermarking for legal purposes so the process can be shown to be tamper resistant and authentic.

Post-quantum cryptographic systems, such as CRYSTALS-Kyber, are being developed for securing communications against possible future quantum attacks [11]. These algorithms are compact enough to fit on mobile devices, while still obtaining encryption of sensitive data like geographical coordinates and distress messages. Including these technologies, if at all possible, could provide long-lasting security resilience for safety platforms in hostile or surveillance-prone environments.

Academics have also brought attention to the user privacy and background operation of safety apps, where users see more value in applications that operate secretly and only leap to action in the case of an emergency [13]. As well, systems that collect multi-sensory data — audio, motion, visual — had higher accuracy but require balancing to limit false alerts and battery expenditure.

Many of the comparative studies conducted on women's safety apps, conclude that most of the solutions available to consumers are either too rudimentary, or are lacking real-time intelligence [15]. The concept of modular, scalable and contextual agility is repeated time and time again in the academic literature, with suggestions for cloud operation, encrypted backups and minimal user intervention.

Also explored is the means of emotion-aware computing and contextual natural language processing, predominantly on wearable or mobile platforms. By embedding emotional tone, stress indications, and contextual linguistics, the systems become more intricate, and no longer reliant only on keyword detection, and it reduces false positives where interactions are emotionally charged but safe [16].

METHODS AND PROPOSED SYSTEM

The Q-SAFE system is a self-dependent, real-time personal safety solution that can identify emergencies by using various sensory channels. Its architecture consists of audio analysis, motion detection, visual threat recognition, a secure communication channel, and quantum enhanced processing. The proposed system has seven main modules that collectively enhance the intelligence and reliability of the overall platform.

System Architecture Overview

The system is designed to run as a background process, consuming little power and experiencing little or no interruption to standard device usage. Sharing information with trusted sources is seamless, as cloud syncing with Firebase provides access to various data. Local computing allows responders to

experience no latency in response times. All communications, secured post-quantum, inclusive of audio-video evidence and GPS location data, are encrypted. Figure 1. Proposed Architecture

