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A SYSTEMATIC SURVEY ON IOT-BASED DEVICES FOR ENHANCING WOMEN'S SAFETY

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ABSTRACT

Since many women face varied safety concerns, such as harassment, rape, molestation, and domestic abuse, for a variety of societal or cultural causes, women's safety has been emphasised as one of the main priorities of any community. The Internet of Things, or IoT, is emerging as a potential technology to help with daily issues and assist in managing a variety of matters. The community has developed a number of IoT-based tools to assist women in addressing possible safety risks. This study offers a comprehensive overview of the literature on IoT devices for women's safety, including wearable technology, sensors, and machine learning algorithms, as well as the key characteristics these devices provide. The evaluation process involves a thorough analysis and synthesis of the research publications published in reputable research venues between 2016 and 2022. The findings showed that several sensor types are employed to record the condition of women experiencing safety concerns, with pressure and pulse-rate sensors being the most often utilised sensors in these devices. Additionally, the devices employed a variety of technologies, such as the Raspberry Pi, worldwide positioning system (GPS), and global system for mobile communication (GSM), to send the notifications. Additionally, a number of machine learning methods, including logistic regression, hidden Markov, and decision trees, are employed to detect possible ladies who may be in danger and assist in averting the unfavourable circumstances for them in advance.

It was determined that in order to successfully address the issue, systems that emphasise auto-activation of alarm creation with less human participation and greater accuracies must be created, even though much research has been produced in the underlying topic. This study proposes a taxonomy of various wearables, sensors, features, and approaches utilised in IoT-based women's safety devices in addition to analysing the literature. Additionally, the shortcomings and difficulties related to IoT devices and their suitability for women's safety have been brought to light. Furthermore, this paper suggests an architectural model that highlights key elements required to create IoT-based safety devices for women. Finally, this study highlights the utilisation of sensor combinations to get various input data types that may result in more accurate and precise threat detection.

I. INTRODUCTION

One of the most important topics is women's safety, since many women over the world face various hazards including harassment, molestation, and assault. Numerous organisations released data on incidents of violence against women, highlighting the seriousness of the problem on a global scale. Nine out of 10 women have experienced violence of some kind, according to a survey by Action Aid UK at International Safe Cities for Women [1]. According to WHO (World Health Organisation) data, one in three women worldwide experience violence [2]. According to the Global Gender Gap Report, sexual assault

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affects one in five women worldwide [3]. These numbers demonstrate how the women's safety is deteriorating daily [4]–[5]. Women have concerns about their safety both at home and in public settings, such as marketplaces and workplaces. Women are harassed during the day, even in public settings, and not just at night or in the evening. Nearly 80% of women think they are completely unsafe [6]. Women are employed and working outside to make ends meet in the current environment, but they are not safe. Crimes against women are on the rise, and these days, cultures are increasingly concerned about women's safety. Efforts must be made to stop these incidents from happening so that the women may live their lives with self-assurance and carry out their social obligations. Technology's introduction helped people from all walks of life overcome the problems and challenges that were prevalent [7]. Similarly, it is necessary to investigate how technology might help prevent incidents of violence against women and assist women in coping with any security threats and dangers.

The Internet of Things (IOT), which offers assistance through technologically aided solutions of linked objects, has become a promising area of study. For women's safety and protection, the community has implemented a number of IoT-based gadgets. While some of these devices use voice recognition technology to automatically identify and capture safety issues [8], others use mobile phones to convey explicit alarms [9]. These gadgets provide a variety of capabilities to aid in the cause, which is primarily concerned with alerting the woman's guardian when she is in danger. [10] suggested a gadget with a speech recording feature, a fingerprint sensor, and a shock generator. The location is then tracked and a warning of danger is sent to the woman's guardian via the global positioning system (GPS) and the worldwide

system for mobile communication (GSM). Another research [11] introduced a tool for protecting women by tracking their precise position and alerting their guardian of any threat.

