GIZMO COP- An Intelligent Security Device for Women Safety with Machine Learning

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***Abstract*—Despite the technological advancements and civilization, issues regarding personal safety especially for women and children never go out of trend. Statistics state that in India, an average of 86 rape happen daily and nearly 49 offences against women are reported for every hour. In such an unsafe society today, it is necessary to carry a smart gadget that ensures safety for women. GIZMO COP has a panic button which upon being activated sends the current location of the victim via SMS with the help of GPS and GSM to the security number fed. In the worst case, when the victim is unable to press the panic button, the temperature and pulse rate of the victim is continuously monitored by sensors and if it changes from the normal pattern or level (when feared) the location details are automatically sent. The threshold values are highly customized using linear regression from machine learning with a set of sensor values related to the user's body condition. In addition to this, the device warns the user from entering into zones that contain hazardous gas and also has sound recording feature for legal evidence. The main advantage of this system is that it operates with cell phone towers, not requiring internet connectivity. With all the wattage values of the individual components, the average battery life is being calculated to approximately 4 hours. Regarding the threshold level for all sensor values, machine learning is implemented to detect the threshold value rather than to use an average value. By this implementation, the accuracy is enhanced by 22% to 28%. With all the basic features required for safety, this device becomes more economical and portable.**

***Keywords*—Women safety, GPS, GSM, Temperature, Pulse Rate, Machine Learning, Linear Regression, Arduino**

I. Introduction

Gandhi once said, "Real freedom is when a woman can walk with jewels in the streets of India at midnight". If this is the true definition of freedom, then it is meaningless for us, as Indians, to call ourselves citizens of an independent and a democratic country. Violations against women never leave our country; rather they exist in different forms. Women while traveling alone will face situations where strangers try to move closer to them and try to misbehave with them. Extremities exist where women or girls get kidnapped and then gang raped. There are several such issues like the Nirbhaya rape case, Pollachi issue, Kathua rape case etc where the victims' bodies are recovered in a pathetic state. As a solution, personal defense devices should be incorporated with features where the user can activate the device or in worst conditions where the user is not able to activate the device, there must be an automatic mechanism where the device gets activated when the user fears or gets scared. For such a mechanism to work, the threshold levels or the regular patterns cannot be assumed as it might affect the accuracy of the outputs. Hence technologies like machine learning or artificial intelligence must be incorporated. Amiya, K., et.al [1], Femme band is built using Arduino uno and works around only 2 sensors namely the pulse sensor which continuously tries to sense the user's pulse rate. Once the pulse is being sensed, it activates the EMG sensor which is generally used to assess muscle activation. If the device senses any change in the heart rate pattern, then the device sends an alert message. This device has esp8266_01 incorporated into this which is the wi-fi module being used for wireless transmission of signals to the mobile SOS application being developed. The noise correction of the data collected will be done through the fuzzy normal distribution technique. Rubaiat, K et.al [2], implemented a fingerprint sensor which upon not being correctly authenticated within a specific time it assumes that the user to be in danger and it turns on the buzzer to attract the public's attention. It also sends an ALERT SMS by using the GSM module. It also has a feature to monitor the user's temperature and pulse rate with the help of sensors and display these values on OLED. This device also has a feature of communicating with android phones using Bluetooth and the user can login to a mobile application to view his/her health conditions and handle other features. Security is ensured such that the device can be stopped from functioning only when the fingerprint is authenticated correctly otherwise the process cannot be stopped by any stranger or intruder. Srinivasan,K et.al [3], has a button which upon enabling activates the touch sensor and low voltage shock circuit for self-defense purposes.

