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A HOLISTIC FRAMEWORK FOR CRIME PREVENTION, RESPONSE, AND ANALYSIS WITH EMPHASIS ON WOMEN SAFETY USING TECHNOLOGY AND SOCIETAL PARTICIPATION

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ABSTRACT

Ensuring women's safety in smart cities is a need of the hour. Even though several legal and technological steps are adopted worldwide, women's safety continues to be an international concern. Criminal records are maintained by law enforcement agencies and are most often not available to the public in an easily comprehensible form. While some wearable devices and mobile applications are available which are touted to aid in ensuring women's safety, they utilize limited societal intervention and are not very efficient in ensuring the safety of the women as and when required. Most often the crime response, crime analysis, and crime prevention schemes are not integrated, leading to gaps in ensuring women's safety. Our major contribution is in developing a holistic system encompassing the three crucial aspects, i.e crime analysis and mapping, crime prevention, and emergency response by leveraging societal participation for women safety management. This work applies the Geographic Information System (GIS) for the identification of hotspots and patterns of crime. The proposed system uses data generated from the mobile application and/or wearable gadget prototyped as a part of this work along with the criminal history records for crime response, analysis, and prevention. The system for the hotspot identification is demonstrated for the Pilani town in the Jhunjhunu district in the state of

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Rajasthan, India, and can be easily scaled up geographically and utilized as a safety strategy for smart cities. While the common man is provided a costeffective solution via the developed mobile application or wearable gadget, the various components are integrated into a website for supervisory management and can be utilized by law enforcement agencies.

1.INTRODUCTION

Gender-based disparities are one of the major issues of the current century. Even though constitutional rights have vouched for gender equality, it is a reality that gender-based disparity exists in several sections of societies across the world. The 21st-century women have to a certain extent succeeded in contributing to society and working shoulder to shoulder with men in several fields. However, violence against women is being increasingly reported in recent times across the world. According to AntónioGuterres, the ninth Secretary-General of the United Nations, violence and abuse against women are among the world's most horrific human rights violations, affecting 1 in every 3 women in the world . Gender equality is the prerequisite for a better world. Gender-based violence on females limits women's participation in decision making leading to a decline in life quality. Women's equal participation is vital to stability, to prevent conflict, and to promote inclusive and sustainable development.

Though the intensity of violence against women may vary, no country has remained unaffected and there is a need to understand the root cause behind the crimes and find solutions. Today, the crime mapping and crime response remain majorly a responsibility of law enforcement agencies. Crime record data is maintained by law enforcement agencies and is most often not available to the public in an easily comprehensible form to take necessary precautions. Even though crime prevention is a major concern of the police force, since the human resource capacity of the police force is small relative to the population, their services sometimes tend to get limited to crime response than crime prevention. Some wearable devices and mobile applications are developed overthe years towards ensuring omen's safety. However, most of these applications and wear ables either raise an alarm in the form of visual or audio cues or sent messages to the contact (guardians)

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or law enforcement agencies. If a woman moves out of the city or away from their guardians these systems do not serve the purpose. These systems utilize limited societal intervention and are not very efficient in ensuring the safety of the women as and when required. Most often the crime

response, crime an lysis, and crime prevention schemes are not integrated leading to gaps in ensuring women's safety. In this paper, we present a holistic framework encompassing the three crucial aspects, i.e crime analysis and mapping, crime prevention, and prompt emergency response leveraging community participation. Geographic Information System (GIS) techniques are utilized in the proposed system to identify hotspots and patterns of crime by integrating socio-economic attributes of the area along with the criminal history. Using the information generated regarding the crime statistics using the GIS techniques, the user can take necessary preventive measures before visiting an area. A prototype of a wearable device and mobile application is developed. The mobile application and the wearable gadget can be used to trigger a panic signal to alert the volunteers in proximity, in addition to the contacts and law enforcement agencies. The mobile application and gadget allows tracking of the person/volunteer and generates data for further crime analysis. This caters to the prompt crime response as societal participation is also leveraged. An interactive website is developed for the visualization of GIS analysis, and data generated through wearable and mobile applications. Through this website, the administrator (law enforcement agencies) can track the movement of victims and nearby volunteers in real-time and assist both in an emergency. The administrator can also update the database of criminal records regularly and the crime hotspot analysis will be updated automatically The prototype of the framework developed for crime mapping, prevention, and crime response can be easily scaled up geographically and updated easily as a safety strategy in smart cities. The novelty, detailed design, implementation of the proposed system is described in detail in the subsequent sections.

