A Technology-Based Aggregate System For Offense Control And Survey With A Focus on Women Safety

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Abstract- *Today ensuring women's safety in smart cities is the need of an hour. Even though several technologies and prevention measures have introduced and implemented, it remains still an international concern to be noticed. Criminal records are generally maintained by Law Enforcement Agencies, which are not easily accessible are available to the general public in easy way. While some wearable devices and mobile app has been developed to aid crime against women, is not an exact idea in ensuring women's safety when she is in need. Our major aim is to prevent and protect them before the crime incident occurs. Here we are going to develop a mobile application, a wrist band to track a victim using Geographic Information System (GIS) to analyze, map and prevent the crime by alerting the volunteers nearby the crime hotspot. This work with the GIS identifies the hotspot and patterns the crime. The proposed system uses the data generated from the mobile app and wrist band to analysis the crime areas and prevents it before it occurs in nearly future.*

Keywords- Smart cities, geographic information system (GIS), crime analysis, crime response, women safety, mobile application, wearable device.

I. INTRODUCTION

In today's world, the growing number of crime cases (mostly against women) in Indian cities, it has become a need of the hour to ensure a safe environment for everyone. 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 has become more prevalent in recent years across the world. Gender equality is a necessary condition for a better society.

Despite the number of solutions implemented for curbing offence (against women), Indian cities continue to be poor in ensuring a safe environment. The main drawback is in providing a prompt response. Thus effective utilization of technology in public safety management is important. Today, the crime mapping and crime response remain majorly a responsibility of law enforcement agencies. Law enforcement authorities keep track of criminal records, which are seldom made available to the public in a readily understandable format so that required safeguards can be taken.. 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, rather than focusing on crime prevention, we prefer to focus on criminal reaction. Over time, certain wearable technologies and mobile applications have been created to ensure women's safety. These wearables are also not gone well for ensuring women's safety since the sound alert produced by it may cause the offenders to attack the victim to safeguard themselves from public nearby. The reaction to crime, crime analysis, and crime prevention plans are frequently poorly connected, resulting in gaps in protecting women's safety

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In this study, we describe an integrated system that includes three critical components: crime analysis and mapping, offence control, and fast emergency response leveraging community engagement. The suggested approach employs Geographic Information System (GIS) techniques to detect hotspots and patterns of crime by combining socioeconomic characteristics of the region with criminal history. Using the information obtained on crime statistics using GIS methods, the user may take the required precautions before visiting a certain area. A wearable gadget prototype and smartphone application are being created. The mobile application and wearable device may be used to send a distress signal to nearby volunteers, as well as contacts and law enforcement agencies, and can follow the person/volunteer and produce data for future criminal investigation. This facilitates quick criminal response by leveraging society engagement. An interactive website is being created to visualise GIS analyses and data collected by wearable and mobile applications. The administrator (law enforcement agencies) can use this website to follow the movement of victims and nearby volunteers in real time and aid both in an emergency. The administrator can also frequently update the

criminal records database, and the crime hotspot analysis will be automatically updated. As a safety strategy in smart cities, the prototype of this system built for crime mapping, prevention, and response may be readily scaled out regionally and updated. The detailed design and implementation of the proposed system is described in the subsequent sections.

II. RELATED WORK

Women's safety has been one of the top priorities for law enforcement agencies for several decades. Even police departments around the world are facing difficulties to adopt newer solution to handle the concern of women safety. Several initiatives have been undertaken by police and public such as dedicated police wings, me too initiative, mobile applications and wearables. Through which the offenders are punished severely. With these mobile applications other than dialing police control room, the SOS triggers call to their given emergency contacts. In this part, we look at some of the most popular mobile apps and wearables for women's safety, as well as various technological interventions to increase women's safety. With the developments in GIS methods, preventative measures may be designed to identify crime hotspots and prepare preventive activities. In this section, we also discuss the notable works in analysing occurrence of crime using GIS technologies.

