THE USAGE OF SMARTPHONE APPLICATIONS IN SMART CITY DEVELOPMENT – PUBLIC SAFETY AND EMERGENCY SERVICES

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Purpose: The purpose of this publication is to present the usage of smartphone application in Smart Cities in public safety and emergency services.

Design/methodology/approach: Critical literature analysis. Analysis of international literature from main databases and polish literature and legal acts connecting with researched topic.

Findings: The integration of smartphone applications into smart city development for public safety and emergency services is a pivotal step toward creating safer, more efficient, and resilient urban environments. These apps empower citizens and authorities to collaborate effectively, enhancing response times and resource allocation during emergencies. Smartphone applications also provide timely alerts, navigation tools, and educational resources for disaster preparedness. However, challenges like limited access, privacy concerns, and digital literacy gaps must be addressed to fully harness their potential. Embracing these challenges through technology enhancements and user education can lead to safer and smarter urban environments.

Originality/value: Detailed analysis of all subjects related to the problems connected with the usage of smartphone applications in public safety and emergency services.

Keywords: Smart City, urban mobility, public safety, smartphone applications, smart mobility.

Category of the paper: literature review.

1. Introduction

The usage of smartphone applications in smart city development for public safety and emergency services is vital for creating safer, more efficient, and resilient urban environments. These apps empower both citizens and authorities to collaborate, respond effectively to crises, and make data-driven decisions, ultimately contributing to the overall well-being and quality of life in modern cities. Smart cities are a growing trend globally, and their development relies heavily on harnessing technology to enhance various aspects of urban life, including public safety and emergency response.

Smartphone applications play a pivotal role in improving the response times of emergency services. Citizens can use these apps to quickly report emergencies, such as accidents, fires, or medical incidents, by providing real-time location data and essential information. This enables emergency responders to reach the scene faster, potentially saving lives and minimizing property damage (Rahman, Dura, 2022).

Smart city applications can help allocate emergency resources more efficiently. By analyzing data from smartphones and other sources, city authorities can identify areas with higher accident rates, crime hotspots, or health emergencies. This data-driven approach allows for a more precise deployment of police, firefighters (Rachmawati et al., 2021; Dutta et al., 2021; Ivanyi, Biro-Szigeti, 2019).

The purpose of this publication is to present the usage of smartphone application in Smart Cities in the case of public safety and emergency services.

2. The usage of smartphone applications in public safety and emergency services

Smartphone applications are powerful tools for enhancing public safety and emergency management. They facilitate timely communication, provide vital information, and empower both authorities and the public to respond effectively to emergencies, ultimately saving lives and minimizing damage during crises (Herdiansayah, 2023; Rose et al., 2021). Many government agencies and local authorities have developed apps that can send emergency alerts and notifications directly to users' smartphones. These alerts can include weather warnings, natural disasters, Amber Alerts for missing children, and other critical information to keep the public informed and safe (Prajeesh, Pillai, 2022; Kuntska et al., 2023).

Citizens can use smartphone apps to report emergencies or suspicious activities to the authorities. These apps often allow users to provide details about the situation, attach photos or videos, and share their real-time location data. This reporting feature can significantly speed up emergency response times (Wolniak, Sułkowski, 2015, 2016; Wolniak, Grebski, 2018; Wolniak et al., 2019, 2020; Wolniak, Habek, 2015, 2016; Wolniak, Skotnicka, 2011; Wolniak, Jonek-Kowalska, 2021; 2022). During emergencies like natural disasters or large-scale events, smartphone apps can provide real-time navigation and evacuation route information. This helps people find the safest and quickest way to leave an affected area, reducing congestion and improving overall safety. Apps can provide information about nearby emergency shelters, their availability, and what amenities they offer (Wolniak, 2016; Czerwińska-Lubszczyk et al., 2022; Drozd, Wolniak, 2021; Gajdzik, Wolniak, 2021, 2022; Gębczyńska, Wolniak, 2018, 2023; Grabowska et al., 2019, 2020, 2021). This is especially useful during events like hurricanes, wildfires, or prolonged power outages (Benevolo et al., 2016; Kalasova et al., 2021).

Many apps include a list of important emergency contacts, including local police, fire departments, hospitals, and non-emergency services (Kalasova et al., 2021). Users can quickly access these numbers if needed. Some apps offer basic first-aid information and instructions for common medical emergencies. They can guide users through CPR, offer advice on handling burns or bleeding, and provide other essential medical information (Boichuk, 2020).