2.LITERATURE SURVEY

Paper1 Details

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Prakash N, Uday Kumar E, Kumareshan N, &Gourishankar R (2021). GSM-based design and implementation of women's safety devices using the Internet of Things

Pros

The use of GSM-based women's safety devices with loT technology can enhance women's safety by providing real-time monitoring and reporting of emergencies to designated contacts or authorities

Cons

GSM technology is limited to areas with cellular network coverage, which may limit the use of GSM-based women's safety devices in remote or rural areas with poor network coverage.

Paper 2 Details

C. M. Carter. Meet the Millennial Who Created Athena, A Safety Wearable for the 21st Century. Accessed: Jun. 16, 2020.

Pro

A safety wearable can enhance personal safety by providing real time monitoring and alerts for potential danger or emergencies.

Cons

Wearable devices may be prone to false alarms or unnecessary emergency responses, which can be costly and time-consuming.

Paper 3 Details

W. L. Gorr, K. S. Kurland, and Z. M. Dodson, GIS Tutorial for Crime Analysis. Redlands, CA, USA: ESRI Press, 2018

Pros

GIS technology allows for comprehensive data analysis and visualization of crime patterns, which can help identify crime hotspots and trends

Cons

The implementation of GIS technology for crime analysis requires technical expertise, which may be a challenge for some law enforcement agencies or organizations to acquire

3. EXISTING SYSTEM

- Most of these applications are reactive, i.e. can raise an alert when the user is in danger. These applications provide a means to contact the police, selected

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contact persons, or guardians when triggered. If the user goes to a distant location away from the contacts, only the police force will be available for help, and sending alerts to contacts at a distant place may be of limited use. Most of the applications do not offer assistance in warning women about a danger prone area.

- My SafetiPin app classifies a public area as ‘unsafe’ or ‘safe’ at night, based on parameters such as lighting conditions, openness, visibility, number of people in the vicinity, number of police stations, walking path, etc. However, the reliability of the warnings generated by this application is mostly limited by the perceived data as entered by other users and not based on criminal history records from reliable sources. Also, higher number of people of the opposite sex in an area or poor visibility or lighting conditions may not necessarily indicate that the area is unsafe for women. It has to be noted that the safety of women is compromised even within house premises. These factors thus cause limited use of the available applications in ensuring women’s safety.
- Many of the existing apps pair with a mobile application on a smartphone using Bluetooth technology and then use the smartphone features to send alerts to pre-configured contacts, police, etc. ‘Safelet’, has two buttons on the side that can be pressed to send a distress message to selected contact numbers. The ‘Stiletto’ charm pairs with the mobile app and transmits a voice-assisted alert to selected contacts when triggered. The Sonata watch ‘ACT’ paired with a smartphone can send out panic messages to a set of contact numbers. If the phone is lost, thrown away by the attacker, or if phone is out of charge then the wearable will not serve its purpose. Current solutions focus on limited crowd sourcing and are insufficient in ensuring the safety of the women as and when required. With the advancements in GIS, it is possible to design proactive response measures whereby the hotspots of crime can be identified and preventive actions can be planned.

Disadvantages

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- In the existing work, the system did not implement Geographic Information System (GIS).
- This system is less performance due to Bluetooth connection which will connect only within a few meters.

Propose System

We propose a holistic framework leveraging societal participation and four major components as described below and depicted in the system.

1) Mobile application

2) Prototype of the wearable device

3) GIS analysis for the identification of hotspots of crime

4) Website for integrated crime monitoring, response, and Analysis

Each city is unique and hence we propose that the safety of the women can be best addressed by leveraging societal participation rather than completely relying on law enforcement agencies. Through our system, the users are provided with raise an alert when they are in danger. The crime response is leveraged through community participation. The volunteers who are in the vicinity of the person in danger will receive notifications regarding the users in danger and can track the person in danger and assist her in addition to the police or guardian. The use of wearable gadget is optional. Wearable gadget designed in the system can be utilized as a standalone device and hence, can be used to trigger alerts even when the smartphone is not active. In case if the user do not want to invest on buying the wearable, the mobile application can be used for raising the alert. The website developed acts as an integrator between several components of the system such as mobile application, wearable device, and GIS-based hotspot visualization. The GIS visualization of hotspots of crime will help the user to identify possible threats in a locality and take necessary precautions. The supervisory management of the website can be done by the law enforcement agencies. The system is designed in such a way that the website administrators can update the crime records from time to time and the hotspots of crime will be updated in the website accordingly. The website administrators or law enforcing agencies can monitor the users in danger and responses of volunteers to the alert.