A. MOBILE APPLICATIONS FOR WOMEN SAFETY

There are several popular smartphone applications for women's safety. The majority of these applications are reactive, meaning they can send a warning when the user is in danger. When activated, these applications contact the police, designated contact individuals, or guardians. If the user moves to a remote area away from the contacts, only the police will be able to assist, and issuing alerts to contacts in remote locations may be of little benefit. The majority of the applications do not aid in informing women about dangerous areas. My 'SafetiPin' app assesses a public location as 'unsafe' or 'safe' at night based on factors such as illumination, openness, visibility, the amount of people in the area, and the number of police stations, walking path, etc. [1].

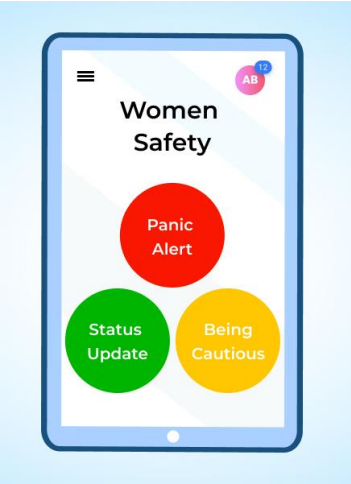

Figure: 1 Sample Mobile application image

However, the application's warnings are primarily restricted by perceived facts supplied by other users and are not based on criminal history records from credible sources. Furthermore, a greater number of persons of the opposite gender in a location, as well as low visibility or lighting conditions, may not always imply that the place is risky for women. It should be mentioned that women's safety is endangered even within the confines of their own homes. As a result of these reasons, the existing applications for protecting women's safety are only used infrequently.

B. WEARABLE DEVICES FOR WOMEN SAFETY

There are several smartphone applications available that allow the user to inform contacts in the event of a suspected risk. However, in an emergency, accessing the phone, unlocking it, opening an app, and triggering the alarm may not always be achievable. Wearable technology is being developed to handle this problem. Figure 2 depicts some of the most common commercially available wearable gadgets. Some wearables (for example, Siren or Sound Grenade) are stand-alone devices that create high decibel sound when activated, alerting persons in the immediate vicinity. However, this may also endanger the woman since the pervert may assault her in an attempt to rescue himself.

They use Bluetooth technology to connect to a mobile apps

Figure: 2 Sample Wearable Devices

on a smartphone, and then use the smartphone's functionality to send warnings to pre-configured contacts, police, and so on. 'Safelet' includes two side buttons that may be used to transmit a distress message to pre-programmed contact numbers. When activated, the 'Stiletto' charm connects to the mobile app and sends a voice-assisted alert to specified contacts. When coupled with a smartphone, the Sonata watch 'ACT' may send panic messages to a list of contact numbers. If the phone is lost or thrown away by the attacker, or if the phone is not charged, the wearable will be useless.

Current solutions focus on limited crowd sourcing and are insufficient in ensuring the safety of the women as and when required. With the developments in GIS, proactive response measures may be designed, allowing hotspots of crime to be recognised and preventive steps to be prepared [2].

C. GIS FOR CRIME ANALYSIS

In this section, provides a brief review of the notable works reported for crime analysis and hotspot mapping based on GIS techniques. Reference [3] analyses crime against women in Chandigarh, India using GIS Analysis. It's a preliminary project that entails mapping crime data and local police stations. The study reveals that crime against women is lesser in areas closer to the police station. As a part of the 'Free to Be' project, in the year 2018, young women were enabled to travel to popular cities across different countries to identify and share public spaces that make them feel uneasy and scared, or happy and safe [4]. Those women were asked to identify their experiences based on perceived safety. The identified points were tagged to a precise geographical location and a visual representation was derived in which the aggregated perceived level of safety was marked using color-coding. The visual representation was then made available to the public through a website. However, the data used for the visualization is based on data collected in 2018, and the hotspot identification is based on the perceived level of safety and not based on actual crime history. As very limited work is available in the literature regarding the application of GIS techniques for analysis of crime specifically against women we also reviewed the works on crime analysis in general.