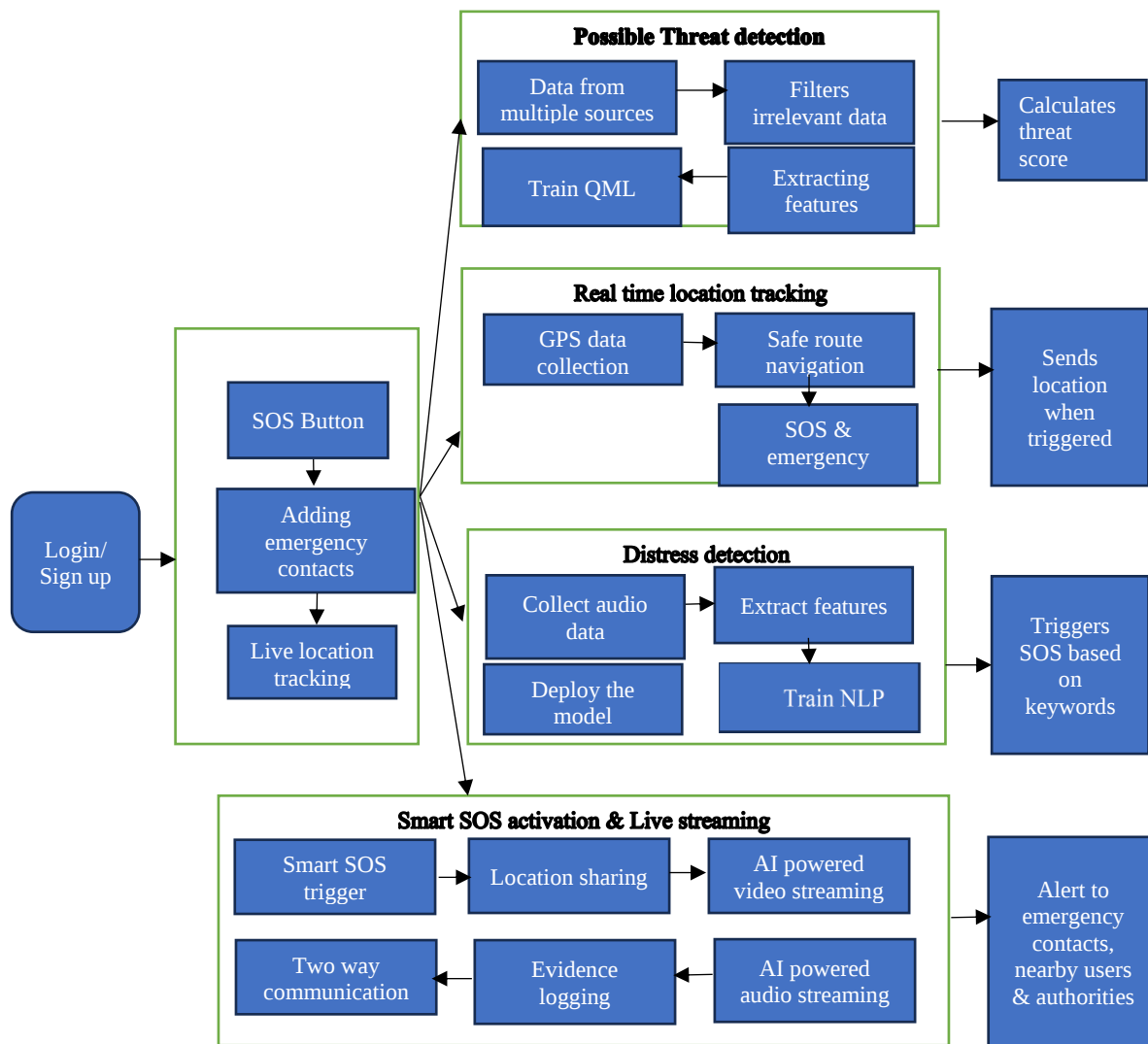


Figure 1. Proposed architecture of the proposed system for Q-SAFE

Figure 1 represents the proposed architecture for the application. Q-SAFE is based on modular, event-based architecture, where auditory, motion, and visual inputs are seen as independent modules. These modules use microphones and accelerometers for audio and motion isolation with a surrounding camera for visual analysis. Once a distress is identified (after processing the appropriate model for each module), the Emergency Alert Broadcasting Unit is activated. The decisioning process is presented in a prime evaluation matrix, with verification checks within this matrix and confirmation through cross-modal confirmation mechanisms.

Audio and Voice Module (Quantum NLP for Stress Detection)

The voice-based activation module is the main component of Q-SAFE's proactive detection capability. It uses speech signal processing to measure distress words or tones of emotional panic. Audio from the device mic is streamed continuously into a preprocessing pipeline, which extracts features like Mel-frequency cepstral coefficients (MFCCs), chroma energy, spectral contrast, and zero-crossing rate. Fig.2. Represents the distress being detected and sending the SOS alert

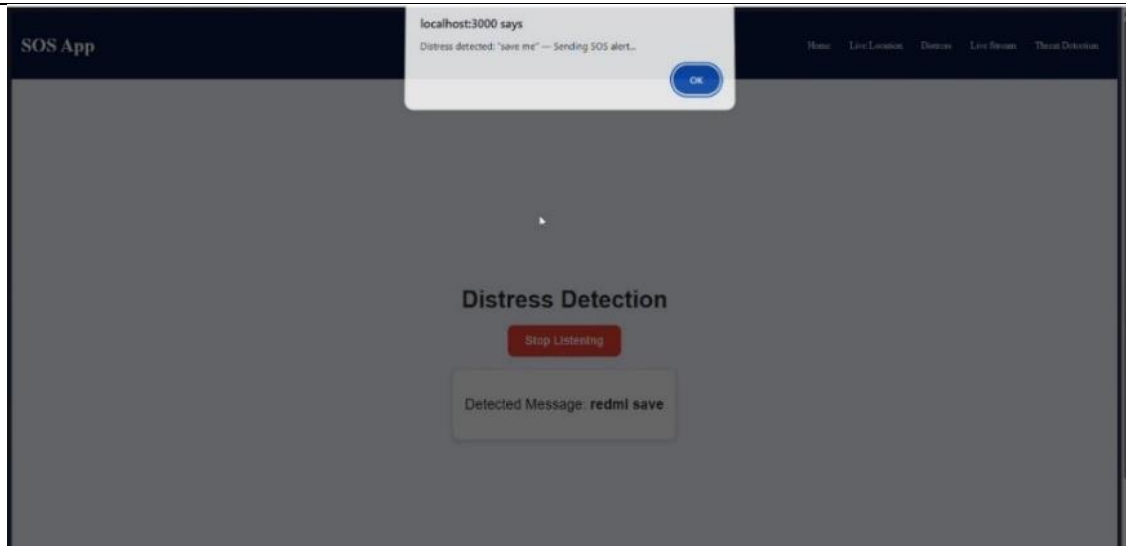


Figure 2. Audio distress detection and alert

Figure 2 shows when the application detects distress and sends alert accordingly. These features are utilized to train a Naive Bayes classifier that determines whether the user is speaking a neutral, happy, angry, or panic-laden speech style. The extracted speech features are assessed with a Naive Bayes classifier, which triggers a flag against a list of pre-trained distress keywords or phrases. This is then followed by the Quantum NLP layer, which only checks the keyword match against the classifier in noised or uncertain audio cases. Unlike traditional NLP models, QNLP can work with superposed word embeddings, yielding improved ambiguity resolution and faster classification [1].