As IOT-based gadgets for women's safety become wireless and integrated into women's wearables, developments in these technologies are evident. Wearable technology based on the Internet of Things is connected to several sensors. These gadgets are cordless and compact. The wearable technology must be affixed to the human body in many ways, such as clothing, accessories, gadgets, or even intelligent tattoos. The sensors that are used to obtain readings from the specific device and turn on the modules are connected to the devices. Sensor selection is based on the evaluation of techniques pertaining to the intended device [12]. Wearable technology is used in smart electronics, smart footwear, and even smart jackets in the area of women's safety. Depending on the device being targeted, all of these gadgets have sensors built in. For example, the smart foot gadget just has an accelerometer or acceleration sensor when it first launches [13]. In order to identify any safety risks, the IOT-based gadgets for women's safety also employ a number of sensors to monitor the condition and movement of women. These sensors collect information from various bodily areas. This comprises the temperature sensor [17], heartbeat sensor [16], acceleration sensor [14], and pulse-rate sensor [15]. While certain sensors, like tilt and temperature sensors, may receive data from any region of the body, others, like heartbeat and pulse rate sensors, are exclusive to a particular portion of the body. While certain sensors may be associated with particular body parts, others, like tilt and flex sensors, may be associated with the movement of any portion of the body [18, 19].

Decisions on whether or not a given state of women may be deemed harmful would be made

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by applying machine learning algorithms to the input data obtained by these sensors. Therefore, different machine learning techniques are used in IOT devices for women's safety in order to determine the women's condition. [20]–[21]. Additionally, many technologies are used to send alerts to the guardian, including GPS, GSM, and Raspberry Pi [19]–[22]. While many of these devices are in use, their functionality and efficacy must be investigated in order to pinpoint areas that require improvement and establish future research paths in the designated field of study.

To shed light and give the underlying problems the attention they deserve, the researchers have published a number of research publications. It has been noted that rather than declining as the globe develops, women's safety concerns are growing. Given that the phenomenon has a major impact on economies and societies and plays a crucial role in their development and growth, this highlights the lack of thorough studies that could direct future research efforts to maximise community efforts and create better solutions. This literature review's main goal is to draw attention to the shortcomings of the devices and apps that have been released thus far. Women's freedom and bravery in leaving the house for work have led to the publication of several studies in this area, which are becoming more and more significant. As a result, a thorough analysis is necessary to identify and compile the most recent advancements in the sector. In addition to reflecting gaps in various apps and devices, this Systematic Literature Review (SLR) suggests a taxonomy for IOT-based women's safety devices. It also suggests an architecture for a women's safety system based on the issues and gaps found in current devices, including the solutions employed to improve security systems.

The following categories apply to the remaining

portions of this paper: The related work is identified in Section II, and the research methodology used in this review is covered in Section III. This section includes the research objectives, questions, and motivations, as well as the search strategy, selection process, abstract-based key wording to categorise the articles, and quality assessment criteria. Section IV presents the analysis and outcomes, and in order to assist with future aspects, taxonomy, unresolved concerns, and challenges have been mentioned.

II. SURVEY OF LITERATURE

"Women's security in the modern era: An intellectual tool,"

T. K. Anand, T. S. Anand, G. Gulati, and S. Singh,

Is it ethically appropriate to say that women in our society are incapable of leading independent lives, especially in this sophisticated era of 2020? Women are frequently the targets of physical abuse, rape, and assault. These occurrences are becoming more frequent, especially in cities. CCTVs can be useful in some situations, however they cannot be used to identify the attacker. By encouraging women to become more independent through technology, this research seeks to lower the crime rate against women and girls in India. The concept paper presents a portable, affordable, and fast-acting device that enables women to lead secure, independent lives. The following components are part of the system we designed and implemented: Arduino UNO, buzzers, PCB, breadboards, circuit boards, transformers, switches, Arduino compiler, Neo6mv2 GPS module, force sensing resistor, pulse sensor, Bluetooth module, LCD, resistors, transistors, diodes, LED, and SIM 800 GSM module. The suggested system's dual security feature allows women experiencing discomfort to request help by using their pre-designated emergency number

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to convey their location. Depending on the situation, she can use the gadget in three different modes, although sometimes she feels insecure or out at odd hours. The device may be activated by the victim via a panic button or Bluetooth module. When the gadget is turned on, its GPS, GSM, and pulse sensor all start up immediately. The police and permitted predetermined numbers will receive a message alert from the system that includes latitude and longitude measurements as well as a heart rate reading. In order to let those around know what is going on, it will simultaneously blast a buzzer continually. In the event that it encounters an external force while being handled incorrectly or maliciously, this device features a force sensing resistor. This device has shown to be more powerful and successful in shielding women from violence in the era of smart bands and pepper spray.