Apps can serve as educational tools to help citizens prepare for emergencies. They may include checklists for emergency kits, guidelines for creating family emergency plans, and information on disaster preparedness. During ongoing emergencies, smartphone apps can provide real-time updates on the situation. This includes weather updates, traffic conditions, and updates from local authorities. Citizens can stay informed about the evolving situation, helping them make informed decisions (Simonofski et al., 2023; Chmielarz et al., 2021).

Apps can collect and aggregate crowdsourced data from users, including reports of damage, power outages, or road closures. This information can be valuable for emergency responders to prioritize their efforts. Many apps offer features to support individuals with disabilities or those who speak languages other than the official language of the area (Sułkowski, Wolniak, 2015, 2016, 2018; Wolniak, Skotnicka-Zasadzień, 2008, 2010, 2014, 2018, 2019, 2022; Wolniak, 2011, 2013, 2014, 2016, 2017, 2018, 2019, 2020, 2021, 2022; Gajdzik, Wolniak, 2023). This ensures that emergency information is accessible to a broader range of citizens (Chmielarz et al., 2021).

Some emergency management apps integrate with social media platforms to share critical information and updates with a wider audience (Jonek-Kowalska, Wolniak, 2021, 2022, 2023; Rosak-Szyrocka et al., 2023; Gajdzik et al., 2023; Jonek-Kowalska et al., 2022; Kordel, Wolniak, 2021; Orzeł, Wolniak, 2021, 2022; Ponomarenko et al., 2016; Stawiarska et al., 2020, 2021; Stecuła, Wolniak, 2022; Olkiewicz et al., 2021). This can help reach individuals who may not have the app installed. For emergency management professionals, apps can be used to track the location and deployment of resources such as emergency vehicles, personnel, and supplies. This improves the efficiency of emergency response efforts (Rose et al., 2021). After an emergency, apps can provide resources and information on recovery efforts, including assistance programs, insurance claims, and community rebuilding initiatives (Dutta et al., 2019).

Table 1 contains descriptions of how smartphone applications are used in in public safety and emergency services.

Table 1.
How smartphone applications are used in public safety and emergency services

Aspect	Description
Communication	- **Emergency Alerts**: Apps provide real-time alerts for disasters, weather, and other emergencies.
	- **Two-way Communication**: Allows users to report incidents, send photos, and request assistance.
Mapping and Navigation	- **GPS & Location Services**: Apps offer real-time tracking, mapping, and navigation during emergencies.
	- **Evacuation Routes**: Provides evacuation route information and updates during crises.
Information Sharing	- **Incident Updates**: Delivers updates on emergency situations, road closures, and safety instructions.
	- **Social Media Integration**: Facilitates sharing of information on social media platforms.
Resource Management	- **Resource Allocation**: Helps authorities allocate resources like ambulances and firetrucks efficiently.
	- **Inventory Management**: Tracks equipment and supply levels in real-time.
Emergency Services	- **Request Services**: Allows users to request police, fire, or medical assistance.
	- **Emergency Contacts**: Provides quick access to local emergency numbers.
Crowdsourced Data	- **User-Generated Reports**: Encourages citizens to report incidents, road conditions, and hazards.
	- **Crowdsourced Damage Assessment**: Helps authorities assess damage quickly.
Situational Awareness	- **Live Video Feeds**: Offers live video streaming to assess situations remotely.
	- **Weather Updates**: Provides real-time weather information and forecasts.
Community Engagement	- **Community Alerts**: Sends alerts and updates to residents based on their location.
	- **Community Forums**: Allows users to connect, share information, and support each other.
Training and Preparedness	- **Training Modules**: Offers preparedness and safety training modules.
	- **Checklists & Guides**: Provides emergency response guides and checklists.
Data Analytics	- **Data Collection**: Collects data on incidents, responses, and user interactions.
	- **Predictive Analytics**: Uses data to predict future incidents and allocate resources.
Accessibility and Inclusivity	- **Multilingual Support**: Offers content in multiple languages.
	- **Accessibility Features**: Ensures access for individuals with disabilities.
Privacy and Security	- **Data Protection**: Ensures user data is secure and used only for emergency purposes.
	- **Authentication**: Secures access for authorized personnel only.
Integration with Other Systems	- **Integration with First Responder Systems**: Connects with CAD and RMS systems.
	- **Interagency Coordination**: Facilitates communication between different agencies.
Feedback and Reporting	- **User Feedback**: Allows users to provide feedback on app performance.
	- **Incident Reporting**: Enables users to report issues with the app.
Training and Support	- **User Training**: Provides training materials for app usage.
	- **24/7 Support**: Offers support for technical issues and emergencies.