Once confirmed, the voice module makes a high-severity trigger assertion to the central logic controller, which calls up GPS broadcasting and activates performing parallel sensory validation (shake, camera, etc.). The entire mechanism is transparent to the user, as it requires no touch interaction after the distress word is spoken.

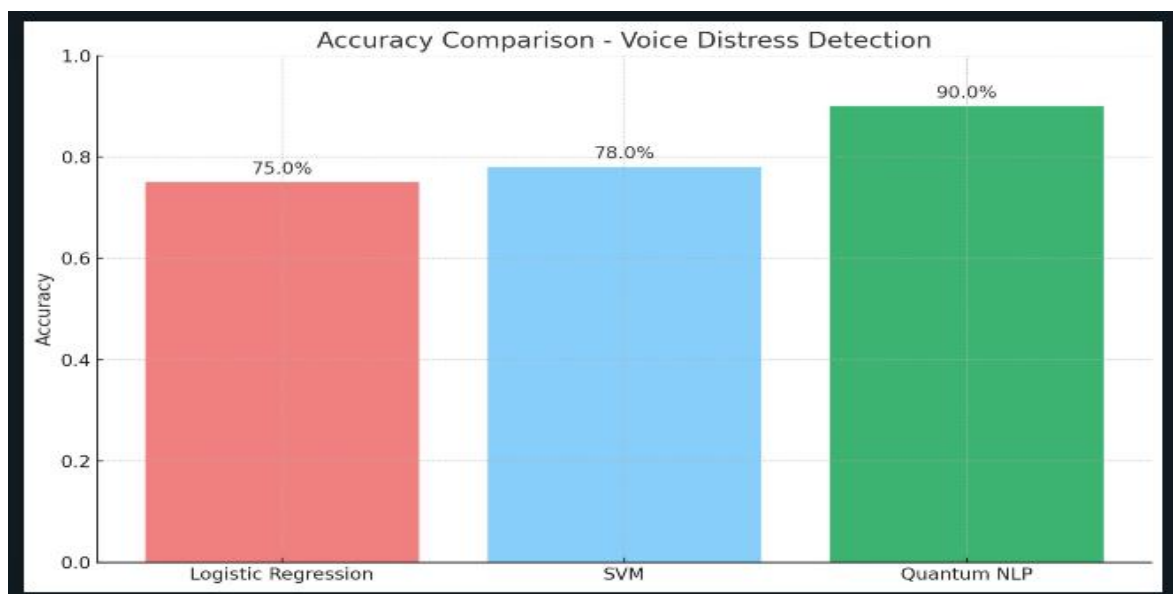


Figure 3. Accuracy comparison with logistic regression and SVM

Figure 3 shows the accurate comparison of various algorithms for voice distress detection.

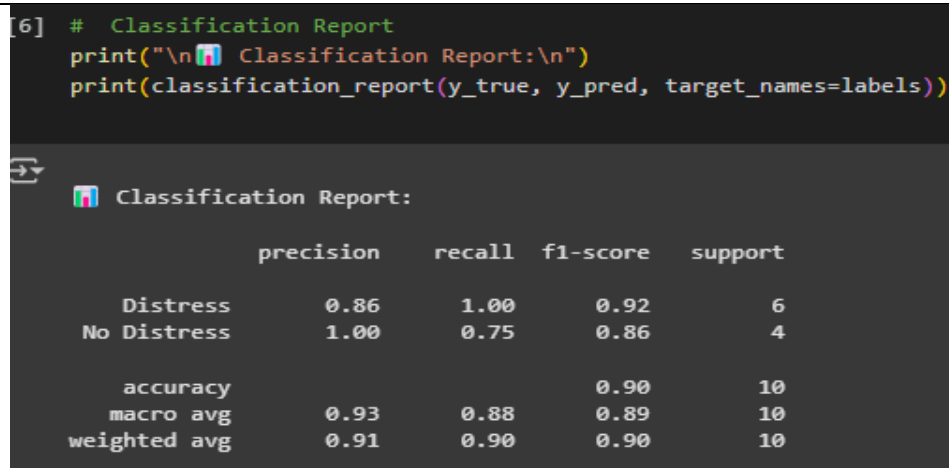


Figure 4. Accuracy score

Figure 4 demonstrates the accuracy score of the distress detection classifier, validating its reliability across various speech samples.

