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iSafeButuan: A GPS-Enabled Android Mobile Application Enhancing Citizen-Police Collaboration for Incident Reporting and Emergency Response

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Abstract: *This paper presents the development and implementation of iSafeButuan, a mobile application designed to improve citizen-police communication and access to emergency services in Butuan City. Developed using an agile methodology, the app integrates GPS technology to accurately locate the nearest police stations and enable officers to pinpoint citizens' exact locations. Key features include an intuitive incident reporting system, direct contact with police officers within the user's jurisdiction, and easy retrieval of emergency hotlines. System Usability Scale assessments, together with positive user feedback, highlight the application's strong acceptance and ease of use, confirming its effectiveness in addressing ongoing challenges in emergency reporting and access. This integrated solution demonstrates the effectiveness of combining mobile technology, GPS integration, and user-centered design, offering a scalable platform to enhance public safety and strengthen collaborative efforts between citizens and law enforcement.*

Keywords: Mobile Application Development; GPS Technology; Public Safety; Emergency Reporting; User Acceptance Testing

1. INTRODUCTION

Police hold significant importance globally as the primary unit responsible for maintaining peace, enforcing laws, preventing crimes, and protecting the community [1]. The study of [2] demonstrates the importance of utilizing modern technologies to tackle the difficulties caused by urbanization and contributes to the advancement of solutions. Thus, the evolving demands of urban safety call for innovative approaches that facilitate effective communication between citizens and law enforcement agencies [3]. Information and communication technologies are transforming modern cities into smart cities [4], specifically in the domain of crime and incident reporting the implementation of cloud-based solutions like Firebase, a NoSQL JSON database that is already utilized to enable data storage and real-time synchronization across Android, Web, and iOS platforms [5]. Firebase handles database management for stored reports, while the Google Maps API provides reliable geolocation services to display and locate the nearest police stations for prompt response [6], [7]. The React framework is widely adopted for its scalability and reusable interface components, facilitating elastic web applications[8]. React Native, combined with the Expo framework, simplifies mobile app development by streamlining setup and build processes[9]. Prior studies demonstrate these technologies' applications in crime reporting: [10]developed an Android-based system using Firebase; CitiSafe utilizes React Native, Firebase, and ReactJS for mobile and web interfaces [11]. Additionally, [12] employed the Geolocation API and Haversine formula to calculate distances in reporting, while [7]integrated Google Maps API for location tracking and reporting to nearby police stations. These studies collectively highlight the effectiveness of combining contemporary web and mobile technologies with geolocation services to enhance crime reporting and response mechanisms.

Within Butuan City, from July 2023 to January 2024, there were 2,531 recorded incidents, including 642 index

crimes and 1,889 non-index crimes. The Butuan City Police Office (BCPO), comprising five police stations, operates within distinct jurisdictional areas. Prompt communication between citizens and police stations or officers within the correct jurisdiction is essential for effective response. Traditional reporting mechanisms rely mainly on manual phone calls or in-person visits [6], which complicates timely and efficient communication during emergencies. Additionally, many applications lack integration with local administrative boundaries, which can delay or misdirect emergency responses, especially in multi-jurisdictional urban landscapes, as noted in the development challenges faced by interactive crime reporting platforms [11].

To address these challenges, the iSafeButuan mobile application was developed to enable residents to efficiently report incidents and access emergency services through an intuitive platform integrated with geolocation functionalities. The app identifies the police station jurisdictions corresponding to the user's barangay, facilitates locating the nearest police station, enables police officers to respond to the precise location of an incident reported by the user, supports incident reporting including anonymous submissions, and provides quick access to emergency hotlines for police and related authorities. By leveraging GPS technology coupled with reliable internet connectivity, the iSafeButuan application promotes a safer and more interconnected urban environment. The system's context-sensitive approach advances the collaborative capacity between law enforcement agencies and citizens. Therefore, utilizing these technological features enables the system to effectively meet the community's specific needs and significantly support public safety efforts within Butuan City.