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Simultaneously GSM and GPS gets activated which sends the alert message along with location details of the victim. Imtiaz, et.al [4], as a common feature, this device too has a button which upon enabling starts the process. But the uniqueness of this project is that it has a feature of making calls. When the button is long pressed it makes a call to the emergency number and when it is pressed once GPS detects the location and uploads it to the webpage designed. Prottasha,G et.al [5], attempts to ensure women safety which has a discrete trigger mechanism. The uniqueness of this device is that this can be clipped onto the user's footwear and that this can be triggered when the user taps his one foot behind another four times. When this device is triggered this sends an alert to the victim's mobile phone through Bluetooth, which in turn sends SMS using the GPS module to the security number fed. Acceleration sensors are used which differentiates walking phase and tapping phase and plotted as positive and negative regions. Hari.K et.al [6], designed device has an emergency button which upon being high starts the normal process of detecting the location and sending it via SMS. It also has a pulse sensor being implemented which continuously monitors the user's pulse rate. If any changes detected that normal level, then the alert SMS is sent. It has a vibrator motor for defense purposes. Garima,T et.al,[7] a system named KAVACH has the implementation of a help button which upon activation sends the location as SMS using GPS and GSM. It also has a fingerprint module for security purposes. Hyndavi.V et.al [8] This device has two mechanisms. The manual mechanism has a button which upon pressing activates the alert mechanism and also activates the buzzer to attract attention. The other one is an automatic mechanism which has several sensors like temperature and pulse which monitors the users' temperature and pulse which upon exceeding the normal level will automatically activate the alert mechanism. Muskan.K et.al [9], has sensors like the temperature sensor and the pulse sensor which continuously senses the user's temperature and pulse rate and uploads them to the database. Logistic regression from machine learning is implemented to predict binary values from a range of values of temperature and pulse rate to determine whether the user is feared. General features of GPS and GSM are included to determine the current location of the victim and send that information to the security or the guardian number fed in the program. Bhuvaneswari.G et.al [10] the unique mechanism of this device is that whenever someone comes close to the user with this device, (distance of 3 feet) the device starts to vibrate and buzzer gets turned on. Emergency message is also sent. If the person is known by the user, then the user can turn off the process. Considering all the situations and dangers of the user, GIZMO COP has been implemented with all possible solutions and safety measures that guide women traveling alone in abandoned places.

II. PROPOSED SYSTEM

Fig. 1. shows the block diagram of GIZMO COP which contains several components like Arduino uno as main processor, GSM module, GPS module, sound recorder, fingerprint module, power supply, buttons, LED, buzzer and several sensors like temperature, pulse, touch and gas.GSM module (SIM 900) helps to send SMS using cellular network. GPS module (NEO-6M) determined the latitude and longitude of the current location. Pulse sensor (SEN 11574) and Temperature sensor (LM 35) detects the pulse rate and temperature of human being with one single touch. Sound recorder (ISD 1820) records the environmental noise and allows to replay the recorded sound for any number of times. Gas sensor (MQ 2) detects the presence of other gases in the environment by differentiating the pressure around. Fingerprint module (FPM 10A) is capable of storing 127 patterns of fingerprint during setup.