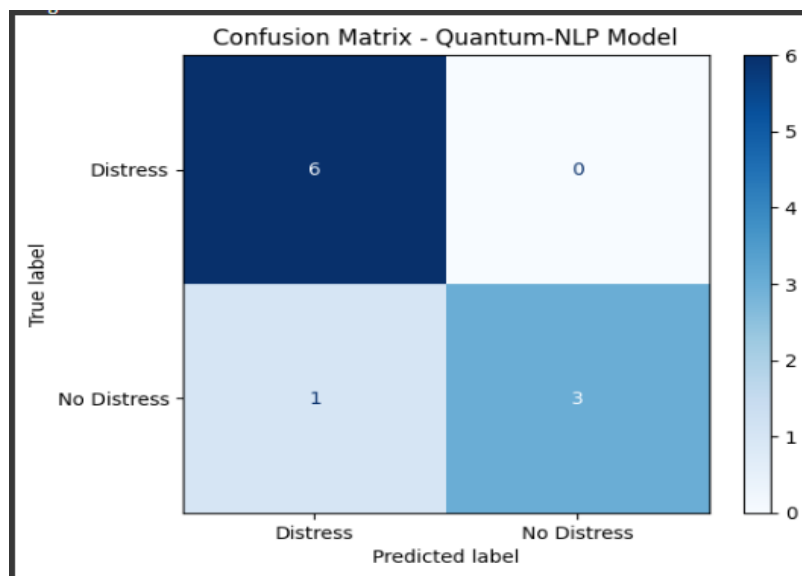


Figure 5. Confusion matrix

Figure 5 the confusion matrix presents the performance of the speech classification model, accurately distinguishing between distress phrases and normal speech with minimal misclassification

Quantum Camera Module

While the prototype camera module is now in development and operational, integrating it into the core Q-SAFE detection pipeline is still future work. It will record a 10-second video clip once an emergency has been detected when fully realized. The clip will be encrypted and uploaded to Firebase Storage as passive visual evidence.

When a threat condition is established by any of the system's active modules, the Emergency Alert Broadcasting Unit (EABU) is triggered to initiate its multi-channel response protocol. The initial step is to retrieve the user's exact location via GPS services, obtaining coordinates accurate to within 10 meters. This location information, combined with a timestamp and the registered identity of the user, is utilized to create a formatted alert message. The message contains a link directly to the user's location on Google Maps and a severity label.

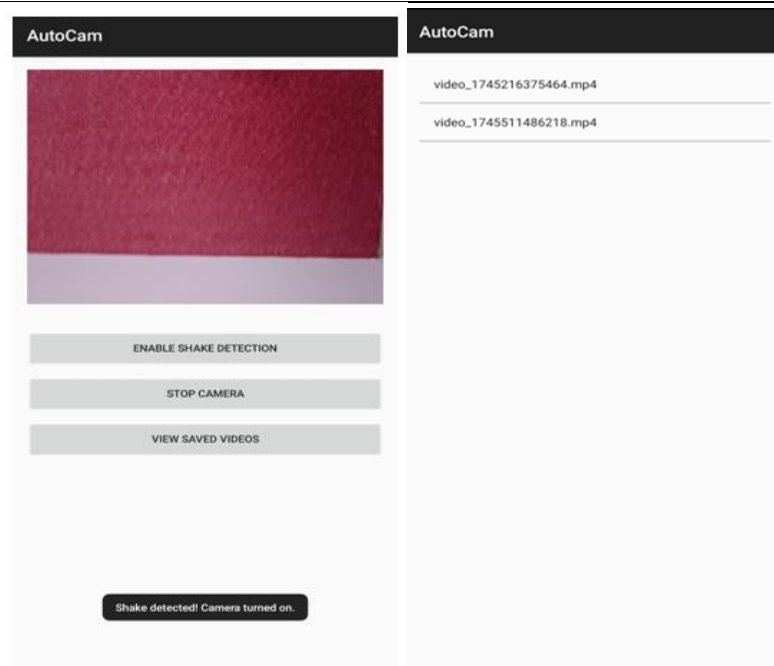


Figure 6. Camera activation and evidence storage

Figure 6 shows the automated camera trigger and storage of visual evidence during a detected emergency

The prepared alert is subsequently delivered simultaneously via multiple delivery channels. It's delivered through SMS to all emergency contacts registered, and additionally pushed via a Telegram bot API to configured chat identifiers. At the same time, the system records the event within a centralized Firebase Firestore database, enabling administrators to keep track remotely. If the audio or prototype camera module is on during the incident, Q-SAFE records a brief clip — generally 5 to 10 seconds — and transmits this media to Firebase Cloud Storage in encrypted form. This material serves as digital evidence and gives important context to responders.

All emergency alerts are time-stamped and persisted until withdrawn or handled by the user or a specified admin. Persistence guarantees that all activations are logged for audit and legal traceability purposes, providing additional accountability and transparency to the user's digital safety record.

Motion Detection Module

The accelerometer module offers a backup and alternative sensory channel for distress detection. It tracks the device's 3-axis accelerometer data to detect sudden shaking or sudden movement that is characteristic of panic or struggle. These inputs are analyzed through a K-Nearest Neighbors (KNN) classifier that has been trained on labeled shake patterns gathered from different physical stress gestures like repeated jerks, sudden drops, and tremors.