Reference [5] paper presents a data-driven approach for the prediction of the number of crimes in the city of Chicago. On the basis of the real-world data set available for the Chicago area, crime concentrated zones or hotspots were identified. Once the hotspots were identified, the number of crimes reported in hotspots were extracted and a time series prediction technique was used for the prediction of the number of crimes in each hotspot.

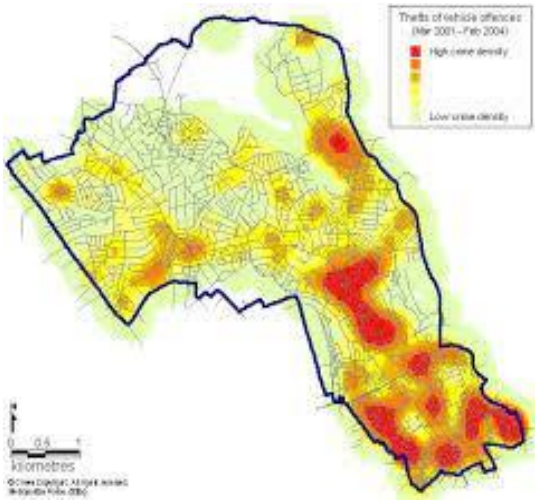

Figure: 3 GIS and Crime Mapping

The dataset contained details such as the kind of offence, place, date, community area, and so on. The Density-based Spatial Clustering of Applications with Noise (DBSCAN) clustering algorithm was used to identify hotspots. DBSCAN gathers points in space that are densely packed together, leaving out outliers, given a set of points in space. The goal of hotspot identification in this work was to only identify and limit further investigation to hotspot locations, hence a clustering approach was used. The scope of the work did not include the identification of hotspot shifts or the analysis of causes leading to the crime.

References [6]–[8] highlighted the potential of GIS techniques in identifying crime prone sites and then mapping them. A vital part is the creation of a database with relevant criminal data and accompanying geographical data. The type of additional non-spatial information included in the database such as population, gender, etc varies across the different applications. Byung Yun Yang identified crime prone areas based on the Kernel Density Estimation (KDE) technique [9]. Grubesic et al. in their work identified crime hotspots using the clustering technique[10]. The author highlighted that additional research work to reduce its complexity in

addressing hotspot detection is required for its application to practical scenarios. The scope of the work was to identify the factors affecting the crime rather than identifying hotspots of crime.

Hotspot mapping approaches include discrete point mapping, choropleth mapping, grid mapping, spatial ellipse mapping, and kernel density mapping[11]. In choropleth mapping, the study area is divided into various geographic units and each unit is shaded based on the number of crimes reported within it. The geographic units can be of different sizes and shapes. In grid mapping, grids of uniform size and shape are generated across the study area and shaded depending on the number of crimes reported within each of them. In spatial ellipse hotspot mapping method, points are grouped into clusters based on their proximity, and a standard deviational ellipse is fitted to each cluster to indicate the dispersion of points in the cluster through the ellipse's size and alignment. Density mapping is probably the most commonly used hotspot mapping technique. The point density, line density, or kernel density can be mapped [12]. In a point (or line density) calculation, the magnitude-per unit area from point features (or polyline features) that fall within a neighbourhood around each raster cell is calculated. Kernel density mapping computes a magnitude-per-unit area from point or polyline data by fitting a smoothly tapered surface to each point or line using a kernel function. However, smoothing can lead to mistakes, particularly in applications such as crime monitoring when the amount of data provided is little in comparison to the geographic region or population of the area. WebGIS is a sophisticated GIS system that is accessible over the web. This allows users to search geographical data, produce or display thematic maps on the WebGIS site more easily. The major components of a WebGIS system are GIS software, associated database and server (integrated database and server systems are also referred to as database server), web server, and the web client [11]. Zhou et al. on a WebGIS system, they presented five hotspot mapping strategies for crime analysis, including discrete point mapping, choropleth mapping, grid mapping, spatial ellipse mapping, and density mapping [11]. The database server used in the work is 'PostgreSQL', which stores crime data. The 'PostGIS' software is used in this work. PostGIS is a free and open-source GIS software that supports various types of operating systems such as Windows, Linux, iOS, etc. The web client uses Adobe Flash Player to access web resources via the webserver ('Tomcat') and GIS functionality via the 'PostgreSQL' server. Another WebGIS system using 'GeoServer'GIS software and a 'MySQL geospatial database is presented in reference [13]. Through the spatial database engine, it publishes Open Geospatial Consortium (OGC) services. They used Hyper Text Markup Language (HTML), Asynchronous JavaScript and XML (AJAX), and the 'Tomcat' webserver. Reference [14] made use of a virtual machine with 2GB of RAM that was imaged with Microsoft Windows Server and hosted a SQL Database, ArcGIS software, an ArcGIS database server, and a JavaScript-based web application. References [15, 16] compare the features of popular GIS software, their supporting data servers, and web clients.