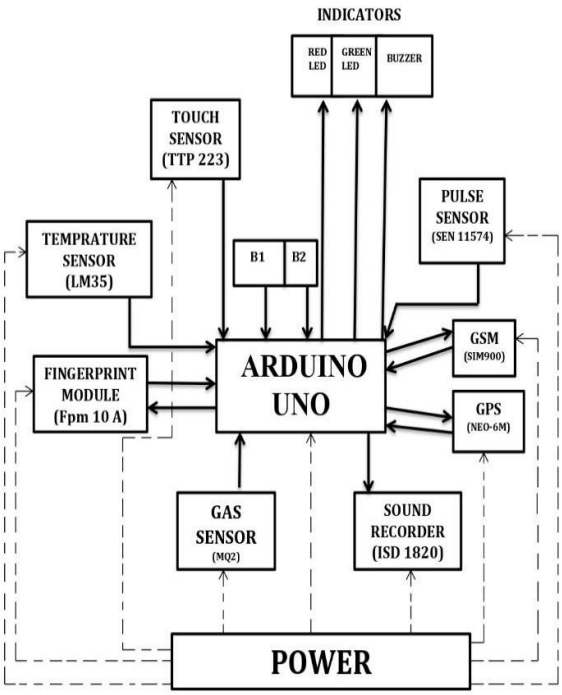

Fig. 1. Block diagram of GIZMO COP

A. Traditional Mechanism

As a traditional mechanism noticed in several models, there is an implementation of PANIC BUTTON which upon enabling activates the system. Once the panic button is enabled, the GPS module starts to detect the current location and the GSM module sends the ALERT SMS to the security number stating that the victim is in danger and along with that the latitude and longitude information. This forms the basic framework of the system.

B. Automatic Mechanism

Secondly, there is a mechanism implemented whenever the victim is in a situation where he/she is not able to activate the panic button. For such situations, there is a mechanism where several sensors like TEMPERATURE , PULSE and TOUCH sensors are implemented. These sensors continuously monitor and sense the victim's temperature, pulse and touch status. Whenever a human being is tense or feared or scared, there are significant changes in their body with respect to temperature and pulse. This characteristic of human beings is used to detect whether the victim is in danger or not. The user is monitored for a certain time and a large set of temperature and pulse values are obtained. With a linear regression model, the threshold value is obtained. Once the values go above the threshold, again an ALERT SMS along with the victim's current location details with

GPS module and GSM module. But this ideology may have disadvantages like, when the victim fears or gets scared for some other variety of reasons. Even in such cases, the system should not assume that the victim is facing danger due to harassment, abuse and sexual violation. The action of sensing the fear cannot be stopped but the further process can be modified by following the process if the fear is of other silly reasons.

C. Fingerprint Module

For such a case, the system has been built with the FINGERPRINT module fed with the samples or instances of the victim's fingerprint. So once the victim feels like he/she has feared for other reasons, he or she can use the finger to be sense. Once the fingerprint matches, immediately the GSM module sends a SMS stating that the victim is SAFE. This does not mean that the danger SMS mechanism gets stopped. As soon as temperature and pulse values go high, alert SMS is sent. But overriding that, safe SMS is sent. Another drawback of this sensing mechanism is that not everyone's body conditions are the same. So, an average threshold may not yield an accurate result all the time. To deal with this disadvantage, we use MACHINE LEARNING concepts to customize the device. The specific user's body conditions are sensed for a particular duration and a huge set of values are collected. These values are then fed to the software and an appropriate threshold level for that particular data is derived.

D. Miscellaneous Features

The sound recording feature, which gets automatically activated either when the panic button is pressed or in an automatic mechanism where temperature and pulse values go across threshold levels. The user or the victim may not have the presence of mind to purposely turn on the recorder. This acts as legal evidence. The second feature is the implementation of a gas sensor which senses hazardous gases in the surrounding and warns the user accordingly.