2. METHODOLOGY

2.1 Conceptual Framework

The data flow and interaction processes within the iSafeButuan system are depicted in Figure 1.



Fig. 1: Conceptual Framework of iSafeButuan

Figure 1 provides a visual representation of the essential components and their interconnections, illustrating the key processes underlying the operation of the iSafeButuan application. The iSafeButuan mobile application, developed using React Native and Expo Go with Expo SDK, enables citizens to submit incident reports directly to the police station within their jurisdiction via Android devices. The application integrates the Google Maps API for location services, facilitating features such as geolocation and routing.

Each police station is equipped with a web-based application built on React and served by a backend running Node.js, allowing authorized personnel to log in and receive incoming reports from community members. Data is stored and synchronized across the Butuan City Police Office (BCPO) and its five subordinate police stations using a shared Firebase Firestore database, ensuring efficient real-time updates. User authentication, including anonymous, email/password, and phone number sign-ins, is securely managed via Firebase Authentication, providing controlled access to both the mobile and web apps. Upon receipt of an incident report, the police station assesses whether it requires deployment of uniformed or non-uniformed personnel and forwards the report to officers' mobile devices via Firebase Cloud Messaging for real-time notifications.

Police officers, upon acceptance of the report, activate location sharing powered by GPS and Google Maps routing to track their route and distance to the incident site, enhancing situational awareness. The centralized police station web app monitors the response status. The app's "help me" feature allows victims to share their current geolocation with the nearest responding officer and the police station, accelerating emergency response. Additionally, citizens can identify the nearest police station with integrated Google Maps routing support, utilize anonymous reporting functionalities to safeguard reporter privacy, and access emergency hotline numbers for police, Bureau of Fire Protection, and City Disaster Risk Reduction and Management Office directly through app interfaces leveraging Expo Call and Expo SMS APIs. This integrated technology stack enables efficient data flow and interaction among citizens, police stations, and responding officers, strengthening collaboration and improving public safety in Butuan City

2.2 Data Collection and Pre-survey

To gather essential data on smartphone and internet usage, as well as citizen reporting and law enforcement accessibility in Butuan City, a pre-survey questionnaire

was administered through both surveys and face-to-face interviews. The questionnaire utilized a binary (yes/no) response format, known for its high reliability [13] and ease of interpretation [14].

QUESTIONS	YES	NO
I. Smartphone and Internet Usage		
1. Do you always use a smartphone whenever you go?		
2. Whenever you go, do you always have an internet or mobile data network?		
II. Citizen Reporting and Knowledge of Police		
3. Do you know the location of each of the police stations here in Butuan City?		
4. Is it easy to reach out the police station that covers your Barangay when you need to make a report?		
5. In your Barangay, is it easy for you to contact the police officers to report incidents and seek immediate assistance?		
6. If you are in a different Barangay, is it easy for you to reach the police station that has jurisdiction over the Barangay you are in?		
7. If you are in a different Barangay, is it easy for you to reach out police officers that has jurisdiction over the Barangay you are in to report incidents and seek immediate assistance?		
8. Is it easy for you to get hotline numbers and contact relevant authorities for emergency response?		
9. If you find yourself as a victim, is it easy for you to report to the nearest police station and request immediate assistance from police officers?		
10. Is it easy for you to report and share information about suspicious activities or potential suspects with the police in Butuan City?		

Figure 2: Pre-survey Questionnaire

To ensure the representativeness and accuracy of the study results, the sample size was calculated using Cochran's formula $n = \frac{z^2 p (1-p)}{e^2}$ for finite populations. Parameters applied included a Z-score of 1.96 for a 95% confidence level, an estimated proportion of 0.5, and a margin of error of 0.05. Given the population of Butuan City at approximately 385,000, the calculated sample size was determined to be 384 respondents. Purposive sampling was employed to select participants meeting specific criteria, notably Android smartphone users residing in Butuan City. Before participation, informed consent was obtained to uphold ethical standards, ensuring the anonymity and confidentiality of respondents.

