Child Safety AI QR: Empowering Child Safety through Artful QR Technology

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Abstract: The safety of children remains a paramount concern, with incidents of child abduction, missing children, and accidents posing persistent challenges to caregivers and society at large. Traditional methods of ensuring child safety, such as identification cards, often fall short of delivering effective solutions. In response to these pressing issues, this paper introduces an innovative web application that combines cutting-edge AI technology with artful Quick Response (QR) codes to enhance child safety. Incidents of child abduction, missing children, and accidents pose ongoing challenges for caregivers and society. Traditional methods, particularly identification cards, have proven inadequate in keeping pace with the dynamic nature of these threats. The limitations of these approaches necessitate innovative solutions that can offer real-time and comprehensive child safety enhancements. Child Safety AI QR is designed as a web application that integrates cutting-edge Artificial Intelligence (AI) technology. This integration allows for a dynamic and proactive approach to child safety, going beyond the static nature of traditional identification methods.

Keywords: Child Safety, AI Technology, QR Codes, Artful QR Technology.

1. Introduction

The safety of children has long been a primary focus of society, yet despite continuous efforts to protect them, incidents of child abduction, missing children, and accidents persist, creating an atmosphere of uncertainty and vulnerability. Conventional methods like identification cards have often proven insufficient, prompting the need for innovative solutions that can adapt to the challenges of our dynamic world. In response to these critical issues, an innovative initiative aiming to revolutionize child safety by combining cutting-edge artificial intelligence (AI) with the creative use of Quick Response (QR) codes has been introduced. Our proposed web application enables users to create a comprehensive digital record of a child's essential details, transforming this crucial information into a unique and artistic QR code. These distinctive QR codes can be easily attached to everyday items such as stickers, keychains, badges, etc., serving not only as identification tools but also as engaging symbols of protection.

The proposed work has the following major objectives:

Child Safety Enhancement: Traditional methods of child safety assurance have shown limitations in providing comprehensive, real-time, and accessible solutions. Child safety is a persistent concern for parents, caregivers, and law enforcement agencies, and there is an urgent need for a modern approach that leverages technological advancements to enhance child safety. Traditional methods often fail to keep pace with the evolving dynamics of child safety threats, necessitating innovative solutions to bridge the gaps.

Data Accessibility: In the event of a child going missing or facing an emergency, rapid access to critical information is crucial. Traditional methods of documentation often suffer from limited accessibility. Law enforcement agencies, first responders,

and even the child's guardians may struggle to access crucial details in a timely and efficient manner. The inability to swiftly retrieve vital information can hinder response efforts, and it is imperative to develop a solution that offers instant access to essential child details.

QR Code Innovation: While QR codes have found widespread applications, they are often underutilized in child safety contexts. Traditional QR codes, though functional, often lack engagement and visual appeal when used as identification tools. This deficiency in design hampers their effectiveness in capturing attention and encouraging widespread adoption. The need for QR codes that are not only functional but also visually striking is evident.

User-Friendly Platform: Many parents and guardians, despite their best intentions, may not possess advanced technical skills. The complexity of technology can pose a significant barrier to the adoption of child safety measures. Therefore, there is a need for a user-friendly platform that enables individuals, regardless of their technical proficiency, to easily input child details and generate effective identification tools.

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Scalability and Adoption: To make a meaningful impact in enhancing child safety, any solution must be scalable and accessible to a broad audience. Child safety is a concern that spans diverse socioeconomic backgrounds and technological proficiency levels. Therefore, the proposed solution must be easy to use, understand, and adopt for individuals from various walks of life.

The paper has been formed as follows. The related works has been depicted in section 2. The proposed solution has been presented in section 3. The result and discussion section has been depicted in section 4. The conclusion is tabled in section IV.

2. Related Works

In 2019, Lee and Martinez [1] highlighted the importance of intuitive interfaces that allowed individuals to input child details and generate identification tools without technical hurdles. The safety of children had been a subject of grave concern, and it had given rise to a body of literature that highlights the evolving landscape of child safety measures. This literature review provides insight into the existing research and technological developments pertinent to child safety, data accessibility, and the use of QR codes in safety contexts

In 2020, Williams *et al.* [2] emphasized the significance of developing scalable and accessible child safety solutions that resonate with a wide-ranging audience. The literature stresses the need to craft solutions easily embraced by users hailing from diverse backgrounds and socio-economic conditions.

In 2021, Richardson, Michael C. *et al.* [3] underscored the increasing prevalence of QR codes across diverse applications, shedding light on their burgeoning role in child safety—a realm ripe for innovation. While extant literature predominantly delved into the efficacy of QR codes in supply chain management, marketing, and document handling, it concurrently recognized a crucial limitation. Traditional QR codes, as outlined by existing studies, tend to falter in terms of user engagement and aesthetic appeal, particularly when harnessed for identification purposes. This underscores a compelling call for the development of QR codes that seamlessly blended functionality with visual allure.