III. WORKING

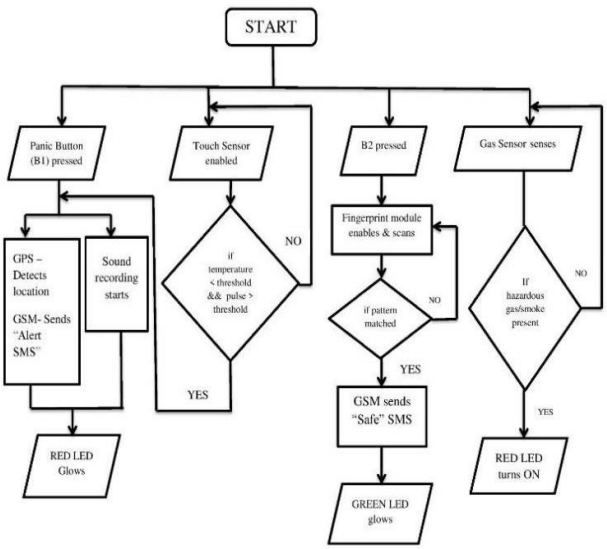

Fig. 2. Flowchart of the process in GIZMO COP

Fig. 2. Shows the sequence of actions performed once GIZMO COP is turned on. Whenever the user is in situations of physical danger, harassment, sexual abuse, button B1 is pressed, GPS module gets enabled and detects the current location of the victim. The GSM module automatically gets activated and sends the ALERT SMS along with the location details to the security mobile number fed initially which can be customized according to user's choice. Meanwhile, the sound recording also automatically turns ON to record sounds in the surrounding area. As an indication that this process has been completed, a RED LED is made to glow. In worse situations where the user is unable to press the PANIC BUTTON, whenever the TOUCH sensor value goes from 0 to 1, the temperature and pulse sensor starts to sense the user's temperature and pulse conditions. In such a case, for customization purposes, machine learning models are used to determine the threshold values for temperature and pressure. The user of the specific device is monitored for a certain amount of time to collect a large set of values which are then fed to the regression model to derive a personalized threshold value for the user. So whenever such changes happen with temperature and pulse, automatically the GPS senses the location details and sends ALERT SMS to security number with sound recorder and RED LED turned ON. The system has another button which upon being pressed activates the fingerprint module. Initially the fingerprint patterns of the user are fed. Whenever the fingerprint matches with the stored patterns, GSM immediately sends a SMS stating that the user is safe. Another safety feature of this device is the implementation of a gas sensor. There are several hazardous gases in our environment like methane, CO2 and even smoke that lead to serious health issues. In places where the concentration of such gases are high, the GAS sensor detects the presence of these gases and as a warning to the user, RED LED gets turned on to make the user aware about the presence of these gases.

A. Sensor Cases

Fig. 3, 4, 5 and 6 are several cases for various combinations of temperature, pulse and touch sensor values. The solid horizontal line in each plot is the threshold level for the particular parameter.The linear regression model took a large set of temperature and pulse values from user as input and produces 2 threshold levels – one for temperature as 96-98 C and another for pulse as 77-79.

B. Case 1

Fig. 3a. Shows that the touch sensor value has not gone from 0 to 1. Fig. 3b. shows that temperature values also have not fallen below the set threshold values. But Fig. 3(c) shows that the pulse rate alone has gone above the threshold level of 100. This does not mean that the person or user is feared or scared. In such a case, the automatic mechanism of sending location from GPS through SMS does not happen.

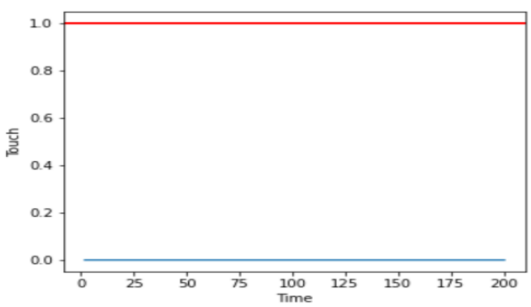

Fig. 3a. Touch vs Time

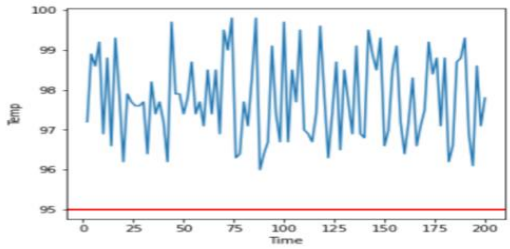

Fig. 3b. Temperature vs Time

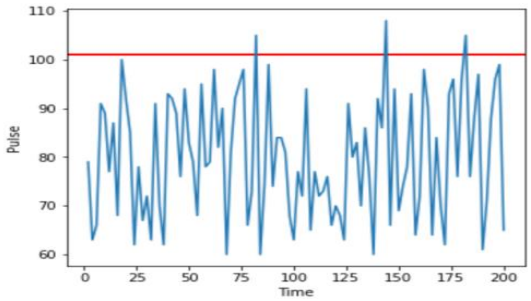

Fig. 3c. Pulse vs Time

C. *Case 2*

In Fig. 4a, the touch sensor value has not changed from 0 to 1. Fig. 4b. Shows that the temperature has gone below the threshold value of 95. But Fig. 4c. shows that the pulse rate has not gone below the threshold value. So further process of sending the location details does not happen.

