ISSN No. 2321-2705 | DOI: 10.51244/IJRSI | Special Issue |Volume XI Issue XIV November 2024

Building a Smarter, Safer City: Leveraging AI for Enhanced Security Systems

Jitendra Pandey, Vikas Rao Naidu, Anjum Zameer Bhat

Middle East College, Muscat, Sultanate of Oman

DOI: https://doi.org/10.51244/IJRSI.2024.1114SDAICO15

Received: 04 July 2024; Accepted: 25 July 2024; Published: 02 November 2024

ABSTRACT

Cities worldwide face growing public safety concerns. The rapid development of smart cities, fueled by information technology advancements, unlocks social and economic potential but also presents significant security challenges. However, smart cities offer a unique opportunity to improve quality of life through intelligent networks connecting objects and mobile devices. As outlined in the Slovak Republic's National Strategy for Long-Term Sustainable Development, such advancements should prioritize sustainability, ensuring the well-being of current and future generations. Security and safety are fundamental for a high quality of life. Natural disasters, crime, violence, and public health threats are just a few emergencies that threaten cities and sustainable urban development. Artificial intelligence (AI) can empower smart systems to capture critical safety data and respond swiftly and efficiently to incidents. These interconnected systems can monitor, predict, and prevent suspicious activities, both ongoing and potential. This research proposes an AI-powered mobile application that integrates the natural environment and technology. This app aims to: Enhance public safety and security processes by leveraging a network of intelligent systems. Foster a healthier living environment for citizens. Provide easy access to emergency services to ensure preparedness and rapid response. Facilitate swift recovery and rehabilitation efforts. Establish a platform for community volunteer networks. Offer online public safety awareness programs for citizens.

Keywords: Artificial Intelligent, Safer City, Security Systems.

Smart cities leverage technology for efficiency. They integrate information and communication technologies to manage resources, services, and assets efficiently. Sensors and electronic systems collect data, which is then analyzed using technologies like data analytics and AI to improve city operations. With urbanization on the rise, the United Nations predicts 68% of the world's population will live in cities by 2050. By 2030, we expect 43 megacities with over 10 million inhabitants, mostly in developing regions, with some of the fastest growth in Asia and Africa.

Security challenges threaten smart city success. The increasing number of devices creates security vulnerabilities. While the goal of a smart city is to improve quality of life (Lacinák & Ristvej, 2017), focusing solely on technology advancement can neglect public safety. A safe city is crucial for attracting investment and fostering a positive social and economic environment.

Disaster preparedness is vital. Responding effectively to natural and man-made crises minimizes casualties and economic losses. Natural disasters claim an average of 60,000 lives annually (Hannah Ritchie, 2014). Additionally, the World Health Organization (2020) reports that violence and bullying affect 42% of boys and 37% of girls in 40 developing countries.

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI | Special Issue |Volume XI Issue XIV November 2024

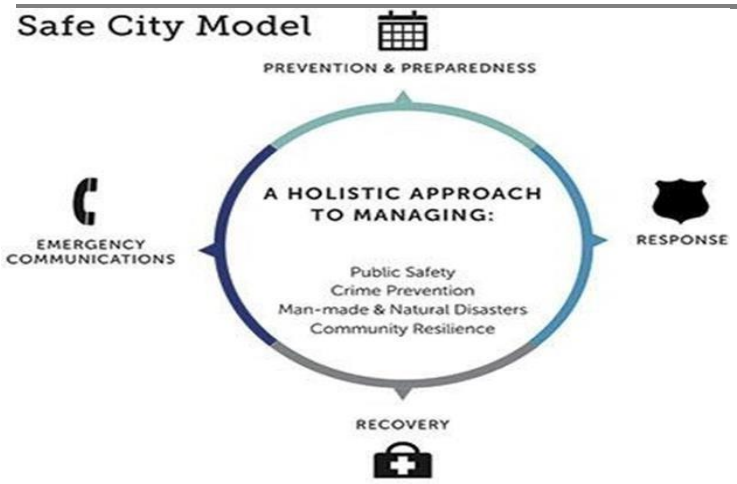

Figure 1 Safe city model

Technology can enhance smart city resilience. Information and communication technologies can integrate risk reduction strategies and strengthen a city's ability to recover from crises. Advancements in AI enable video analytics for city surveillance, incident detection, and analysis. Technology can also facilitate remote filing of police reports, a process often hindered by various factors. Social media platforms can be used to establish community volunteer networks that collaborate with local police for improved security.

LITERATURE REVIEW

Previous research highlights advancements in smart city safety and security.

Disaster Management: Fajardo and Oppus (2010) developed a mobile app for disaster response, allowing victims to request help and volunteers to locate them. Series and Science (2019) presented a system for rapid disaster recovery in Japan.