In previous investigations [4], the application of technology to bolster child safety had been a subject explored, not without precedence. An exemplar of this was the successful implementation of Amber Alert systems, effectively facilitating the swift dissemination of information regarding missing children. Nevertheless, conventional means of identification, including ID cards and photographs, exhibit restricted efficacy in this realm. The existing body of literature strongly advocated for contemporary, technology-centric strategies to elevate the safeguarding of children.

In 2014, Mello, Débora Falleiros de *et. al.* [5] focused on child safety from the perspective of essential needs, particularly in the context of maternal care for children under one year of age. The study, conducted through qualitative analysis of interviews with 16 mothers, aimed to characterize maternal care practices at home with a view to promoting child health.

In 2022, Surynovych, Olena *et. al.* [6] had been analysed general properties of PLA plastic, its benefits and its harmlessness for the nature. 3D printing ease of use had been defined too. There had been described all elements of the developed product for children's safety. The database for QR code had been analysed. Results of parents' poll according to the idea had been showed too.

Parents are always worried regarding their children's security mainly when they visit crowded public places and travel in widely physically located places. Number of applications was being developed to guard children in every manner. In 2020, Chaudhary *et. al.* [7], a Parent-Hook product which was designed for child tracking if the child was lost had been introduced. The Parent-Hook was a safety band without the sensor or any chip harmful for the children can be put on the whist of the children. This band was easy to carry which was made up of soft cotton webbing with parent contact information with QR Code and Cloud URL.

3. Proposed Work

The safety and well-being of children are issues of paramount importance in society. Despite ongoing efforts to protect children, the incidence of child abduction, missing children, and accidents involving children continues to generate concerns. Traditional methods of ensuring child safety, such as identification cards and photographs, have often proven to be inadequate in addressing the dynamic challenges of an increasingly connected world. It is in this context that the need for innovative and technology-driven solutions emerges.
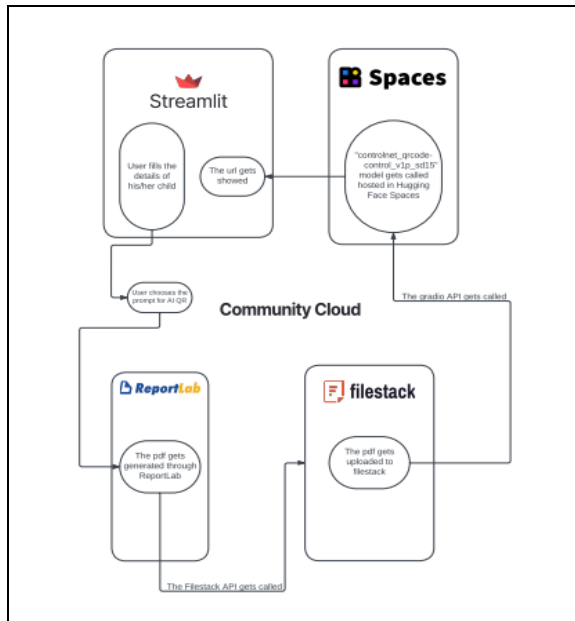
Fig. 1. workflow of the Child safety QR web app

Fig. 1 describes the workflow of creation of the Child safety QR web app. The main components of the workflow diagram presented in Figure 1 have been described below.

Streamlit is an open-source Python library that is used to create web applications for data science and machine learning projects with minimal effort. It is designed to simplify the process of turning data scripts into shareable web applications, allowing users to interact with and visualize data without requiring extensive web development knowledge. Here, the parent fills out the details of his/her child and selects a prompt according to which the QR is generated, and the URL of the pdf is shown.

ReportLab is an open-source Python library that allows for the creation of PDF documents through a simple and flexible programming interface. It provides a range of tools for generating complex and customized PDFs, making it a popular choice for tasks such as creating reports, invoices, and dynamic documents in Python applications.

Filestack is a cloud service that provides developers with a set of tools and APIs to manage and handle files in web and mobile applications. It simplifies the process of uploading, storing, transforming, and delivering files, offering a range of features to enhance file management capabilities in applications.

Hugging Face Spaces primarily focuses on providing collaborative environments for natural language processing (NLP) projects, enabling users to share and collaborate on models, datasets, and code related to NLP and machine learning.