2.3 System Response Workflow

The iSafeButuan system facilitates a comprehensive workflow to enhance citizen reporting and law enforcement responsiveness in Butuan City. This process involves coordinated interactions between citizens, the police station, and police officers in the field, supported by the features of the iSafeButuan mobile application.

- Citizen Reporting** – Citizens can transmit various types of reports through the iSafeButuan Android mobile application. The app enables direct submission of emergency reports requiring immediate police assistance, anonymous reports to protect the identity of the informant, and incident reports detailing non-urgent issues. Features include the ability to send location data, select barangay jurisdictions, and provide detailed information via structured forms. For anonymous reporting, citizens enter an alias, choose the type of report, specify details, and submit without fear of being traced, thus encouraging reporting by those otherwise hesitant due to safety concerns. Additionally, the app offers convenient access to emergency hotlines, police contacts, and a feature to locate the nearest police station using GPS technology. Citizens can initiate calls or messages directly from the app to the relevant authorities, ensuring swift communication channels.

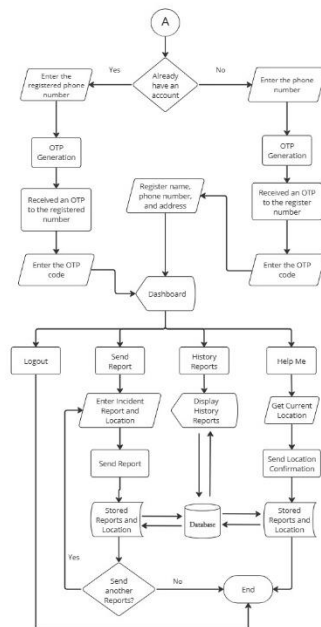


Fig. 3. Flowchart A – LogIn and Citizen Reporting

- Police Station Response** – Upon receiving reports, police officers stationed at the police station access a centralized dashboard that consolidates all submitted reports—emergency, anonymous, and incident reports—with a default status of "pending." The dashboard provides tools to monitor report statuses, mark anonymous reports as "investigated," and flag reports as true or false, updating their status accordingly to "responded." Police station personnel also oversee emergency reports to verify timely responses and assign officers to incidents. Through the dashboard, officers can dispatch either uniformed or non-uniformed responders based on the nature and urgency of the reported incidents. This centralized workflow ensures an organized and prioritized response to citizen reports.

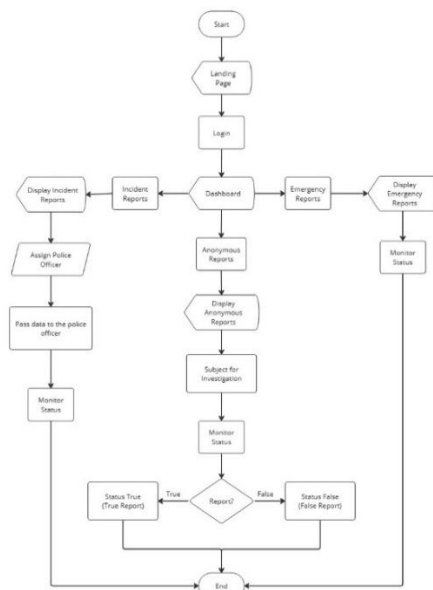


Fig. 4. Flowchart – Police Station Web Application

- Police Officer Response** – Police officers in the field receive notifications and incident details on their mobile devices. They can view report specifics, assess the situation, and update the report status. Officers have the capability to navigate to the exact location of the incident using the app's GPS-enabled features, facilitating rapid and accurate deployment. The system also supports police officer authentication and account management, allowing officers to maintain access to real-time updates and respond effectively. Officers can mark investigations as completed and provide status feedback to the police station, ensuring seamless communication throughout the incident resolution process.