Surveillance Systems: Gautam et al. (2019) proposed a video analytics system for smart buildings using facial recognition with high accuracy. Vishwanath et al. (2002) introduced a real-time crime detection system using deep learning for decentralized surveillance. Sikandar (2019) explored image processing algorithms to detect suspicious behavior in ATM surveillance videos.

Security Frameworks: Ismagilova et al. (2020) provided a comprehensive review of security issues in smart cities, covering mobile devices, infrastructure, healthcare, and privacy concerns. Vogiatzaki and Zerefos (2020) proposed a framework using sensors, AI, and big data analytics to improve safety in public spaces. Elmaghraby and Losavio (2014) emphasized the need for robust cybersecurity measures in smart city development.

These studies demonstrate the potential of technology to enhance safety and security in smart cities. However, they often focus on specific areas or lack a unified approach. This research aims to address this gap by developing a comprehensive mobile application for various safety needs within a sustainable smart city.

Objectives

This research aims to develop an AI-powered mobile application that proactively enhances safety and security in smart cities. The app will offer a unified platform for various functionalities:

- Emergency and Disaster Management: Users can report and receive assistance during emergencies like storms, floods, fires, earthquakes, and medical situations.

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI | Special Issue |Volume XI Issue XIV November 2024

- Enhanced City Surveillance: Video analytics will enable crime detection, including detection of violence against women and children. Facial recognition, object detection, and anomaly detection will identify suspicious activity like loitering, graffiti, or slip-and-fall accidents.

- Improved Public Safety Reporting: Users can remotely register police reports and trigger discreet panic buttons for immediate assistance.

Community Engagement: The app will facilitate a platform for:

Volunteer Networks: Connecting citizens with NGOs to report suspicious activity and support community safety efforts.

• Public Awareness Campaigns: Delivering online educational resources to promote safety awareness.

By integrating these features, the app fosters a proactive and collaborative approach to safety within smart cities.

The objectives of the research are:

This research will focus on several key areas to achieve a comprehensive safety and security system for smart cities:

1. Analyze existing systems in smart cities to understand their strengths and weaknesses in handling emergencies and disasters.

2. Investigate the effectiveness of video analytics in city surveillance for crime detection, incident analysis, and public safety.

3. Develop a prototype mobile app with functionalities for: Remote registration of cases (e.g., emergencies, reports)

4. Discreet panic button for immediate assistance

5. Post-incident recovery and rehabilitation resources

6. Design a platform within the app to facilitate:

7. Connecting citizens with NGOs for safety efforts and reporting suspicious activity.

8. Enabling citizens to work with law enforcement for improved security.

9. Recommend a robust and unified safety and security system for smart city ecosystems.

10. Explore avenues for sharing the developed system with relevant stakeholders and potentially securing patent protection.

RESEARCH DESIGN AND METHODS

The comprehensive system consists of two parts. The first part is mobile based system prototype developed using Artificial Intelligence (AI) algorithms. The system prototype accepts video, image, text, schematics, drawings, audio and other smart city data consisting of various parameters as an input. The system prototype then process the data based on AI algorithms and provides the predictions of smart city safety and security issues as per various indicators. The predictions such as demographics, crime predictions, crime rate

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI | Special Issue |Volume XI Issue XIV November 2024

predictions, safety violation, security breaches, security violation, environmental hazard etc are based on various indictors. The proposed system also intelligently detects slip and fall, face detections in the crowd, objects detections in the crowd, pose detection, loitering detection which can act as a suffice and supplement to the safety measures needed for the smart cities of the future. The proposed system further facilitate collaborations between the community volunteers and the authorities to establish community volunteer network platform, which is an integrated approach towards public safety to provide safe and secure environment for citizens and business in a smart city. The system will be developed for mobile platform using android technologies, artificial intelligence, machine learning and image processing tool kits. The proposed system facilitates vision APIs, optimized for mobile devices and easy to use approaches. The second part is the final report which consists of various information pertaining to the development of the proposed research work. The report will be created as per the guidelines of TRC and compiled as per the report template provided by the TRC. The report shall be attached with a CD/Flash drive comprising of the prototype of the proposed system.