To comprehend the current state of child safety measures and the challenges faced by parents, guardians, and law enforcement agencies a thorough needs assessment has been conducted. This encompassed reviewing existing literature on child safety, conducting interviews with parents, caregivers, and law enforcement personnel, and analysing pertinent statistics on incidents related to child safety. The primary objective is to pinpoint the main issues and deficiencies in traditional child safety measures.

Integration of artificial intelligence (AI) into the proposed system is a crucial aspect of this proposed work. To create an efficient AI model, machine learning algorithms and natural language processing techniques has been employed. The model underwent training using a diverse dataset containing child profile information to ensure accurate extraction and organization of crucial details, such as name, age, physical descriptions, and emergency contact information.

The development of visually appealing QR codes was achieved through collaboration between graphic designers and digital artists. User preferences and feedback on QR code designs are gathered through surveys and focus groups. These insights are utilized to create aesthetically engaging QR code templates that are not only visually appealing but also securely encoded with the child's data.

A user-friendly web application that enables parents and guardians to input child details and generate visually appealing QR codes effortlessly has been designed. The web application is created using modern front-end and back-end technologies, ensuring compatibility across various platforms and delivering a seamless user experience. Extensive usability testing is carried out to refine the application's interface and functionality.

To assess the user-friendliness of the proposed system, a user testing with parents and guardians from diverse backgrounds and technological proficiency levels has been designed. Participants are tasked with creating QR codes and providing feedback on their experience. This iterative process allows us to enhance the system based on user input.

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4. Results and Discussion

The Fig. 2 & 3 show the interface for the guardians. The guardians are required to fill up essential details about their child to enhance the child safety features. This user-friendly platform aims to streamline the process for parents, ensuring comprehensive information is available.

To enhance the customization of the QR code for the child's safety, the user is prompted to choose a specific prompt and seed value during the generation process. This has been shown in Fig. 4. This additional layer of personalization allows the guardian to tailor the QR code to their preferences. Here's how this feature can be implemented:

Choose a Prompt: The guardian can select a prompt that will be associated with the QR code. This prompt could be a question or phrase that holds significance to the child or the guardian, adding a personal touch to the identification process.

Set Seed Value: The option to set a seed value for the QR code adds an extra layer of uniqueness. The seed value can be a specific number or alphanumeric code chosen by the guardian. This customization ensures that each QR code generated is distinct and easily recognizable.
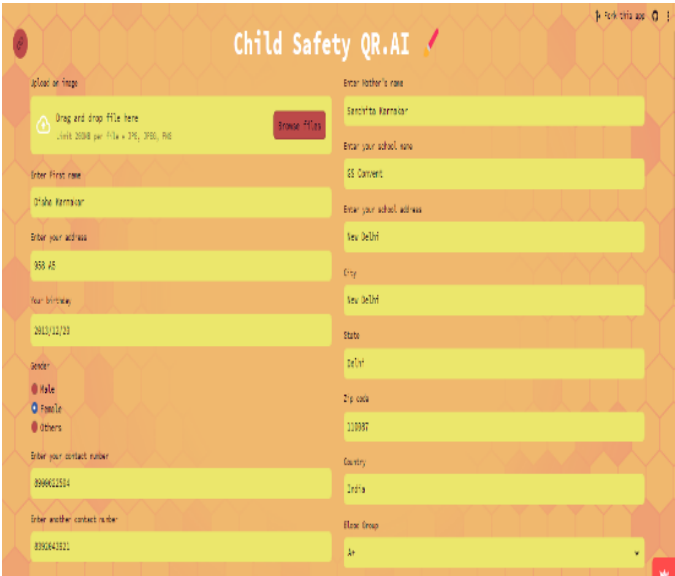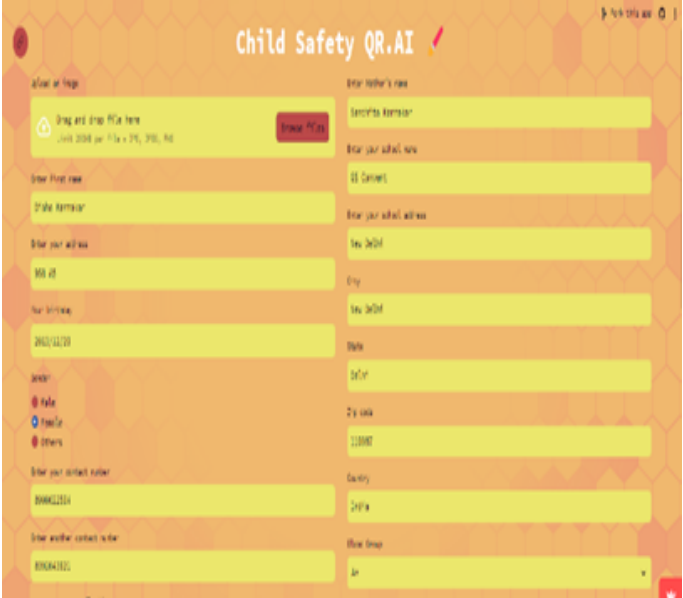
Fig. 3. 2nd Interface for the guardians

Fig. 4. Generated QR code

Preview QR Code: Before finalizing, the system can provide a preview of the generated QR code based on the chosen prompt and seed value. This allows the guardian to review and confirm that the information is accurately encoded.