Source: (Kalasova et al., 2021; Chmielarz et al., 2021; Rose et al., 2021; Dutta et al., 2019; Ivani, Biro-Szigeti, 2019; Leal et al., 2023; Chowdhury et al., 2023; Sanchez et al., 2018; Aguilera, Boutueil, 2018).

Table 2 highlighting the advantages of using smartphone applications in in public safety and emergency services within smart cities. These advantages underscore the crucial role that smartphone applications play in enhancing public safety and emergency services within smart cities, ultimately contributing to the well-being and resilience of urban communities.

Table 2.

Advantages of using smartphone applications in public safety and emergency services

Advantage	Description
Rapid Communication	- Instant notifications and alerts to residents during emergencies.
	- Two-way communication between authorities and citizens for real-time updates.
Enhanced Situational Awareness	- Real-time mapping and geolocation for improved incident response.
	- Access to live video feeds and sensor data for better decision-making.
Efficient Resource Allocation	- Smart apps help allocate resources like emergency vehicles and personnel optimally.
	- Data-driven insights lead to quicker response times and resource management.
Timely Emergency Alerts	- Residents receive timely alerts about natural disasters, accidents, or security threats.
	- Personalized alerts based on location, ensuring relevance.
Crowdsourced Data	- Citizens can report incidents, hazards, and provide valuable situational data.
	- Authorities gain a broader perspective of ongoing events.
Improved Community Engagement	- Apps foster community cohesion and trust by involving residents in safety efforts.
	- Enables community-driven initiatives for disaster preparedness.
Efficient Evacuation and Navigation	- Provides evacuation routes and real-time traffic updates during crises.
	- GPS navigation helps residents find safe zones quickly.
Data Analytics for Predictive Insights	- Collects and analyzes data to predict future emergencies and plan accordingly.
	- Supports data-driven policymaking and urban planning.
Access to Critical Information	- Access to emergency contact information, medical records, and medication lists.
	- Enables first responders to make informed decisions.
Accessibility and Inclusivity	- Ensures accessibility features for individuals with disabilities.
	- Multilingual support for diverse populations.
Reduction in Response Times	- Faster incident reporting and response through mobile apps.
	- Reduced manual data entry and paperwork.
Integration with IoT and Sensors	- Integrates with smart city sensors and IoT devices for real-time data.
	- Monitors environmental conditions and detects anomalies.
Enhanced First Responder Safety	- Real-time updates on hazards and threats to first responders.
	- Improved coordination among emergency services.
Privacy and Security Measures	- Ensures data security and privacy compliance.
	- Authentication mechanisms to prevent unauthorized access.
Cost Savings	- Efficient resource utilization leads to cost savings.
	- Reduced infrastructure costs compared to traditional alert systems.

Source: (Kalasova et al., 2021; Chmielarz et al., 2021; Rose et al., 2021; Dutta et al., 2019; Ivani, Biro-Szigeti, 2019; Leal et al., 2023; Chowdhury et al., 2023; Sanchez et al., 2018; Aguilera, Boutueil, 2018).

Table 4 highlighting some of the common problems and challenges associated with the usage of smartphone applications in *in public safety and emergency services* within smart cities. These problems and challenges highlight the complexity of implementing smartphone applications for public safety and emergency services in smart cities. Addressing these issues requires a multi-faceted approach, including technology infrastructure development, user education, and robust data governance.

Table 3.
Problems of using smartphone applications in in public safety and emergency services within smart cities