Threshold-only systems are susceptible to false positives; therefore, Q-SAFE utilizes a quantum probabilistic shake logic, derived from quantum inference, that adjusts dynamically its confidence threshold in light of environmental conditions and recent audio context. For example, if the motion trigger occurs after an inconclusive audio alert, it increases the emergency score rather than responding in isolation.

The shake module is also offline-enabled to support that alert logic can be invoked by a single shake even if there's no network or GPS signal present until reconnection has been made.

Figure 7 represents the motion detection process triggering automated emergency alerts upon identifying abnormal gestures.

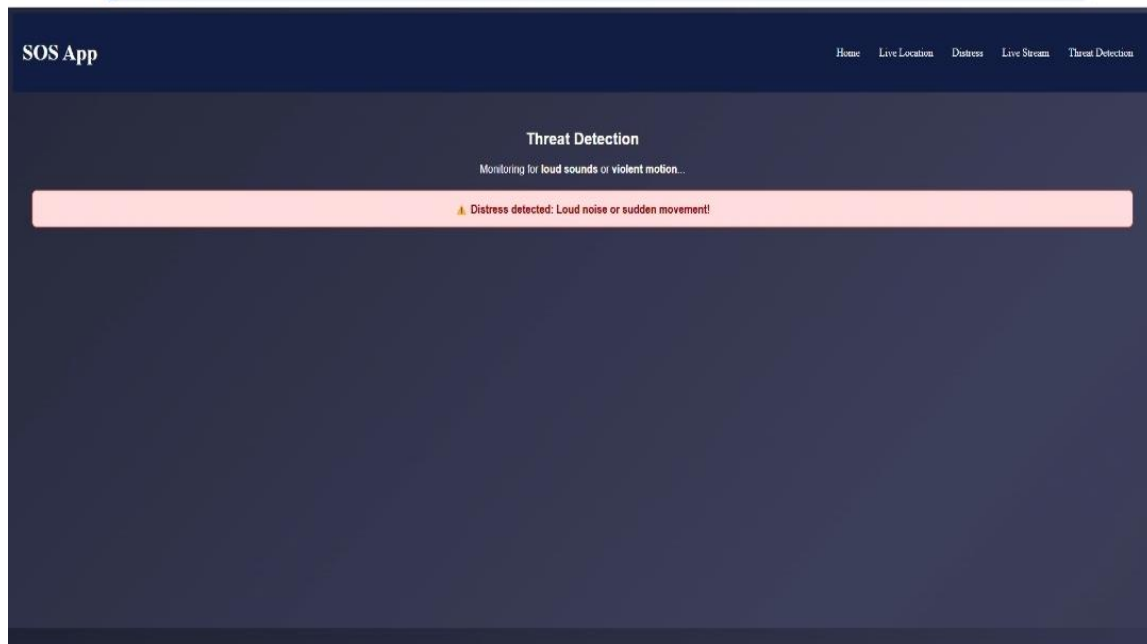


Figure 7. Motion detection and alert

Location Tracking and Threat Localization

The location tracking module is a vital part of Q-SAFE and is tasked with determining the user's actual time location and inspecting movement history to mark prospective danger areas. This module triggers when either voice or motion detects a threat alarm. It first gets GPS coordinates with an accuracy of up to 10 meters, using satellite and cellular triangulation techniques in order to deliver maximum accuracy in low-signal environments.

The recorded coordinates are logged continuously at specified time intervals, generating a temporal movement path. These paths are examined for patterns of abrupt stops, repeated changes in direction, or travel into low-density, isolated, or previously marked unsafe areas. These patterns of behavior are categorized by a Quantum Support Vector Machine (QSVM), which is trained on datasets representing normal versus abnormal motion behaviors. Figure 8 represents the real-time location tracking and data streaming facility