Generate QR Code: Once satisfied with the selected prompt and seed value, the guardian can proceed to generate the QR code. The system uses the chosen prompt, seed value, and previously entered child details to create a visually striking and personalized QR code.

Download and Print: The generated QR code can be made available for download and printing. Guardians can store digital copies and print physical copies to be used on identification cards, personal items, or in case of emergency situations.

Fig 2. 1st Interface for the guardians

Fig. 5. After scanning the QR, the generated PDF file

After scanning the QR, a PDF file will be generated shown in Fig.5 which will contain all the necessary information of the child which was provided as input by the guardian.

The "Child Safety AI QR" web application endeavors to present an innovative and comprehensive solution to the critical issues surrounding child safety. Our approach combines state-of-the-art technology, creative design, and a user-friendly interface to create a robust tool for enhancing child safety.

Few more features of the web app are as follows:

AI-Enhanced PDF Generation: To tackle the challenge of improving child safety, we propose integrating artificial intelligence (AI) technology for the efficient creation of PDF documents. This AI model is trained to extract and organize crucial details about a child, such as name, age, physical descriptions, emergency contacts, and other pertinent information. The use of AI streamlines the process of creating a comprehensive child profile, ensuring no essential data is overlooked.

Innovative QR Code Design: To overcome the limitations of traditional QR codes, we introduce a unique approach to QR code design. Collaboration with graphic designers and digital artists has led to the development of visually appealing QR code templates. These artistic QR codes not only encapsulate the child's information but also engage the viewer, transforming a utilitarian tool into an aesthetically pleasing identification medium.

User-Friendly Platform: Recognizing the need for a user-friendly solution, the "Child Safety AI QR" web application is designed to be intuitive and accessible to users with varying levels of technical expertise. The platform allows parents, guardians, and caregivers to input child details effortlessly, ensuring that the creation of artistic QR codes is a seamless and user-friendly process. This user-centric design minimizes the technical hurdles traditionally associated with such tools.

Instant Data Accessibility: To address the challenge of data accessibility in emergencies, the unique QR codes generated by our platform are easily scannable by anyone with a QR code reader. This feature ensures rapid access to vital child details in critical situations, empowering law enforcement agencies, first responders, and even bystanders to act swiftly and decisively. The solution bridges the gap between the need for instant access to information and the constraints of traditional documentation methods.

Scalability and Adoption: The scalability of the "Child Safety AI QR" system is a fundamental component of our solution. We have designed the platform to be easily accessible and usable by individuals from diverse backgrounds, ensuring that it caters to a broad audience. The user-friendly interface and artistic QR codes make child safety measures inclusive, transcending technological and socio-economic barriers.

5. Conclusion

In an ever-changing and interconnected world, the safety and well-being of children are of utmost concern. Traditional methods of ensuring child safety have proven insufficient in addressing challenges such as child abduction, missing children, and accidents. To tackle these issues, this research introduces the "Child Safety AI QR" web application—a groundbreaking and multifaceted solution that utilizes cutting-edge technology. Our comprehensive approach involves AI-powered PDF generation, creative QR code design, and a user-friendly platform, with the goal of enhancing child safety, improving data accessibility, and bridging the gap between QR code utility and visual appeal. Emphasizing user-friendliness ensures that individuals from diverse backgrounds can easily create and use artistic QR codes, making child safety measures inclusive and accessible. Our proposed work addresses challenges in child safety enhancement, data accessibility, QR code innovation, user-friendliness, and scalability. It aims to empower parents, guardians, and caregivers in safeguarding children by providing quick access to vital details through unique and aesthetically pleasing QR codes, which serve not only as functional tools but also as symbols of hope and protection. This work is a commitment to the safety and security of the most vulnerable in our society. It signifies a

paradigm shift in child safety, challenging traditional norms and envisioning a future where technology and art converge to protect our children. As technology advances, there are new opportunities to enhance child safety, offering peace of mind to countless families. This innovative work can redefine child safety, ensuring every child is protected, and every parent has the necessary tools to keep their loved ones safe. The proposed work exemplifies the limitless potential of technology and design when harnessed for a greater purpose—the protection and well-being of our most precious resource, our children.

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