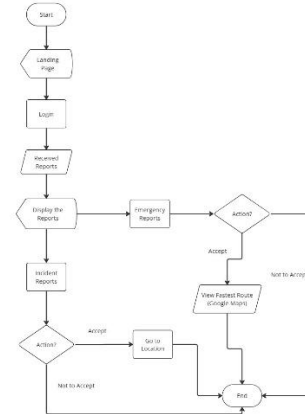


Fig. 5. Flowchart – Police Officer

2.4 Testing

A comprehensive testing process was conducted to ensure the reliability, functionality, and user-friendliness of the iSafeButuan mobile application. This process involved unit testing, integration testing, and user acceptance testing, each designed to validate specific aspects of the system.

- Unit Testing** – Unit testing is a fundamental part of the Software Development Life Cycle (SDLC), emphasizing its importance in software design, implementation, integration, and maintenance stages[15]. Modules such as the login system, report submission interface, GPS integration, emergency contact features, and notification services were tested independently. Test cases aligned with system requirements were executed to detect bugs or malfunctions at an early stage. Detected issues were documented and resolved promptly to ensure component reliability.
- Integration Testing** – Following unit testing, integration testing assessed the interaction between combined modules. This phase focused on confirming seamless communication among the mobile application's user interfaces, backend databases, web APIs, and police dashboard functionalities.
- User Acceptance Testing** – User acceptance testing evaluated the system's usability and acceptance under real-world conditions with participants representative of the target user base in Butuan City. Participants performed typical tasks such as incident reporting,

emergency contact, and location tracking. Feedback was collected through structured surveys using a five-point Likert scale ranging from strongly disagree to strongly agree. This approach facilitated assessment of ease of use, functionality, and overall satisfaction, providing valuable input for further system enhancements[16], [17].

- **System Usability Scale Testing** – The study utilizes the System Usability Scale (SUS) to assess the usability of the application. The SUS is a widely used questionnaire-based method for measuring the perceived usability of a system or application[18]. It consists of a series of statements related to the system's usability, and respondents rate their level of agreement or disagreement on a Likert scale.

3. RESULTS AND DISCUSSION

3.1 iSafeButuan Citizen Mobile Application

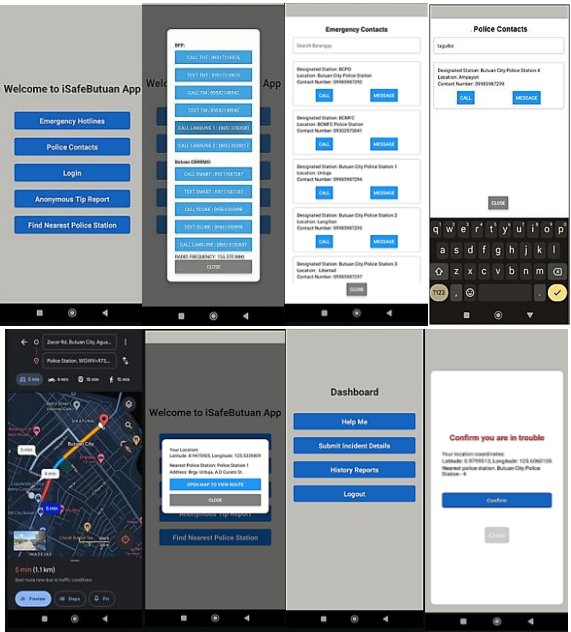


Fig. 6. iSafeButuan Citizen Mobile Application Interface

The iSafeButuan mobile application as shown in Figure 6, has been deliberately designed with a user-centric approach to enhance communication and collaboration between the citizens of Butuan City and local law enforcement agencies. The application's Home Page functions as the central navigation hub, providing users with immediate access to critical features essential for emergency situations and routine reporting. Key functionalities accessible from the Home Page include Emergency Hotlines, Police Contacts complete with hotline numbers, a secure Login system, Anonymous Reporting options, and a GPS-integrated tool to locate the nearest police station. This centralized and intuitive interface ensures that users can quickly and effortlessly navigate the application even under stressful or urgent circumstances. The Emergency Hotlines interface aggregates essential contact information from various emergency response authorities, such as the Bureau of Fire Protection (BFP) and the City Disaster Risk Reduction and Management Office (CDRRMO), thus facilitating swift

communication with relevant agencies. Complementing this is the Police Contacts interface, which provides a curated directory of police stations and officers within the user's jurisdiction, complete with direct hotline numbers. The ability to directly call or message these contacts streamlines the reporting process and improves responsiveness. Leveraging GPS technology, the Find the Nearest Police Station feature allows users to identify their current location on a map or search by barangay name to obtain directions and contact details for the closest police station. This dynamic location service enhances the accessibility of police services and ensures that assistance can be requested from the most appropriate facility.