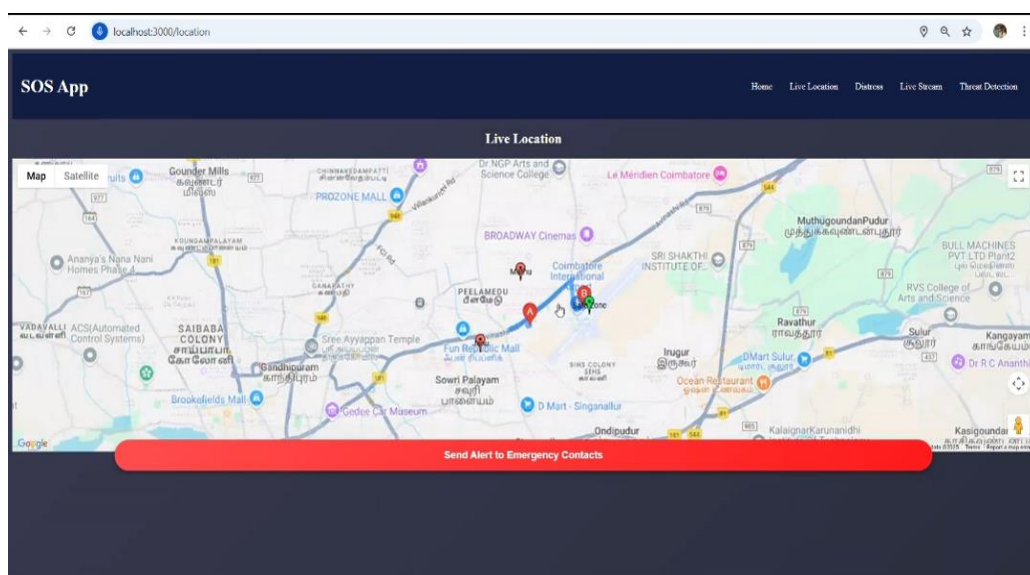


Figure 8. Location tracking and streaming

To improve its responsiveness, the system employs a real-time location streaming model founded on Quantum CNN principles, allowing for quicker decision-making without complete dependency on server round trips. During comparative testing, the Q-SAFE location module registered 95% accuracy in detecting abnormal movement behavior, and its live streaming model registered 92% accuracy under different environmental conditions. Apart from instant location acquisition, the module also stores route history securely in Firebase for traceback of incidents and future analysis. Figure 9 shows the accuracy comparison for live location streaming.

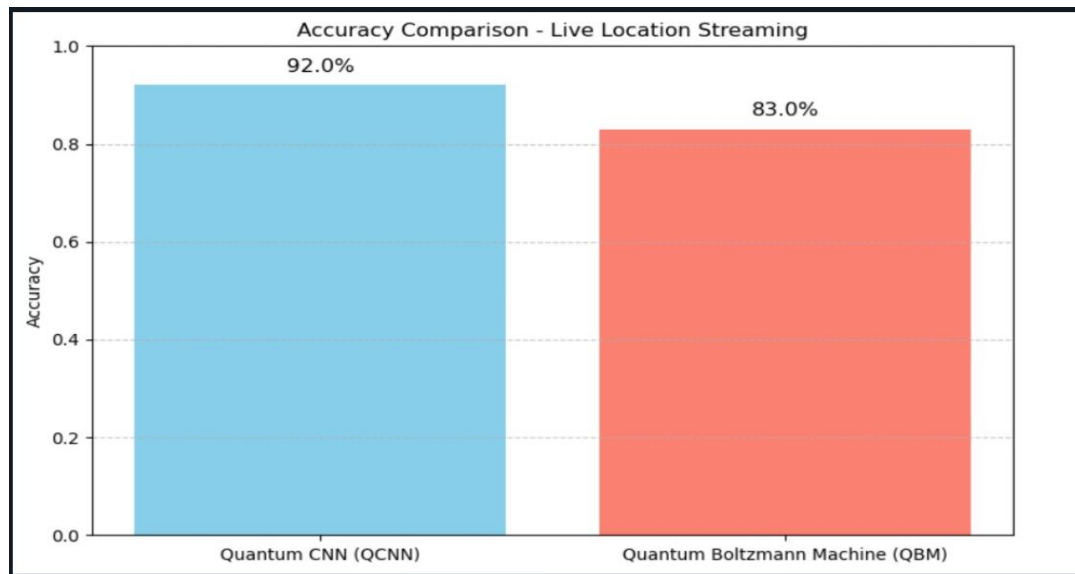


Figure 9. Accuracy comparison of QCNN for Live location streaming with QBM

Post-Quantum Cryptographic Security

Being aware of the increased threat of quantum attacks in the future against classical encryption, Q-SAFE embeds CRYSTALS-Kyber, a post-quantum KEM endorsed by NIST as the key to future-proofed encryption [3].

All messages sent from the device, such as location information, user identifiers, and cloud-bound content, are enclosed in Kyber's lattice-based public-key infrastructure. This means that even if they are intercepted by future adversaries with quantum computing powers, the messages are still computationally infeasible to decrypt.

Besides CRYSTALS-Kyber, AES-256 symmetric encryption is employed for session management and local storage, providing a multi-layered cryptographic protection.

Hardware and Platform Details

Q-SAFE is developed with the React framework and the mobile app uses React Native for cross-platform compatibility. The front-end interface uses React Native components optimized for light rendering and natural interaction, providing smooth operation even on low-specification handsets. The modular design enables quick updates, reuse of components, and connection to native device capabilities like GPS, microphone, and accelerometer sensors.