Problem	Description
Limited Access to Technology	- Not all residents may have smartphones or access to mobile networks.
	- Vulnerable populations may be disproportionately affected.
Reliance on Connectivity	- Dependence on mobile data and internet connectivity may lead to service interruptions during disasters.
	- Offline functionality may be limited.
Privacy Concerns	- Collecting and sharing personal data for emergency response can raise privacy concerns.
	- Ensuring secure data storage and transmission is crucial.
Digital Literacy	- Some residents, particularly older adults, may struggle to use smartphone apps effectively.
	- Requires education and training efforts.
App Compatibility and Updates	- Compatibility issues with different smartphone models and operating systems.
	- Frequent updates may lead to app instability or require user action.
False Alerts and Overload	- Misuse or false reporting through apps can overwhelm emergency services.
	- Distinguishing between genuine and false alarms can be challenging.
Cybersecurity Threats	- Apps and data are vulnerable to hacking and cyberattacks.
	- Ensuring robust cybersecurity measures is critical.
Language and Cultural Barriers	- Multilingual cities may struggle to provide information in all relevant languages.
	- Addressing cultural sensitivities and communication barriers is essential.
Resource Allocation Challenges	- Allocating resources based on app-generated data may lead to disparities.
	- Data quality and accuracy must be ensured.
Data Overload and Analysis	- Managing and analyzing the vast amount of data generated by apps can be overwhelming.
	- Requires advanced analytics tools and expertise.
Dependence on Smartphone Battery Life	- In prolonged emergencies, smartphone battery life may become a concern.
	- Power banks and charging stations may be needed.
Resistance to Adoption	- Some residents may resist using new technology for emergency communication.
	- Building trust and promoting adoption is challenging.
Network Congestion	- During large-scale emergencies, network congestion can hinder app functionality.
	- Dedicated emergency network infrastructure is needed.
Interoperability and Integration	- Ensuring apps can seamlessly integrate with existing emergency systems and technologies.
	- Compatibility between different agencies' apps is vital.
Cost of Development and Maintenance	- Developing and maintaining robust emergency apps can be expensive.
	- Funding challenges may arise.
User Error and Misuse	- Users may unintentionally cause errors or misuse the app during emergencies.
	- Clear user interfaces and training can mitigate this.
Dependence on Electricity	- Smartphones require electricity to function; power outages can disrupt communication.
	- Backup power solutions are needed.

Source: (Kalasova et al., 2021; Chmielarz et al., 2021; Rose et al., 2021; Dutta et al., 2019; Ivani, Biro-Szigeti, 2019; Leal et al., 2023; Chowdhury et al., 2023; Sanchez et al., 2018; Aguilera, Boutueil, 2018).

One of the primary challenges lies in ensuring equitable access to smartphone technology. Not all residents may possess smartphones or have reliable access to mobile networks. To address this issue, local governments can step in by providing subsidized smartphones or mobile hotspots to underserved communities. Additionally, the establishment of public spaces

equipped with free Wi-Fi can bridge the digital divide. Public safety apps heavily rely on mobile data and internet connectivity, making them susceptible to service interruptions during disasters. A solution to this is the development of backup communication systems, such as radio-based networks, to ensure continuous communication even when traditional networks fail. Furthermore, optimizing apps for offline functionality can prove invaluable during emergencies.

As these apps collect and share sensitive personal data for emergency response purposes, privacy concerns inevitably arise. Striking the right balance between collecting necessary data for emergency management and safeguarding individual privacy is crucial. Strict data protection policies and adherence to privacy regulations are a must. Transparent communication regarding data usage and storage policies helps build trust among users. Digital literacy is another challenge, particularly among older adults and those less familiar with smartphone technology. To address this, cities can launch digital literacy training programs tailored to different age groups and skill levels. Furthermore, designing user-friendly interfaces and providing in-app tutorials and guides can make these apps more accessible to all.

The diverse landscape of smartphone models and operating systems can pose compatibility challenges. Regular testing across various devices and operating systems is essential to ensure broad accessibility. Clear instructions for users on updating apps, along with automated update mechanisms, can simplify maintenance. Misuse or false reporting through apps can overwhelm emergency services. Implementing user authentication and verification mechanisms can reduce false reporting. Educational campaigns can educate the public on responsible app usage and the potential consequences of misuse.

Apps and the data they handle are susceptible to hacking and cyberattacks. Robust cybersecurity measures, including encryption, intrusion detection, and frequent security audits, are necessary to safeguard sensitive information. Developing incident response plans to mitigate cyberattacks swiftly is equally vital. Cities with diverse populations may struggle to provide information in multiple languages and navigate cultural sensitivities. Translating app content into relevant languages and consulting with community leaders and cultural experts can help overcome these challenges.

Efficiently allocating resources based on app-generated data can be challenging. Advanced data analytics tools and protocols for validating and prioritizing incoming data can streamline this process. Clear procedures for responding to app-generated reports and incidents are essential. The vast amount of data generated by these apps can be overwhelming. Investing in big data analytics tools and expertise to manage and extract insights from these datasets is critical. Automated algorithms can assist in analyzing and interpreting data in real-time.