Advantages

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1.Understanding of various socio-economic factors that lead to violence against women so that effective measures for social reforms can be designed,

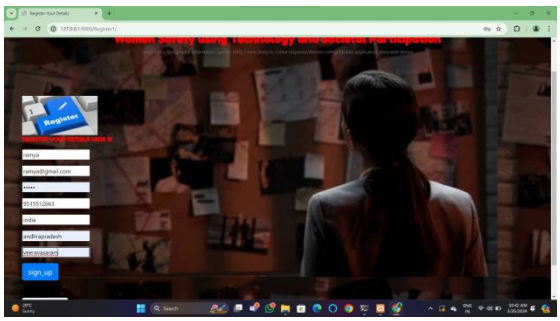
2.Crime analysis and mapping to identify hotspots of crime and hotspot shifting,

3.Effective use of technology through which a woman can raise alerts in case of danger

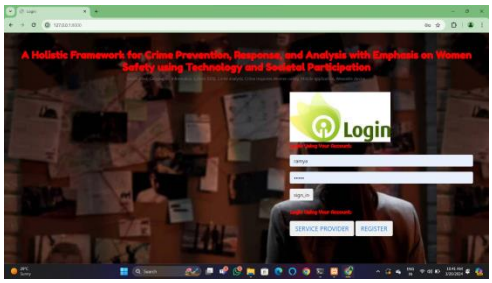
4.Prompt emergency response leveraging community participation, all of which are addressed in the proposed solution. Even though some prior work is available in each of these areas, a holistic system encompassing crime prevention, crime analysis, and crime response is not available.

4. OUTPUT SCREENS

User Registration Page



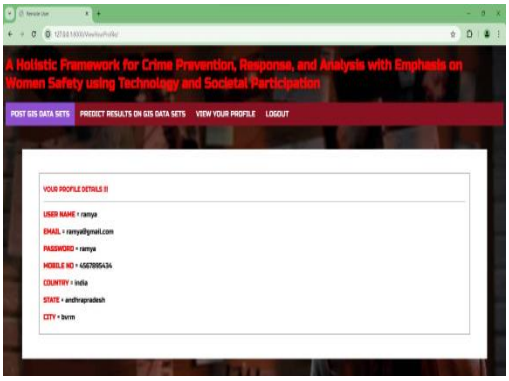
User Login Page



DataSetDetails

Search GIS Dataset

View Your Profile



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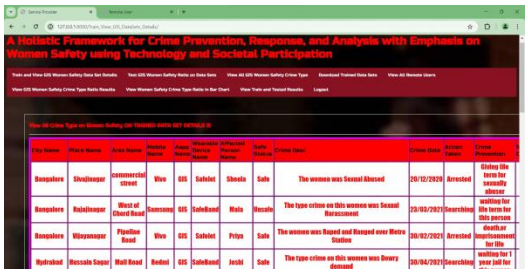
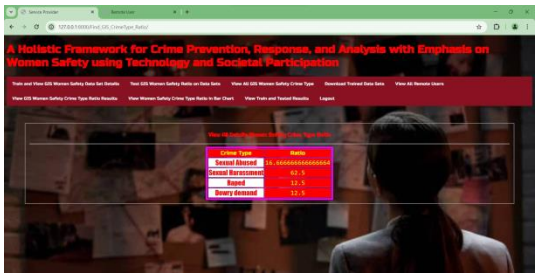
Admin Login Page