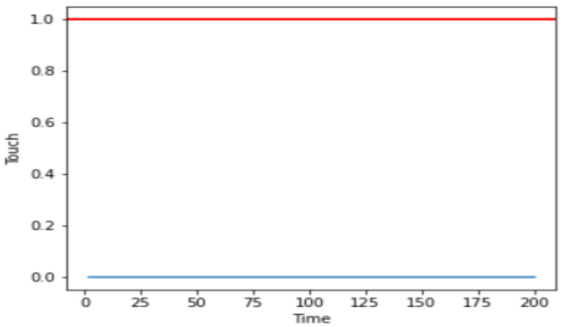

Fig. 4a. Touch vs Time

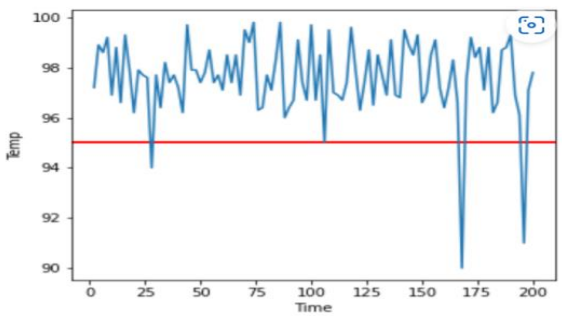

Fig. 4b. Temperature vs Time

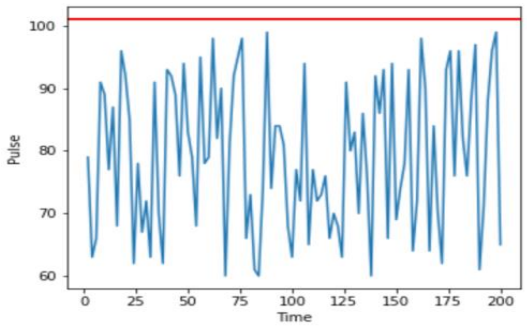

Fig. 4c. Pulse rate vs Time

D. *Case 3*

Fig. 5a. Shows that the touch sensor value has moved from initial 0 to 1.Fig. 5b. and 5c. Shows that the pulse and temperature values have not crossed the threshold level. ALERT message is not sent to the guardian or the security person.