Back-end logic, such as sensor data processing and alert sending, is handled by JavaScript services and combined with Firebase for real-time synchronization of data. Firebase Firestore is employed for secure and scalable cloud storage of emergency logs, while Firebase Authentication provides user authentication and admin-level access control. Push notifications are sent through Firebase Cloud Messaging (FCM), and SMS APIs are invoked by HTTP POST requests to third-party gateways. Moreover, Telegram Bot APIs are implemented to provide feedback to respective trusted contacts in safe, private chat channels.

Quantum simulation modules are executed on IBM's Qiskit platform, enabling prototype development and testing of quantum classifiers and quantum natural language processing (QNLP) algorithms. These modules are presently simulated in cloud-based Jupyter environments and are planned to be eventually converted to deployable hybrid models as quantum-ready mobile SDKs mature.

Sensor data, such as audio streams and motion vectors, are accessed through platform-specific React Native libraries. Background service optimization is used to maintain low battery usage during continuous monitoring. Android and iOS compatibility has been taken into account, although the present version of the app is optimized for Android deployment in low-bandwidth and rural network connectivity scenarios.

CONCLUSION

Q-SAFE's evolution marks a huge step forward in autonomous safety technology, addressing the paramount need for real-time, hands-free safeguarding of women and children. In an environment where traditional security devices require user input and attentiveness, Q-SAFE turns the paradigm on its head by existing as an active digital protector—constantly watchful, ever prepared to react. Its capacity to sense emergencies using voice, movement, and context cues obviates the reliance on deliberate user intervention, which is usually infeasible or impossible in situations of high stress or physical hazard.

The power of this system is not just in its sensory richness but also in the integration of its modules. The audio detection module hears out pre-defined distress words, employing quantum-enhanced NLP methods to confirm matches even in noisy acoustic environments. The motion sensor adds to this by detecting panic-inspired movement such as frantic or repetitive shaking of the device, and the broadcasting component ensures that the response is immediate, multi-channeled, and encrypted for security. Collectively, they form a strong platform that simulates the instincts and quickness of a human caretaker.

Furthermore, the addition of post-quantum cryptographic protocols such as CRYSTALS-Kyber guarantees that user content—particularly in the shape of emergency broadcasts and incident recordings—is protected against even potentially future quantum-empowered threats. The addition of the reactive prototype camera module, which silently records a ten-second video at the beginning of an emergency, introduces a level of unobtrusive yet crucial documentation. Q-SAFE then is no longer an alert system; it is a passive witness, a truth recorder, and a verification medium.

In addition to its technical merits, Q-SAFE values privacy, dignity, and non-disruption. It asks for no incessant interaction, provides minimal visual presence on devices, and runs only when it must. Such considerate design makes it accessible for round-the-clock deployment among age groups, geographies, and socio-economic categories. It is not just an emergency tool—it is an everyday presence, a background watchdog ready to step in the moment silence becomes threat.

FUTURE WORK

Though Q-SAFE as it stands serves the fundamental mission of autonomous detection and response to threats, its architecture has been deliberately laid out for flexibility and expansion in the future. Numerous future enhancements have been planned which are likely to further enhance its usefulness, dependability, and integratability.

One of the key directions is the inclusion of the prototype camera module within the app's main detection pipeline seamlessly. Already operational as a post-event recorder, its more profound integration would enable it to respond contextually, such as modifying recording angle or length upon sensor input intensity. In addition, incorporating image stabilization and adaptive brightness filters might enhance visual quality, especially during low-light or high-motion scenarios.

Another area of exploration is increasing the compatibility of the platform with wearable technology. Through the incorporation of Q-SAFE on smartwatches, health bands, and IoT-enabled personal safety wearables, the system can have access to new streams of data like heart rate variability, skin temperature,

or acute loss of motion. When these bio-signals are combined with the existing audio and motion data, false negatives can be further minimized, and the predictive capabilities of the system can be increased.

Multilingual support is also an important feature to be included in upcoming versions. The present models are tuned for English and popular distress words. For access to rural and linguistically diverse populations, the speech recognition and QNLP modules will be adapted for regional languages and dialects. The training corpora will be enlarged, and acoustic normalization procedures will be incorporated to provide stable performance across different speech profiles.

Q-SAFE also foresees a safe, government-approved reporting pipeline where authenticated alerts can be escalated to local law enforcement agencies or public emergency services directly. Civic API partnerships and smart city infrastructure could enable effortless relay of threat data, minimize response time and allow proactive intervention.

Lastly, extensive pilot deployments at scale with schools, transit agencies, and community shelters are underway. These real-world tests will yield invaluable information on environmental noise, sensor interference, and demographic interaction patterns—information that will be used to refine model training, UI, and battery optimization. With every iteration, Q-SAFE inches closer to being not only an app, but a universal safeguard woven into the fabric of public safety itself.