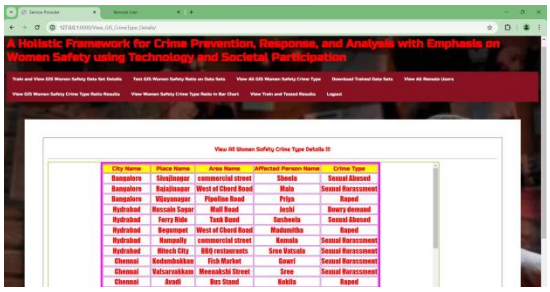
Train View DataSets Details



Find GIS CrimeType Ratio

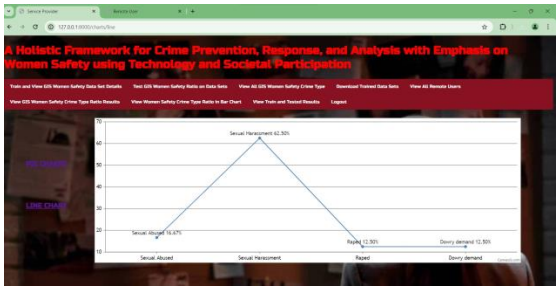


View GIS CrimeType Details

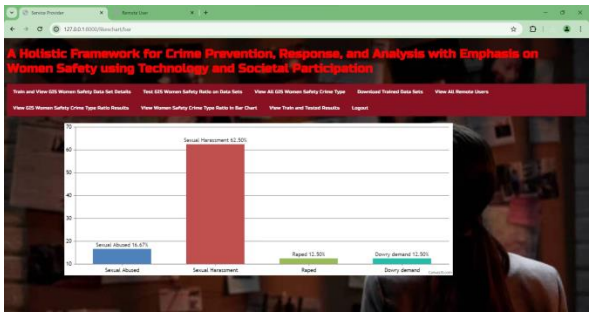


Pie Chart

Line Chart



Bar Chart



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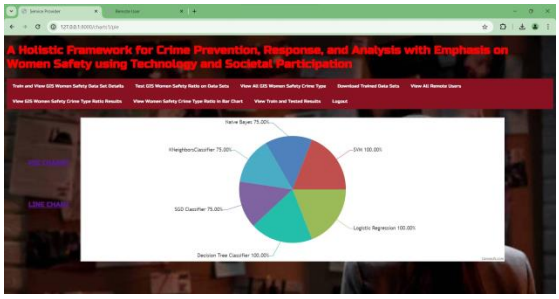
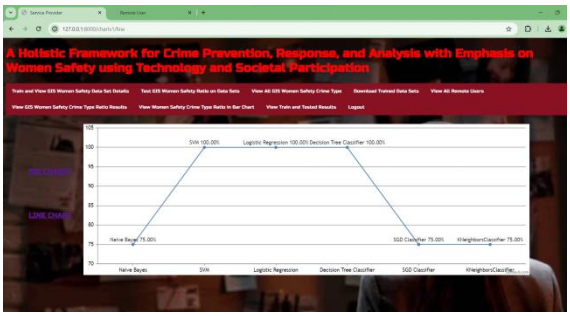
Algorithm Accuracy in Pie Chart



Algorithm Accuracy in Line Chart



5. CONCLUSION

Building safer cities for women requires holistic measures for crime prevention, analysis, and response. This will be effective only with the understanding of various socio-economic factors that lead to violence against women so that effective measures for social reforms can be designed. Also, technological interventions will not be effective in providing timely help if only law enforcement agencies or personal contacts are involved in rescue and response. The work presented in this paper describes the holistic framework for crime prevention, response, and analysis with emphasis on women safety using technology and societal participation. The Integrated system offers the components Web GIS, including the geospatial database storing criminal records and for hotspot generation, analysis, and visualization. Mobile Application for raising alerts and enabling tracking of the person in danger, viewing the crime hotspots in the locality to enable taking precautionary measures. The mobile application is designed to ensure that the registered users receive alerts about the person in danger in the locality. The user can commit to approaching the person in danger after which both the user and person in danger can be recorded and monitored by the system administrator. A cost-effective wearable gadget with GPS/GSM/GPRS for raising alerts and can be used as a standalone device even when the smart phone is not active. Website which acts as an integrator for the various components developed such as ‘Spot Her’ mobile application, wearable device, and Web GIS system. The website provides visualization for the data collected from the mobile application, wearable device, geospatial server, and criminal records. The administrator can also update the crime data

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to the geospatial database through the website. The website allows viewing of important information such as the real-time location of the user, safety stat s of the user, the number of volunteers who responded to an SOS, details of the user such as name, phone number and emergency contacts, etc. It is thus possible to design proactive response measures whereby which the hotspots of crime can be identified, users in danger can be tracked and preventive actions can be planned. The supervisory management of the website will be done by law enforcement agencies. Societal participation, in addition to providing immediate relief to the victims, can also create awareness in society regarding crime against women and indulge a sense of shared responsibility towards ensuring the safety of women. The data collection for developing the GIS-based crime monitoring and analysis system was completed using fieldwork in the town of Pilani town in Rajasthan, India. Based on the analysis, Inverse Distance Weighted was selected as a suitable interpolation technique for the thematic mapping of socio-economic causes of crime. This paper describes the system design process in detail, including system components, functional design, architectural choices, and experimental testing. The system will be subjected to continuous stress testing in the subsequent months before final deployment. The framework developed for crime analysis, prevention, and response can be easily scaled up geographically and can be used for safety in smart cities

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