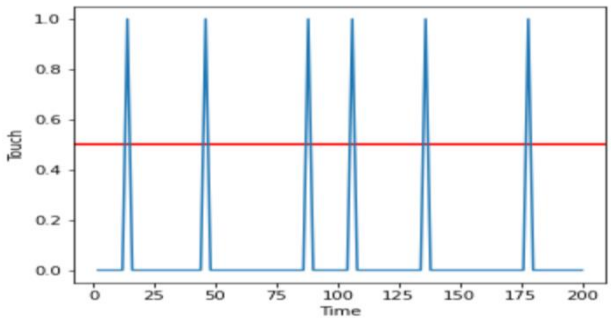

Fig. 5a. Touch vs Time

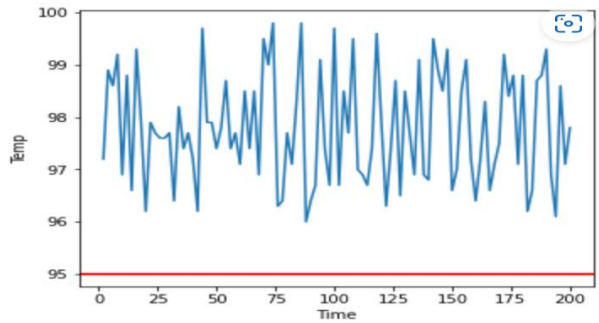

Fig. 5b. Temperature vs Time

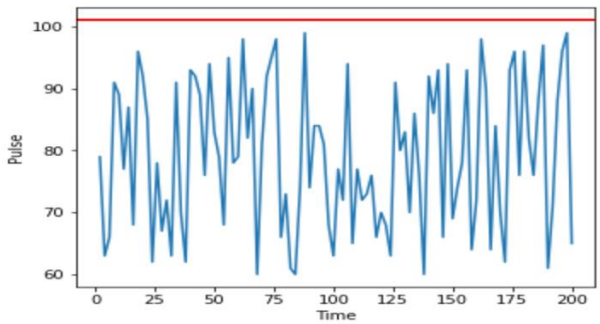

Fig. 5c. Pulse rate vs Time

E. Case 4

Fig. 6a. shows that the touch sensor value has changed from 0 to 1 at instances. Fig. 6b. shows temperature value has gone below threshold value. Fig. 6c. shows that the pulse rate has gone above threshold level. The above condition is the ideal situation where the user is feared or scared of something. This is the correct situation where the alert message has to be sent and accordingly the device sends the user's current location in the SMS to the security person.

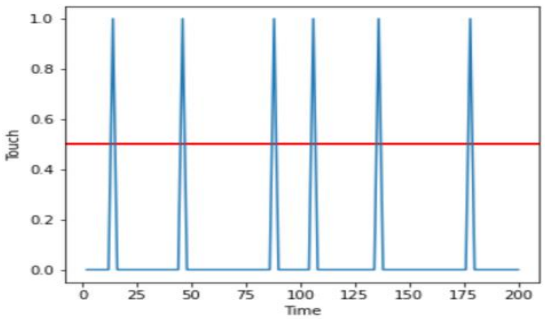

Fig. 6a. Touch vs Time

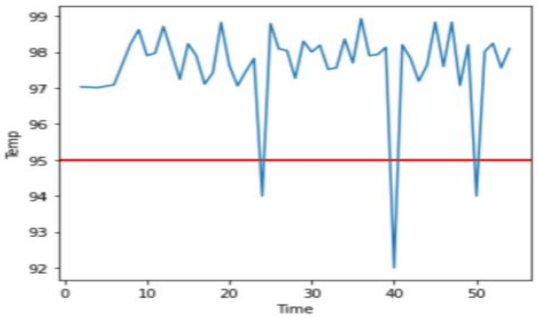

Fig. 6b. Temperature vs Time

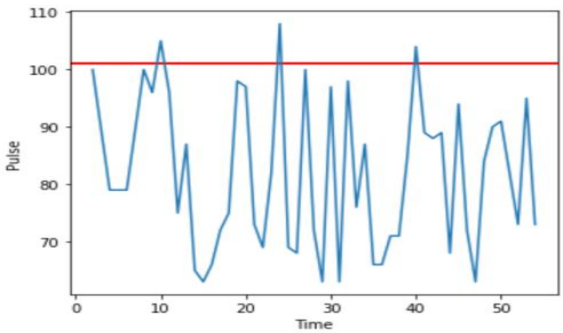

Fig. 6c. Pulse rate vs Time

IV. Result & Discussion

Fig. 7. Hardware implementation of Gizmo Cop

Fig. 7. Shows the hardware implementation of Gizmo Cop with several sensors, Arduino UNO, GPS, GSM and power supply.