"IoT-based survey on women's safety,"

M. Swetha, M. Tamilarasi, D. Vinodha, and B. S. Bala

Nowadays, both in urban and rural places, women's safety is regarded as the main issue. Although it is very challenging to alter society as a whole, we can offer a number of safety tools to women who are subjected to molestation, acid assaults, sexual harassment, and other forms of abuse. Numerous smart gadgets and software were created to provide security. Although there are a lot of smart gadgets and apps on the market, they don't offer a practical answer. Women's safety devices that operate both manually and automatically were discovered by experts from a variety of fields. This article looks at several methods connected to women's safety. There is also discussion of the potential and disadvantages of women's safety gadgets.

"The personal stun—A clever gadget for women's security,"

Women's security is urgently needed these days, according to S. Ahir, S. Kapadia, J. Chauhan,

and N. Sanghavi. There are several instances of women being harassed and molested in India. Women's safety is important, whether they are at home, outside, or at work. Numerous mobile applications are employed for women's safety, according to the literature review. According to a recent study, when a person taps one leg behind the other four times, a footwear chip that is adhered to the shoe becomes active. Our main goal is to create a smart band prototype that can be activated by twice pressing the screen. The GPS position is sent to the police control rooms and ICE contacts as soon as the gadget is turned on. The gadget is equipped with a temperature sensor that measures the user's body temperature and a pulse rate sensor that measures the user's pulse rate. When the band is flung violently, a force sensor is triggered, transmitting the victim's current position. After the gadget has been turned on for one to two minutes, a piezo buzzer alarm will sound. The buzzer's range is 80–110 dB, making it audible from a 50-foot distance. An electric current-emitting circuit for electric shocks is constructed. Two metal spikes on top of the band screen, which produce shock when they make contact with any surface or person, are located there. Micro USB charging is supported by the gadget. An intelligent application will be created for the Android platform that connects to the device through a Bluetooth interface and displays the subject's detected data to the ICE contacts. The gadget will continually beep and communicate the location every five minutes until it is switched off.

"Voice-controlled tool for women's safety at any time,"

Maurya, A. Patil, and A. Agrawal,

Women are empowered in the twenty-first century, which encompasses social security as well as financial security. In every aspect, women are actively shaping a new society, yet the situation is completely disgraceful when it

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comes to protection from rape, murder, acid attacks, and sexual assault. India ranked 133rd out of 167 countries in terms of women's safety, with an index score of 0.625, making it one of the most dangerous countries for women and children's safety, according to Georgetown University's Institute for Women, Peace, and Security (GIWPS), which assessed 167 countries worldwide and released its second report on the Women, Peace, and Security Index in November 2019 [22]. To ensure that this area is secure for women to dwell in, government officials and other Indian people should take this matter seriously. Because they lack the resources to protect oneself in a challenging scenario, women in the workplace experience feelings of vulnerability and insecurity. They endure a variety of physical and verbal abuse, and the majority of these complaints go unreported or unacknowledged. Numerous women's safety gadgets have been introduced to the market, and nearly all of them are operated manually, such as by pressing a button or via a smartphone app. But since such horrible crimes occur without warning and the victim never has enough time to flee, these gadgets are unable to provide the highest level of protection in every aspect. As a result, an advanced protective system is required to address as many dangerous circumstances as feasible. To get over such issues A smart bracelet that can be operated by voice is designed for ladies. This survey report discusses the design, operation, and deployment of a "voice-controlled smart band for women" in addition to the statistics and specifics of the rising crime rate against women and minors. 1) The victim's voice activates this gadget, which then uses its GPS module to follow the victim's whereabouts. An alarm message is delivered to the pre-registered contact number anytime the voice command matches. 2) An alert message wristband for women is deployed, and the GPS on a mobile phone is utilised to locate the

victim's closest position and send a call or SMS to the closest police location indicating the victim's location. 3) To protect oneself and go to a safe location, an attacking circuit is connected. "SMARISA: An Internet of Things-based smart ring for women's safety,"