In prolonged emergencies, smartphone battery life may become a concern. Providing access to charging stations in public spaces and emergency shelters is a practical solution. Encouraging residents to maintain backup power sources, such as power banks, can also mitigate this challenge. Some residents may resist using new technology for emergency communication due

to unfamiliarity or distrust. Public awareness campaigns that highlight the benefits of emergency apps, along with endorsements from community leaders and local influencers, can promote adoption.

During large-scale emergencies, network congestion can hinder app functionality. Investment in robust network infrastructure with priority access for emergency services and protocols for load balancing during peak usage can alleviate this issue. Ensuring seamless integration of apps across various emergency agencies and with existing systems is crucial. Establishing standards and protocols for app integration, along with fostering collaboration between agencies, can enhance information sharing and coordination.

Developing and maintaining robust emergency apps can be expensive. Seeking public-private partnerships for funding and resource sharing can alleviate budget constraints. Prioritizing budget allocations for these critical applications is essential. Users may inadvertently cause errors or misuse the app during emergencies. Designing intuitive user interfaces, providing clear instructions, and offering ongoing user support and education can minimize these challenges.

Smartphones require electricity to function, making them vulnerable during power outages. Installing backup power systems in critical locations, such as emergency operations centers and communication hubs, and creating awareness about power outage preparedness can mitigate this concern.

Addressing these challenges requires a collaborative effort involving government agencies, technology developers, community organizations, and the public. By proactively tackling these issues, cities can harness the full potential of smartphone applications to enhance public safety and emergency services, ultimately creating smarter and more resilient urban environments.

3. Conclusion

In the ever-evolving landscape of smart city development, the integration of smartphone applications for public safety and emergency services stands as a vital pillar in creating urban environments that are safer, more efficient, and ultimately, more resilient. These applications empower both citizens and authorities to collaborate effectively, respond swiftly to crises, and make data-driven decisions that enhance the overall well-being and quality of life in modern cities.

Smart cities are rapidly gaining traction worldwide, and their evolution hinges on harnessing technology to improve various facets of urban life, including public safety and emergency response. Smartphone applications play a pivotal role in this transformation, revolutionizing the speed and efficiency of emergency services.

By allowing citizens to report emergencies in real-time, provide critical information, and share their precise locations, smartphone applications enable emergency responders to reach incidents faster, potentially saving lives and reducing property damage. These applications also contribute to more efficient resource allocation by analyzing data from various sources, ensuring that emergency personnel and equipment are deployed precisely where they are needed most.

Moreover, the advantages of smartphone applications extend beyond rapid response times. They facilitate timely emergency alerts, equip citizens with navigation tools during crises, provide information on evacuation routes and shelter locations, and maintain up-to-date contact lists for essential services. These apps also serve as educational platforms for disaster preparedness, offering training modules, checklists, and guidelines to help citizens plan and respond effectively to emergencies.

Crowdsourced data collection is another significant feature, allowing users to report incidents, road conditions, and hazards. This invaluable information aids emergency responders in prioritizing their efforts during critical situations. Smartphone applications are designed with inclusivity in mind, offering support for individuals with disabilities and multilingual capabilities to cater to diverse populations.

These applications even transcend individual utility by integrating with social media platforms, facilitating the dissemination of crucial information to a wider audience. For emergency management professionals, these apps enable the tracking and deployment of resources, enhancing the overall efficiency of emergency response efforts. Furthermore, post-emergency phases benefit from these applications by offering resources and information on recovery efforts, insurance claims, and community rebuilding initiatives.

Despite their undeniable advantages, the implementation of smartphone applications for public safety and emergency services within smart cities is not without its challenges. Limited access to technology, reliance on connectivity, privacy concerns, digital literacy gaps, compatibility issues, and cybersecurity threats are among the hurdles to overcome. Additionally, challenges related to language and culture, resource allocation, data overload, user errors, and resistance to adoption require careful consideration and strategic solutions.

Addressing these challenges necessitates a holistic approach that encompasses technological enhancements, user education, and robust data governance. By embracing these challenges head-on and working collaboratively with government agencies, technology developers, community organizations, and the public, smart cities can fully harness the potential of smartphone applications to enhance public safety and emergency services. In doing so, they pave the way for urban environments that are not only smarter but also safer and more resilient for all their residents.

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