Beyond these core functionalities, the application includes a personalized Dashboard that presents users with an overview of their recent reports, notifications, and status updates, supporting continuous engagement and situational awareness. A particularly notable feature is the Help Me Button, designed to enable users to instantly transmit distress signals along with their real-time geolocation data directly to the nearest police officers. This function is critical in emergencies, as it facilitates rapid dispatch of assistance and provides users with peace of mind. Collectively, these interfaces embody a well-structured, responsive, and user-friendly design that not only prioritizes ease of use but also fosters effective collaboration between the community and law enforcement. By integrating diverse communication channels and GPS-assisted services, the iSafeButuan application significantly contributes to enhancing public safety and emergency response efficiency in Butuan City.

3.2 iSafeButuan Police Web Application

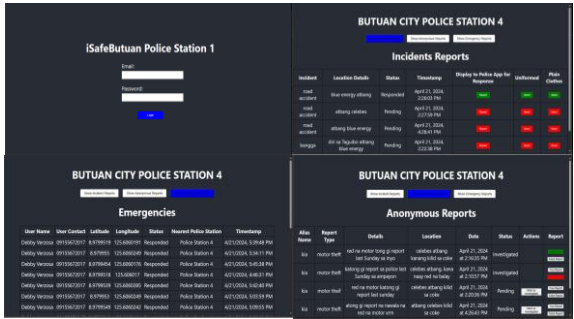


Fig. 7. iSafeButuan Police Web Interface

Figure 7 shows the iSafeButuan Police Web Interface and serves as a platform for police officers and station personnel, enabling efficient management and response to citizen reports submitted through the mobile application. Access to the web interface begins with a secure Police Station Login Page, where authorized officers authenticate themselves using their email and password credentials. This authentication process ensures that sensitive information and incident reports are protected and accessible only to verified personnel. Once logged in, police officers gain access to a comprehensive dashboard that consolidates various types of reports submitted by citizens, categorized into Incident Reports, Emergency Reports, and Anonymous Reports. The Incident Reports section provides detailed information about non-emergency occurrences that require police attention, including specifics such as

incident descriptions, timestamps, and location data. This allows officers to monitor, track, and efficiently prioritize cases that need follow-up or investigation.

The Emergency Reports section focuses on urgent incidents requiring immediate police intervention. These reports are flagged accordingly within the interface to facilitate rapid assessment and deployment of resources, ensuring timely response to critical situations. Police officers can view real-time updates and relevant details that aid in decision-making and incident resolution.

Furthermore, the Anonymous Reports feature addresses community concerns regarding privacy and safety, allowing citizens to submit reports without revealing their identities. The police web interface handles these reports with caution, preserving anonymity while enabling verification and validation where possible. This fosters greater community engagement by encouraging reporting of suspicious activities or incidents without fear of retaliation.

Overall, the iSafeButuan Police Web Interface integrates these various reporting modules into a unified system that enhances situational awareness and operational efficiency for law enforcement. By streamlining access to diverse report types and ensuring secure communication, the web interface supports effective policing efforts and strengthens the partnership between the police force and the community they serve.

3.3 iSafeButuan Police Mobile Application



Fig. 8. iSafeButuan Police Mobile Application Interface

The iSafeButuan Police Mobile Application, as shown in Figure 8, is designed to provide police officers with a secure, efficient, and user-friendly platform to manage and respond to incidents reported by citizens in Butuan City. The interface begins with the Login Page, where officers authenticate themselves through their email and password, ensuring secure access to the application's features and sensitive citizen information.