D. HYPOTHESIS OF THE PROPOSED WORK

We propose an aggregate system leveraging societal participation and four major components as described below and depicted in Fig. 4.

- Mobile application
- Prototype of the wearable device
- GIS analysis for the identification of hotspots of crime
- 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 communal contribution participation rather than completely relying on law enforcement agencies. Through our system, the users are provided with a cost-effective wearable gadget and a mobile application to 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 user in danger and can track the person in danger and assist her in addition to the police or guardian.

Figure: 4 Proposed Work for Crime Prevention and Women Safety

III. PROPOSED SYSTEM

With the analysis of the previous technologies and their boons to meet women's safety factor, we have developed a hi-tech framework (SHE-Out Of Harm's Way) which contains a web application, mobile app and a wrist band. In our hi-tech framework the core theme is ensuring the women's safety and preventing the crime by volunteering the general public volunteers at the victim's location as immediate effect. Our framework contains following building blocks,

1. Registration of Users through Website, where users can register in their details and open an account as volunteer too. The registered user can login via their unique ID generated while registering. And they can download a mobile app for handy.

2. GIS Data for hotspot, data about the crime hotspot are collected and updated by Admin regularly.

3. Mobile App and Wrist Band Alert, when the victim enters the crime hotspot identified by our GIS an alert is sent to the victims at the victim location to prevent the crime scene.

4. Crime Response and Analysis, based on the details from the victim and volunteer the response is tracked and analysis is done by admin for near future.

Registration through website:

User should register in our website (SHE-Out Of Harm's Way) as an initial step with their mobile number, name, contact number to which an alert to be sent in case of emergency, their location and unique SHE-ID will be auto generated for every user who register. Users who are all registered in this portal are also considered as volunteers. After registering successfully, the user can login into their profile using their SHE-ID and OTP sent to their registered mobile number. In their profile they can glimpse the activity as victim if any or as volunteer. And an important part is on their first login a link will be provided to download the mobile app for their handy use. And a link to buy a wrist band for free cost is also provided. The user can also post their experience as a blog in this portal.

GIS Data for hotspot:

Admin can login to their page through the valid login credentials. Admin should gather data from law enforcement agencies and also with the use of Geographic Information System (GIS) the crime hotspot details should be updated regularly. And make easily available and accessible to the general public who are all registered in this web portal.

Mobile and Wrist Band Alert:

When the user nears the hotspot she will be alerted with the push notification to their mobile as "You Are In Safe Area" or "You Are Entering The Unsafe Area" and also the wrist band alerts with the shock trigger and camera starts to capture the crime scene and send it to the cloud DB. At the same time when the victim gets the alert the volunteers also get the notification about the location details and victim information who needs the help. If the volunteers are nearby they will be provided with the victims live location and will be alerted every 30 seconds about the victim crime location and every 30 seconds.