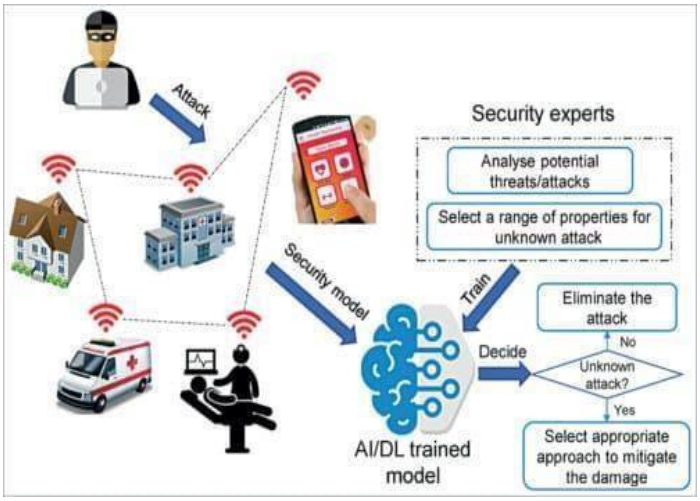

Figure 2 Use of AI in cybersecurity (Credit: www.mdpi.com)

Deductive research on safety and security aspects of the smart city would begin with an inductive research where reasoning and theories are formulated. The research then progresses to testing of these theories for validity. Deductive research methodology further enables formulation of research strategies and testing of hypothesis. The proposed smart city research also demonstrates the development of a prototype system and simulation of prototypes for result analysis. Hence the research also needs to follow system development life cycle models (SDLC) as a part of research methodologies. Development of system prototype will go through sequence of series, parallel and series-parallel process. Hence system prototype development demonstrates iteration model properties.

Significance

Safety and security are one of the primary challenges preventing smart cities to flourish. The standards of the possibly connected systems in the smart cities are evolving leading to exceptional enhancements in the quality of life. In order to take advantage from them, the smart city services and infrastructures are also evolving leading to more and more security and safety issues and challenges. Intelligent and integrated mobile application will aid during disaster recovery, emergency responders and public safety. Collaboration with NGO's and governmental agencies can avoid the delay in responding to public safety situations and also avoid missing any public safety advisory or alerts triggered by state, national or international bodies. More over this would be a more integrated approach to accomplish security and safety. Smart cities can be safer cities with healthier citizens making best use of potentially connected systems leading to a sustainable smart city ecosystem.

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI | Special Issue |Volume XI Issue XIV November 2024

Impact and Benefit to Oman

Owing to climate deviances throughout the globe and global warming (Charabi, 2010), predominantly in the Indian Ocean, Sultanate of Oman has become more vulnerable to cyclones during the past 15 years. Gonu, Phet, Nilofar, Mekunu, Luban etc are some of the cyclones witnessed by Oman. Appropriate measures are vital for fast disaster recovery, support emergency response activities etc. This integrated mobile application will be suitable for supporting life of people during these types of environmental hazards. Moreover, Oman is in the initial stage of establishing smart cities. This research work can form a baseline for further enhancing the security and safety aspects of the citizens accomplishing a sustainable smart city ecosystem.

Enabling technologies

AI relies on a powerful supporting cast to achieve its goals in security systems. This cast includes:

The Internet of Things (IoT): A network of connected devices like smart speakers, car cameras, and smart locks that gather data for AI analysis. As more devices join the IoT, the amount of data available for AI to learn from grows.

Cloud Computing: Companies like Microsoft, Alibaba, Amazon, and IBM offer secure cloud storage centers. This is a more reliable way to store and process the massive amount of data (Big Data) collected from IoT devices compared to traditional on-site servers. Cloud data can be accessed remotely through the internet.

Here's how it works:

Data Collection: IoT devices gather data from their surroundings.

Cloud Connection: Using 4G/5G networks, the data is sent to secure cloud storage centers.

- AI Analysis: Specialized software analyzes the Big Data to identify patterns and potential security threats.
- Actionable Insights: Users can then take preventative measures to protect people and property based on the AI's insights.

Future scope

While AI offers significant advantages in crime and accident detection, its implementation raises critical concerns about privacy and societal structures.

Privacy Risks and Lack of Transparency:

Unfettered use of AI by companies and governments can lead to serious privacy violations. A 2021 report by the Electronic Frontier Foundation (EFF) (https://www.eff.org/) highlights the dangers of unregulated AI surveillance, emphasizing the need for robust oversight mechanisms to prevent misuse. Furthermore, the opacity surrounding data collection and usage practices varies greatly across nations. For instance, some countries lack comprehensive data protection laws, leaving citizens vulnerable to unchecked surveillance practices.

Resource Constraints and Technical Challenges:

Large-scale AI implementation necessitates processing massive datasets, requiring significant computing power and hardware resources. A study by Nature in 2019 indicated that training a single large language model can generate carbon emissions equivalent to five cars over their lifetime. This resource intensiveness can hinder broader adoption, particularly in developing nations like India, which often rely on imported hardware.

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI | Special Issue |Volume XI Issue XIV November 2024

Additionally, compressing data for storage can compromise quality, making it difficult for deep learning algorithms to analyze low-resolution images effectively. Furthermore, reliable and fast internet connectivity is crucial for minimizing latency in data processing.