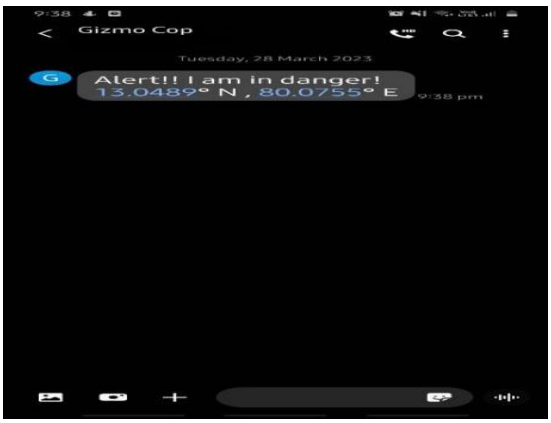

Fig. 8a. SMS when panic button is pressed

Fig. 8b. SMS when sensor values cross threshold

Fig. 8c. SMS when fingerprint pattern matches

Fig. 8a. shows the alert SMS received when the panic button is pressed. The SMS contains the latitude and

longitude of the current location of the victim detected by the GPS module. Fig. 8b. shows the alert SMS sent whenever the temperature and pulse sensor values cross threshold level and touch value changes to 1. Fig. 8c. shows the safe SMS sent whenever the fingerprint pattern matches with the stored patterns. This ensures that the security person need not plan for rescue whenever the alert SMS is sent accidentally.

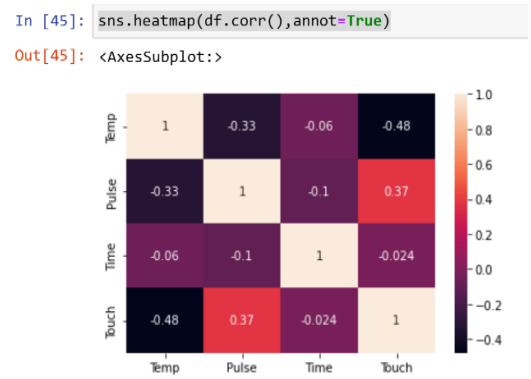

Fig. 9. Correlation Map Of Sensor Values

Fig. 9. depicts the correlation between the various sensor values obtained from PYTHON CODE. The temperature and pulse rate values are in STRONG NEGATIVE CORRELATION with each other. The pulse rate and touch sensor values are in POSITIVE CORRELATION.Temperature and touch sensor values are in STRONG NEGATIVE CORRELATION.The individual watts consumed by each component is taken into account and total watts required by all the components of the device is calculated with the formula in Equation (1) as shown below.Arduino=0.30w,GSM =0.3w,GPS=0.25,Fingerprint sensor=0.26w, Sound recorder =0.15w,Gas sensor=0.15w,Temperature=0.2w,Touch sensor=0.20w,Pulse sensor=0.2w .Total watt of component =2.04 watts

Battery lifetime = Battery current x Battery volt x no. of batteriesx (Battery efficiency /Total watts of component)

= 1.4 x 3.7 x 2 x 0.8 x (0.8 /2.04) (1)

= 4 hours

From Equation (1) the battery lifetime of the system is approximated from 3.5 to 4 hrs

TABLE I. COMPARISON OF FEATURES BETWEEN EXISTING SYSTEM AND GIZMO COP

Existing System	*Panic Button*	*GSM*	*GPS*	*Temperature Sensor*	*Touch Sensor*	*Pulse Sensor*	*Finger Print*	*Sound Recorder*	*Gas Sensor*
[1]	✗	✓	✓	✗	✗	✓	✗	✗	✗
[2]	✓	✓	✓	✓	✗	✓	✓	✗	✗
[8]	✓	✓	✓	✓	✗	✓	✗	✗	✗
[9]	✗	✓	✓	✓	✗	✓	✗	✗	✗
[5]	✓	✓	✓	✗	✗	✗	✗	✗	✗
GIZMO COP(Proposed system)	✓	✓	✓	✓	✓	✓	✓	✓	✓

Table 1. shows that GIZMO COP has all the necessary features when compared to all other existing systems which ensures safety of women in all possible dangerous situations.

V. CONCLUSION

Thus, GIZMO COP tries to provide safety in all worse situations and assists women to travel safely in this cruel and dangerous environment where harassment, physical attacks and sexual abuses are increasing in number each day. This is designed in such a way that the results are 22% to 28% more accurate with the implementation of machine learning concepts and is made to be efficient in every possible way. This requires minimal power supply that lasts for 4 hours and basic cellular tower signal. With this device women freedom can be experienced at the next higher level and women safety is conserved effectively.