Crime Response and Analysis:

After successful prevention of the crime incident the needed information is auto updated to the particular victim and volunteer's activity. Admin also update the response of the victim and volunteers to the DB. And with the data collected he updates the GIS data and also makes an analysis out of it.

IV. RESULTS AND DISCUSSION

According to the requirements, an aggregate system for offence control, crime response, monitoring, and prevention is created and evaluated for functional dependability as well as usability. Meanwhile, the system will still be routinely monitored safety and performance analysis in the months ahead before ultimate public deployment. With time, the database will become richer and vaster, resulting in enhanced accuracy and reliability in the detection of crime hotspots in the future. And also, our validation will evolve in real-time with expanded criminal and socioeconomic data sets. The proposed system provides effective crime analysis and information creation in order to design crime prevention strategies. The efficacy of community-assisted crime response is dependent on network availability, volunteer presence and reachability, volunteer response time, crime area/zone characteristics, and so on.

V. CONCLUSION

Building safer cities for women necessitates a comprehensive approach to crime prevention, analysis, and response. This will only be effective if numerous socioeconomic elements that lead to violence against women are understood so that effective social reform initiatives may be created. Also, if only law enforcement agencies or human

connections are involved in rescue and response, technology interventions will be ineffective in delivering timely assistance.

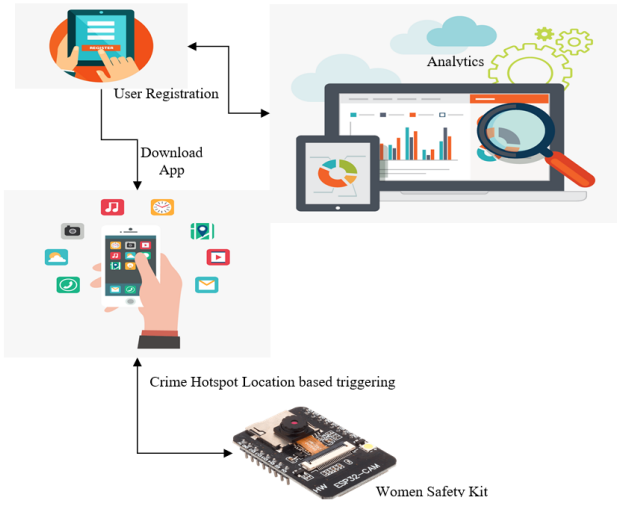

Figure: 5 Architecture Diagram for Women Safety

This study offers a comprehensive framework for crime prevention, response, and analysis, with a focus on Women's Safety through the use of technology and society engagement. The components of the integrated system are: (1) WebGIS, which includes a geographic database for storing criminal records as well as hotspot production, analysis, and visualization. (2) A mobile application for raising warnings and tracking the person in danger, as well as viewing crime hotspots in the area and taking preventative steps. The smartphone application is meant to ensure that registered users receive warnings when a person in danger is present in the area. The user can agree to approach the person in danger, after which the system administrator can record and watch both the user and the person in risk. (3) A low-cost wearable device featuring GPS, GSM, and GPRS that can be used as a standalone device even when the smartphone is turned off. (4) A website that serves as an integrator for the different components produced, including the "SpotHer" mobile app, wearable device, and WebGIS system. The data obtained from the mobile application, wearable device, geospatial server, and criminal records is visualized on the website. The administrator can also use the website to update the criminal statistics in the GIS database. The website allows users to examine critical information such as the user's current location, safety status, the number of volunteers who reacted to an SOS, and user details such as name, phone number, and emergency contacts, among other things. As a result, proactive response measures may be designed, allowing hotspots of crime to be recognized, people in danger to be followed, and preventive steps to be prepared. Law enforcement authorities will be in charge of the website's supervision.

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. Research work in the town of Pilani in Rajasthan, India, was used to collect data for the development of a GIS-based crime monitoring and analysis system. 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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