Accuracy and Bias Issues:

The accuracy of AI systems can be compromised by low-quality data or biases inherent in training datasets. A [research paper] (Selbst, Adrian, et al. " Fairness and Abstraction in Sociotechnical Systems." Proceedings of the Conference on Fairness, Accountability, and Transparency. ACM, 2019.) from 2019 explores how biases in training data can lead to discriminatory outcomes, disproportionately impacting minorities and specific genders. This is particularly concerning for applications like facial recognition, which can exhibit high false-positive rates under poor weather conditions or with distorted images. These limitations pose significant risks in situations of national or international importance.

The Rise of AI Surveillance and the Need for Balance:

Despite the challenges, AI adoption in security is on the rise. Leading companies like Huawei, IBM, NEC Corporation, Hikvision, Cisco, and ZTE are developing cutting-edge solutions to address security needs. However, it's crucial to recognize the need for a balanced approach. We must not blindly pursue the benefits of AI surveillance without establishing a clear equilibrium between:

- The capabilities of AI technology
- Legitimate government surveillance needs
- The fundamental right to privacy of citizens

Moving forward, robust legal frameworks, ethical considerations, and transparent data practices are essential for ensuring responsible and effective use of AI in security systems.

1. Enhance the functionalities in mobile application incorporating cyber security and privacy aspects.
2. Video analytics assisted unified city command and operations to monitor accidents and provide effective collaboration in response to emergencies.

. Enhance the functionalities in mobile application incorporating asset management solutions.

CONCLUSION

AI presents a transformative opportunity to create safer and smarter cities. By integrating AI with existing technologies like IoT and cloud computing, we can develop robust security systems that proactively deter crime, improve emergency response times, and empower citizens to participate in their own safety. However, harnessing the full potential of AI requires careful consideration. Robust legal frameworks, ethical development practices, and a commitment to data privacy are all crucial to ensure AI serves as a tool for good, fostering a secure and thriving urban environment for all. This conclusion emphasizes the potential of AI while acknowledging the need for responsible implementation. It also reiterates the paper's central theme: leveraging AI for a safer and smarter city.

REFERENCES

1. Charabi, Y. (2010) ‘Indian ocean tropical cyclones and climate change’, Indian Ocean Tropical Cyclones and Climate Change, (July), pp. 1–373. doi: 10.1007/978-90-481-3109-9.

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI | Special Issue |Volume XI Issue XIV November 2024

2. Elmaghraby, A. S. and Losavio, M. M. (2014) 'Cyber security challenges in Smart Cities: Safety, security and privacy', Journal of Advanced Research, 5(4), pp. 491–497. doi: 10.1016/j.jare.2014.02.006.
3. Fajardo, J. T. B. and Oppus, C. M. (2010) 'A Mobile Disaster Management System Using the Android Technology', 9(6), pp. 343–353.
4. Gautam K.S. and Senthil Kumar T (2019) 'Video analytics-based intelligent surveillance system for smart buildings', Soft Computing, 23, p. 2813 to 2837. Available at:
5. https://doi.org/10.1007/s00500-019-03870-2.
6. Hannah Ritchie, M. R. (2014) 'Natural Disasters', Our World in Data.
7. Ismagilova, E. et al. (2020) 'Security, Privacy and Risks Within Smart Cities: Literature Review and Development of a Smart City Interaction Framework'.
8. Lacinák, M. and Ristvej, J. (2017) 'Smart city, Safety and Security', Procedia Engineering, 192,
9. pp. 522–527. doi: 10.1016/j.proeng.2017.06.090.
10. Series, I. O. P. C. and Science, M. (2019) 'Implementation of a disaster management system for local governments in Japan Implementation of a disaster management system for local governments in Japan'. doi: 10.1088/1757-899X/615/1/012001.
11. Sikandar, Tasriva, K. H. and M. R. (2019) 'ATM crime detection using image processing integrated video surveillance: a systematic review', Multimedia Systems, 25, pp. 229–251. Available at: https://doi.org/10.1007/s00530-018-0599-4.
12. United Nations (2018) 68% of the world population researched to live in urban areas by 2050, says UN, Department of Economic and Social Affairs. Available at: https:// www.un.org/development/ desa/ en/ news/population/2018-revision-of-worldurbanization- prospects.html (Accessed: 1 June 2021).
13. Vishwanath, S., Prem, A. and S, G. S. (2002) 'Real-time Surveillance based Crime Detection for Edge Devices', Semantics Scholar. Available at: https://www.scitepress.org/ Papers/2020/ 89901/ 89901.pdf.
14. Vogiatzaki, M. and Zerefos, S. (2020) 'Enhancing City Sustainability through Smart Technologies: A Framework for Automatic Pre-Emptive Action to Promote Safety and Security Using Lighting and ICT-Based Surveillance', pp. 1–20.
15. World Health Organization (2020) Youth Violence. Available at: https://www.who.int/newsroom/ fact-sheets/detail/youth-violence.