Upon successful login, police officers are directed to the Incident Reports Page, which serves as a centralized dashboard displaying detailed reports submitted by users. This page presents critical information such as incident descriptions, timestamps, and the status of investigations, allowing officers to effectively monitor, prioritize, and address each case. The interface facilitates easy navigation between reports, supporting timely and organized responses.

Complementing the incident management capabilities is the Need Help Page, designed to assist officers in requesting support or immediate assistance when necessary. This feature enhances communication within the police force by enabling officers to signal

emergencies or call for backup directly through the application, thus improving operational coordination and safety.

Integrating with these functionalities is the Device Google Maps feature, which embeds GPS technology within the application. This mapping service provides real-time geolocation data related to incident reports and user locations, enabling officers to visually track and navigate to reported incidents efficiently. The map interface also assists in resource allocation by displaying geographic distribution of incidents and available personnel.

Together, these components of the iSafeButuan Police Mobile Application Interface form a robust tool that empowers police officers with secure access, comprehensive incident monitoring, rapid internal communication, and geospatial awareness. The cohesive integration of these features enhances law enforcement's responsiveness and operational effectiveness, ultimately contributing to improved public safety within the community.

3.4 Survey Results

Table 1. Pre-Survey Result

I. Smartphone and Internet Usage	Percentage of Yes	Percentage of No
Q1	100%	0%
Q2	91.67%	8.33%
II. Citizen Reporting and Knowledge of Police		
Q3	5.47%	94.53%
Q4	13.28%	86.72%
Q5	5.99%	94.01%
Q6	4.43%	95.57%
Q7	3.39%	96.61%
Q8	2.08%	97.92%
Q9	2.86%	97.14%
Q10	1.82%	98.18%

Table 1 presents the percentage results of the pre-survey questionnaire, organized in a tabulated format to facilitate data analysis using descriptive statistics. In the "Smartphone and Internet Usage" section, 100% of respondents answered "yes" to question Q1, indicating that all participants use smartphones and have internet access. For Q2, 91.67% responded "yes," while 8.33% responded "no," revealing that a small portion of participants do not consistently use smartphones or have internet connectivity.

In contrast, the "Citizen Reporting and Knowledge of Police" section reflects considerably lower awareness and engagement. The percentage of respondents answering "yes" to questions Q3 through Q10 ranges from only 1.82% to 13.28%, whereas the "no" responses vary between 86.72% and 98.18%. These findings highlight a significant gap in knowledge and understanding of citizen reporting and police accessibility among the participants, underscoring the need for targeted educational initiatives to improve public awareness and participation in community safety efforts.

Table 2. User Acceptance Testing Result

	PA _{nnt} (%)	PU _{nnt} (%)	PA _t (%)	PU _t (%)	PA _{av} (%)	PU _{av} (%)
Q3	91.4	8.6	83.1	17	87	13
Q4	98.9	1.2	88.8	11	94	6.2
Q5	99.5	0.5	95.6	4	98	2.5
Q6	97.8	2.2	93.5	7	96	4.3
Q7	93.6	6.4	88	12	91	9.2
Q8	98.4	1.6	95.8	4	97	2.9
Q9	94.7	5.2	93.8	6	94	5.8
Q10	94.9	5.2	91.2	9	93	7

Table 2 presents the User Acceptance Percentage Results, offering a comprehensive breakdown of user acceptance levels for each question in the User Acceptance Testing (UAT) survey. The table details the percentages of both acceptability and unacceptability associated with each survey item.

The analysis of the Likert scale responses reveals a high overall percentage acceptability (PA) of 93.68%, contrasted by a relatively low percentage unacceptability (PU) of 6.32%. This indicates that the vast majority of respondents expressed positive sentiments toward the application, endorsing its ease of use in reporting incidents and facilitating communication with the police. Conversely, only a small minority (6.32%) of participants conveyed disagreement or negative perceptions of the application. Overall, these results reflect a strong and favorable reception of the application among users, supporting its acceptance and potential effectiveness as a tool for community safety and reporting.