U. Nethra, V. Suma, P. Chatterjee, and N. R. Sogi

Every day, moms, young girls, and women from all walks of life fight to keep themselves safe and defend themselves against the roaming eyes of dreadfully insensitive males who regularly abuse, harass, and degrade women. The hunters now control the streets, public transportation, and public areas in particular. A smart security wearable gadget for women based on the Internet of Things is suggested in response to the tragedies that women now face. The Raspberry Pi Zero, Raspberry Pi camera, buzzer, and button to activate the services are all part of the SMARISA smart ring. With simply a button press, the victim may activate this incredibly portable gadget, which will retrieve her current position and use the Raspberry Pi camera to take a picture of the assailant. The victim's smartphone will transmit the position and link of the taken photograph to pre-established emergency contact numbers or law enforcement, eliminating the need for extra hardware components and making the gadget small.

III. SYSTEM ANALYSIS AND DESIGN EXISTING SYSTEM

To the best of our knowledge, very few research have discovered IoT-based devices for women's safety. An IoT survey on women's safety was given by a study [6]. The primary focus of this survey was on the methods for identifying sensors on the human body, and it also emphasised the shortcomings of earlier research. A survey and comparison of previous research on the guardian device for women's protection were published in another study [22]. To get notifications, the researcher created a brand-new

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guardian gadget. The gadget is made to function with sensors, and ladies who are in danger must press the button to notify their guardian. Although the gadget appears to be a good way to help potential victims, there is a drawback in that the victim must control the device in order for it to activate, which renders the individuals in danger immobile and prevents them from taking certain precise acts.

[23] reviewed the literature on new and developing technology for women's safety and protection. The researchers collected information and searched the internet for women's safety equipment that displayed both new and developing technology. However, by putting out an IoT-based architectural model for women's safety, this study has effectively made use of IoT-based technology.

By examining a few sensors and key components found in current IoT-based women's safety devices, the study in [5] carried out a thorough literature assessment on the development of IoT-based women's safety devices. The taxonomy put out in this analysis, however, emphasises several sensors and key characteristics of IoT-based women's safety devices. On the other hand, the researchers in [24] devised a Woman Safety System (WSS) that is specifically made to safeguard women and communicate in the event of danger. The WSS gadget is a smart jacket that can't be worn anywhere, at any time. But the paradigm this study presents is made to be adapted to a wide range of wearables that may be utilised in any circumstance.

[25] compared IoT-based hardware devices with IoT-based mobile applications and discovered that the latter are more useful and efficient in defending a lady in danger. While our work synthesises the state-of-the-art IoT-based smart devices with detailed analysis of the sensors,

wearables, and advanced machine learning algorithms used in IoT-based systems for women's safety, this study is more concerned with comparing IoT-based mobile applications and IoT-based hardware gadgets. The discussion above demonstrated how our evaluation differs from previous reviews by focussing on the publication channels associated with IoT-based women's safety devices, thoroughly examining the technologies, and recognising the gaps and difficulties that modern women confront.

Additionally, we used a more thorough and impartial approach than previous assessments since we methodically chose methods, tools, and sensors and used them to showcase the most recent advancements in IoT-based women's safety gear. Furthermore, we propose an architecture for a women's safety system that could work with multiple sensors and machine learning algorithms that could provide more accurate results of attacks on women. We also propose a taxonomy for IoT-based women's safety devices based on the gaps and challenges identified in existing devices.

DISADVANTAGES

- Data complexity: To identify women's safety, the majority of machine learning models now in use need to be able to correctly comprehend sizable and intricate datasets.
- Data availability: In order to provide precise predictions, the majority of machine learning models need a lot of data. The accuracy of the model may degrade if data is not accessible in large enough amounts.
- Inaccurate labelling: The accuracy of the machine learning models that are now in use depends on how well the input dataset was used for training. Inaccurate labelling of the data prevents the model from producing reliable predictions.

PROPOSED SYSTEM

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There are four main characteristics in the taxonomy that was created. These encompass the majority of the data examined in this research and include IoT-based safety sensors, dominant characteristics, machine learning methods, IoT-based wearables with sensors integrated, and IoT-based technologies. The many precise assaults and the locations of victims and systems are tracked, managed, and monitored by IoT-based technology. It has been established that IoT-based technologies are utilised in women's safety gadgets with their sub-domains. Sensors sense and track a variety of factors to generate useful data.