REFERENCES

[1] Amiya Karmakar, Kaustabh Ganguly, Pritam Ghosh, Anusua Mazumder, Partha Sarathi Banerjee, Debashis De, “FemmeBand: a novel IoT application of smart security band implemented using electromyographic sensors based on wireless body area networks,”Innovations in systems and software engineering,vol. 13, pp.65–84, September 2022

[2] Khan, R., Mahfuz, N., & Nowshin, N., “A Novel Approach of Women Safety Assistant Device with Biometric Verification in Real Scenario,” 2020 IEEE International Women in Engineering (WIE) Conference on Electrical and Computer Engineering (WIECON-ECE) , 2021 vol. 34, pp. 426-431, June 2021, doi:10.1109/wiecon-ece52138.2020.9397938.

[3] Srinivasan,K., Navaneetha, T., Nivetha, R., Mithun Sugadev,K.”IoT based smart security and safety system for women and children,” . International Research Journal of Multidisciplinary Technology(IRJMT),vol. 02, pp.23–30, March 2020, doi: 10.3256/irjmt2024.

[4] Md.Imtiaz Hnaif, Shakil Ahmed, Wahiduzzaman Akanda, Shohag Barman et al., “Anti-Molestation: An IoT based Device for Women’s Self-security system to avoid unlawful activities,”International Journal of Advanced Computer Science and Applications, vol.11, pp. 722-725, January 2020, doi: 10.34276/ijasca3241.

[5] Prottasha Ghosh;Tanjim Masroor Bhuiyan;Muhib Ashraf Nibir;Md. Emran Hasan;Md. Rabiul Islam;Md. Rokib Hasan;Tanvir Hossain et al., “Smart Security Device for Women Based on IoT Using Raspberry Pi, 2021 2nd International Conference on Robotics”, Electrical and Signal Processing Techniques (ICREST), vol.21, pp. 57-60, doi:10.1109/icrest51555.2021.9331174.

[6] Hari Kishore,K., Eswar Teja Ravuri, Pawan Kumar Sankarasetty, Vamsi Krishna Mogilicharla, Raghveera, “An application on Women Safety using Embedded System and IoT,”Turkish Journal of computer and mathematics education, vol.12,pp.65-73,April 2021, doi: 10.1103tjcme233.

[7] Garima Tiwari, Adarsh Tiwari, Amit Kumar, Himanshu Verma, Kalyan Krishna Awasthi,“KAVACH -Women Safety device with GPS tracking and SMS alert,”Journal of Emerging Technology and Innovative Research(JETIR),vol.7,pp.1974-1981, July 2021, doi:10.51632jetir343.

[8] Hyndavi, V., Nikhita, N. S., & Rakesh, S.“Smart Wearable Device for Women Safety Using IoT,” 2020 5th International Conference on

Communication and Electronics Systems (ICCES), vol.20, pp.459-463, Jul 2021, doi:10.1109/icces48766.2020.9138047.

[9] Muskan, Teena,K., Manisha,K., Purnendu,S.,P."Women Safety Device Designed Using IoT and Machine Learning ," IEEE SmartWorld, Ubiquitous Intelligence & Computing, Advanced & Trusted Computing, Scalable Computing & Communications, Cloud & Big Data Computing, Internet of People and Smart City Innovation (SmartWorld/SCALCOM/UIC/ATC/CBDCom/IOP/SCI), vol.18, pp.1204-1210, June 2020, doi:10.1109/smartworld.2018.00210.

[10] Bhuvaneswari.G., Durga,M., Pavithra,M.,"A holdable device for women safety," International Research Journal of Modernization in Engineering technology and Science, vol.04, pp.938-943,February 2022, doi:10.5208irjmets

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