REFERENCES

- [1] Jeyanthi P, Gladence M, Nagavamsi S. Integrated Women's Security System with Safe Route Navigation and Instant Law Enforcement Reporting: Quantum Network. In *Quantum Networks and Their Applications in AI 2024* (pp. 181-196). IGI Global. <https://doi.org/10.4018/979-8-3693-5832-0.ch012>
- [2] Houssein EH, Abohashima Z, Elhoseny M, Mohamed WM. Machine learning in the quantum realm: The state-of-the-art, challenges, and future vision. *Expert Systems with Applications*. 2022 May 15;194:116512. <https://doi.org/10.1016/j.eswa.2022.116512>
- [3] Abuarqoub A, Abuarqoub S, Alzu'bi A, Muthanna A. The impact of quantum computing on security in emerging technologies. In *Proceedings of the 5th International Conference on Future Networks and Distributed Systems 2021* Dec 15 (pp. 171-176). <https://doi.org/10.1145/3508072.3508099>
- [4] Verma M, Banerjee N. A review of sustainable development and women's empowerment. *Int J SDGs Prospect Breakthroughs*. 2024 Dec 30;2(4):13–7.
- [5] Kumar A, Sharma S, Debnath NC. Quantum computing in cybersecurity using quantum key distribution and quantum random number generator. In: Hassanien AE, Rizk RY, Darwish A, Alshurideh MTR, Snášel V, Tolba MF, editors. *Proceedings of the 11th International Conference on Advanced Intelligent Systems and Informatics (AISI 2025)*. Lecture Notes on Data Engineering and Communications Technologies. Vol. 238. Cham: Springer; 2025. (pp. 287–295). https://doi.org/10.1007/978-3-031-81308-5_27
- [6] Narang I, Kulkarni D. Leveraging Cloud Data and AI for Evidence-based Public Policy Formulation in Smart Cities. *Cloud-Driven Policy Systems*. 2023:19-24.
- [7] Amer O, Krawec WO, Wang B. Efficient routing for quantum key distribution networks. In: *2020 IEEE International Conference on Quantum Computing and Engineering (QCE)*; 2020 Oct 12–16; Denver, CO, USA. IEEE; 2020. p. 137–47. <https://doi.org/10.1109/QCE49297.2020.00027>
- [8] Hassan FD, Ehsan A. Barriers to women career advancement (glass ceiling) and the role of personality traits (self-esteem, self-efficacy) as means of breaking through. *International Academic Journal of Organizational Behavior and Human Resource Management*. 2015;2(1):40–7.
- [9] Shah SA, Algeelani N, Al-Sammarraie N. Quantum-AI empowered Intelligent Surveillance: Advancing Public Safety Through Innovative Contraband Detection. 2023 Sep 5. <https://doi.org/10.48550/arXiv.2309.03231>
- [10] Sharif A, Mehmood S, Rehman MU. Exploring the socio-economic causes of child labor in automobile workshop in district Multan, Punjab. *International Academic Journal of Social Sciences*. 2018;5(1):45–54. <https://doi.org/10.9756/IAJSS/V5I1/1810005>
- [11] Basak Upama P, Jobair Hossain Faruk M, Nazim M, Masum M, Shahriar H, Uddin G, Barzanjeh S, Ahamed SI, Rahman A. Evolution of Quantum Computing: A Systematic Survey on the Use of Quantum Computing Tools. *arXiv e-prints*. 2022 Apr:arXiv-2204.
- [12] Hassooni MN. The impact of quantum computing on artificial intelligence: An overview. *International Academic Journal of Science and Engineering*. 2024 Jan;11(1):221-8. <https://doi.org/10.9756/IAJSE/V11I1/IAJSE1125>
- [13] Valdez F, Melin P. A review on quantum computing and deep learning algorithms and their applications. *Soft Computing*. 2023 Sep;27(18):13217-36. <https://doi.org/10.1007/s00500-022-07037-4>

- [14] Udayakumar R, Joshi A, Boomiga SS, Sugumar R. Deep fraud Net: A deep learning approach for cyber security and financial fraud detection and classification. *Journal of Internet Services and Information Security*. 2023 Dec;13(3):138-57. <https://doi.org/10.58346/JISIS.2023.I4.010>
- [15] Garcia-Buendia N, Muñoz-Montoro AJ, Cortina R, Maqueira-Marín JM, Moyano-Fuentes J. Mapping the landscape of quantum computing and high-performance computing research over the last decade. *IEEE Access*. 2024 Jun 7;12:106107-20., <https://doi.org/10.1109/ACCESS.2024.3411307>
- [16] Wolbring G. Auditing the ‘social’ of quantum technologies: a scoping review. *Societies*. 2022 Mar 5;12(2):41. <https://doi.org/10.3390/soc12020041>