The information produced by sensing and monitoring devices is sent to a user or guardian of women via communication protocols (Internet, ZigBee, Bluetooth, and WIFI). There are four main characteristics in the taxonomy that was created. These encompass the majority of the data examined in this research and include IoT-based safety sensors, dominant characteristics, machine learning methods, IoT-based wearables with sensors integrated, and IoT-based technologies. The many precise assaults and the locations of victims and systems are tracked, managed, and monitored by IoT-based technology. It has been established that IoT-based technologies are utilised in women's safety gadgets with their sub-domains. Sensors sense and track a variety of factors to generate useful data.

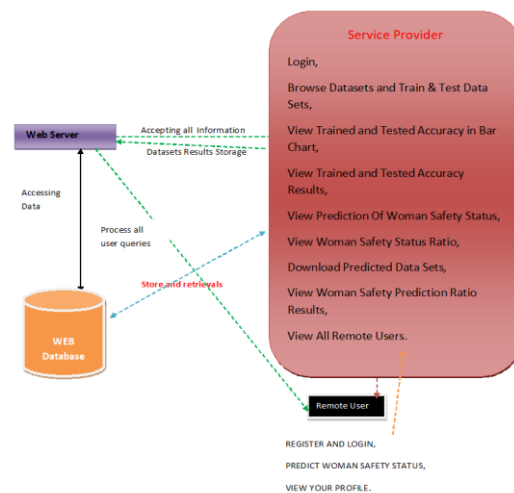
There has been extensive discussion on the sensors utilised in women's safety equipment. Also emphasised are the key characteristics of IoT-based women's safety gadgets that make them effective and that the victim uses in various contexts. Additionally, to highlight the auto-activation of the alert generation feature, the data is gathered via sensors that, upon detecting readings that may indicate a particular state of the woman's body that could indicate a potential threat, activate the machine learning

modules, which subsequently generate and transmit alerts.

Advantages

- Benefits Using machine learning algorithms, which are trained on sensor input values received under various settings, allows the prospective ladies who are in danger to covertly alert their guardians without interacting with the gadgets directly.
- The suggested taxonomy also introduces wearables that are based on the Internet of Things and are utilised for women's safety. These devices have sensors integrated in them that detect danger and trigger machine learning algorithms for additional processing aimed at detecting the threat. Wearables that integrate IoT devices for women's safety rely on sensors to collect user data and automate the device.

SYSTEM ARCHITECTURE



IV. IMPLEMENTATION

Modules

Service Provider

The Service Provider must use a working user name and password to log in to this module. He can perform many tasks after successfully logging in, including browsing datasets and

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training and testing datasets. View Results of Trained and Tested Accuracy, View Trained and Tested Accuracy in Bar Chart, See the Woman Safety Status Prediction, See the Woman Safety Status Ratio, and Download the Predicted Data Sets View the results of the Woman Safety Prediction Ratio. See Every Remote Use.