Table 3. System Usability Scale Testing Result

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Q1	0	0	128	202	54
Q2	90	230	64	0	0
Q3	0	0	28	228	128
Q4	64	228	92	0	0
Q5	0	0	124	234	26
Q6	26	241	117	0	0
Q7	0	0	102	256	26
Q8	115	141	128	0	0
Q9	0	0	77	228	79
Q10	0	204	142	38	0

A majority of respondents expressed positive interest in the system, with 54 strongly agreeing and 202 agreeing that they would like to use it frequently (Q1). Regarding complexity, 230 respondents disagreed and 90 strongly disagreed that the system is unnecessarily complex (Q2), indicating it is perceived as straightforward. Ease of use was affirmed by 228 who agreed and 128 who strongly agreed (Q3). Furthermore, 228 respondents disagreed and 64 strongly disagreed that technical support was needed (Q4), suggesting a high level of user self-sufficiency. In terms of system integration (Q5), 234 agreed and 124 remained neutral, while perceptions of

inconsistency (Q6) were more mixed, with 241 disagreeing and 117 neutral. For learnability, 256 agreed and 102 were neutral (Q7), whereas 141 disagreed and 115 strongly disagreed that the system was cumbersome to use (Q8). Confidence levels were strong, with 228 agreeing and 79 strongly agreeing (Q9). Finally, 204 respondents agreed they needed to learn a lot before using the system (Q10), highlighting differing views on the learning curve. These results emphasize both positive user experiences and areas where improvements can enhance usability.

4. CONCLUSION

This study highlights the positive impact of the iSafeButuan mobile application in addressing the challenges faced by citizens in Butuan City regarding reaching out to police stations and police officers under their area of jurisdiction and accessing emergency hotlines with the objective to develop mobile application and implement GPS feature for the mobile application.

The results of the pre-survey indicate that a large majority of the participants, 95.085%, have limited knowledge or awareness of police and citizen reporting. This highlights the opportunity to leverage technology, especially considering that 95.83% of the population uses Android smartphones. The integration of GPS technology and the development of the application undergoes various testing to ensure its functionality and usability and it has significantly improved users' ability to know the location of each police station, reach out to the police station covering their Barangay, contact police officers, obtain hotline numbers, and report incidents.

The positive user feedback and high agreement percentages of 93.68% indicate a strong level of acceptance for the application's easier report and contact mode. The majority of users agreed or strongly agreed that the application is easy to use and provides a convenient platform for reporting, contacting, and sharing information with the police. This feedback will be valuable for the researchers in determining the usability of the application and assessing its level of acceptance among users. By considering the positive user feedback and high agreement percentages, the researchers can conclude that the application is likely to be well-received and accepted by users, particularly for its ease of reporting and contact features. Moreover, a range of 71.386 score which is equivalent to scale 4 that indicates good and functional of the system usability scale, this feedback contributes to the overall assessment of the application's usability and effectiveness in meeting user needs and expectations. It demonstrates the success of the application in improving public safety and fostering effective collaboration between citizens and the police in Butuan City. The iSafeButuan mobile application has proven to be a valuable tool in enhancing citizen engagement, enabling online reporting processes, and promoting a safer environment.

Overall, the iSafeButuan mobile application has proven to be a valuable solution in promoting citizen-police communication and accessibility to emergency services. The application contributes to the advancement of public safety initiatives and the creation of a safer and more connected community in Butuan City. Future work on the iSafeButuan application should focus on continuous updates and improvements based on user feedback to

maintain its effectiveness and relevance. Efforts to increase user awareness through campaigns and training will help boost adoption and community acceptance. Expanding integration to include more emergency hotlines beyond BFP and CDRMO will enhance functionality and speed emergency responses. Additionally, developing versions of the app for other mobile platforms such as iOS will broaden the user base. Lastly, implementing a dynamic system to update police station locations will ensure accuracy if stations relocate.

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