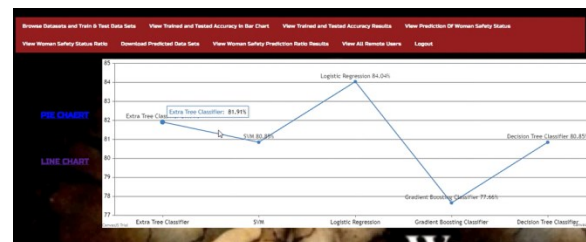
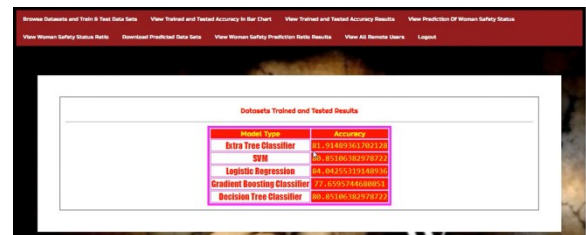
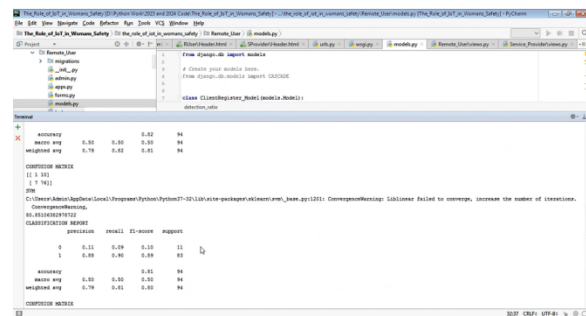
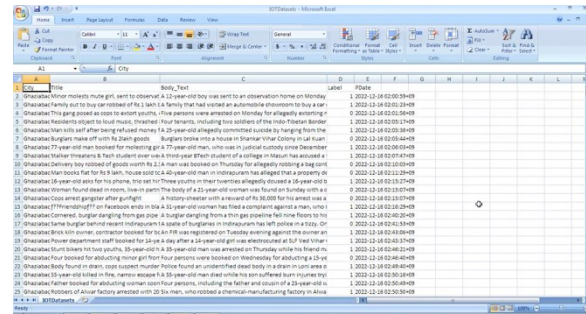
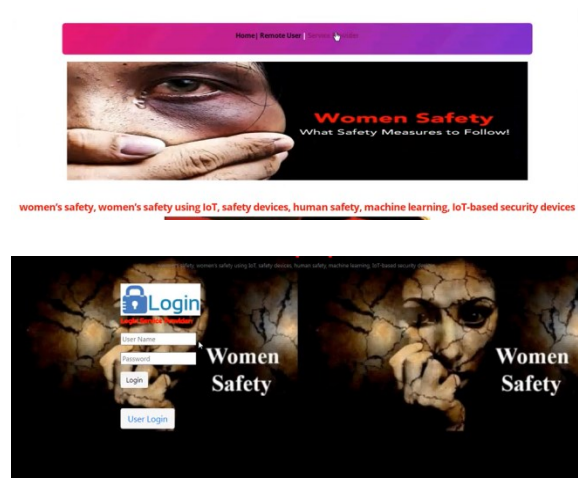
View and Authorize Users

The administrator may see a list of all registered users in this module. Here, the administrator may see the user's information, like name, email, and address, and they can also grant the user permissions.

Remote User

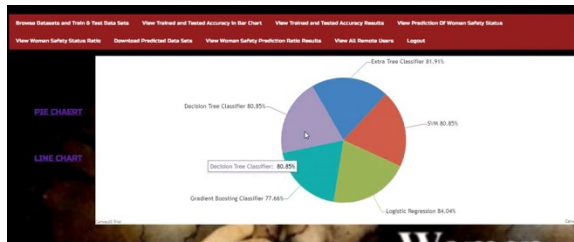
A total of n users are present in this module. Before beginning any actions, the user needs register. Following registration, the user's information will be entered into the database. Following a successful registration, he must use his password and authorised user name to log in. Once Login is successful user will do some operations like REGISTER AND LOGIN, PREDICT WOMAN SAFETY STATUS,VIEW YOUR PROFILE.

V. SCREEN SHOTS



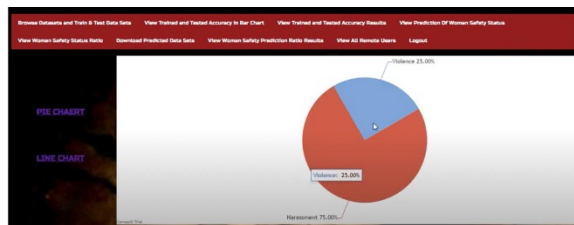
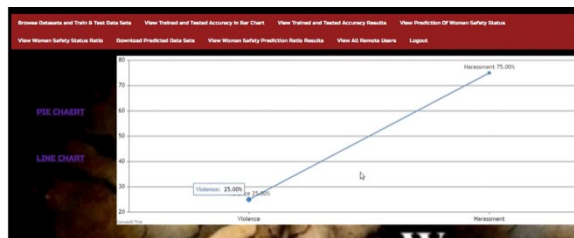
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View Women Safety Prediction Type Details III

City	Title	Body Text	PDate	Predicted
Chattisgarh	77-year-old man booked for molesting girl in lift dies in jail	A 77-year-old man, who was in Chattisgarh's central jail, died after he allegedly molested a girl.	2022-12-16 07:06:03+09	Harassment
Chattisgarh	Labourer thrashed by three, critical	Three people were arrested on Friday for allegedly thrashing a 40-year-old labourer and...	2022-12-16 05:35:49+09	Harassment
Chattisgarh	Three arrested for trying to abduct woman	Three persons, who allegedly tried to abduct a woman after she boarded an auto-rickshaw, in...	2022-12-16 05:42:54+09	Harassment
Chattisgarh	Teacher killed, body stashed in suitcase	The body of a 40-year-old teacher, who had been missing since March 6, was found in a suitcase...	2022-12-16 05:41:48+09	Violence



REGISTER YOUR DETAILS HERE !!!

Order Surname	Mangunath	Order Password	*****
Order Email of	enikmanjya19@gmail.com	Order Address	#9026,4th Cross,Rajajinagar
Order Gender	Male	Order Mobile Number	9535666270
Order Country Name	India	Order State Name	Karnataka
Order City Name	Bangalore		

REGISTER

Registered Status :-

Homey Remote User / Remote Provider

Order Surname	Order Email of	Order Gender	Order Country Name	Order City Name	Order Password	Order Address	Order Mobile Number	Order State Name	PDate	Predicted
Chattisgarh	77-year-old man booked for molesting girl in lift dies in jail	Male	India	Chattisgarh	*****	A 77-year-old man, who was in Chattisgarh's central jail, died after he allegedly molested a girl.	9535666270	Karnataka	2022-12-16 07:06:03+09	Harassment
Chattisgarh	Labourer thrashed by three, critical	Male	India	Chattisgarh	*****	Three people were arrested on Friday for allegedly thrashing a 40-year-old labourer and...	9535666270	Karnataka	2022-12-16 05:35:49+09	Harassment
Chattisgarh	Three arrested for trying to abduct woman	Male	India	Chattisgarh	*****	Three persons, who allegedly tried to abduct a woman after she boarded an auto-rickshaw, in...	9535666270	Karnataka	2022-12-16 05:42:54+09	Harassment
Chattisgarh	Teacher killed, body stashed in suitcase	Male	India	Chattisgarh	*****	The body of a 40-year-old teacher, who had been missing since March 6, was found in a suitcase...	9535666270	Karnataka	2022-12-16 05:41:48+09	Violence

ENTER DETAILS IN CORRECT WAY !!!

Enter City:

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Predict

PREDICTED WOMAN SAFETY STATUS

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PREDICTED WOMAN SAFETY STATUS

Harassment

VI. CONCLUSION

A thorough evaluation of the literature on IOT-based tools for women's protection that shield them from dangers including rape, abuse, harassment, and molestation is presented in this paper. 34 research articles collected from reputable publishing sources were reviewed for the study. Several keywords and their synonyms are taken into consideration when gathering the papers for the assessment of IOT-based devices for women's safety. It is possible that some studies utilised other terms and their synonyms in their work, which might have an impact on the final results, even when certain keywords are employed to search the pertinent literature. By carefully evaluating different keywords, classifying them as primary, secondary, and tertiary to generate the search string, and using

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various Boolean operators to combine the given classification of keywords, this danger was reduced. Furthermore, the authors have classified the research, and two independent reviewers have examined their categorisation. If there was any dispute, the writers had a thorough conversation until they came to an agreement. A good level of agreement was shown by the interpreter reliability of 0.92.

Following a thorough review of the research that made the short list, it was determined that IOT-based women's safety gadgets employ a variety of technologies and have several notable characteristics, including sensors and machine learning algorithms. A taxonomy of IOT-based women's safety gadgets is presented by classifying these elements into several groups. Even while each system has unique features that specify how those devices function, there are still certain drawbacks that prevent these systems from effectively supporting women in addressing possible safety risks. Furthermore, this study highlighted the shortcomings and difficulties in using earlier technologies, which prevented some of them from fulfilling their intended functions. Additionally, as a proposal for the future, this research suggested an architectural paradigm for IOT-based devices for women's safety. In addition to helping practitioners create practical and more efficient IOT-based women's safety gadgets, our effort will assist researchers obtain cutting-edge insight into these devices.

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