



International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijareeie.com

Vol. 6, Issue 2, February 2017

A Survey on Personal Security Systems

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ABSTRACT: Today, there is a drastic change in the society with the increase in crime rate as robbery, murders, kidnapping, rapes, etc. Nobody is confident about their safety whether women, men, children or senior citizens. We are looking forward for the day when everyone will be able to move freely without thinking about their safety and security. But today's scenario demands that we bring our focus on our personal security, for this purpose many solutions were developed and are available in the market in form of wearable devices as belts, watches, rings, etc. and mobile applications as WithU, bSafe, Emergensee, etc. This paper reviews available security systems and devices. Many times available security solutions prove useless due to unavailability of internet facility or if user is unable to activate or trigger the security device or if device gets lost or broken. This paper proposes a personal security system that will overcome all these drawbacks.

KEYWORDS: Wearable device, AI thinker A7, Google Cloud, Email scheduler, Kalman filter

I.INTRODUCTION

The crime rate is increasing day by day in all parts of the world. In the current worldwide situation, the prime question in almost every individual's mind, considering the continuous rise in number of crimes like rape, kidnapping, robbery, murders, etc, is just about their well-being and security. Walking around alone in the middle of the night is scary, especially for women. India is growing economically but still a lot of attention is required in case of security of its citizen.

Police records show high incidence of crimes against women in India. The National Crime Records Bureau reported that the growth rate of crimes against women is going to be higher than the population growth rate. Earlier, many cases were not registered with the police due to the social stigma attached to rape and molestation cases. Official statistics show that there has been a dramatic increase in the number of reported crimes against women. Many times, especially in kidnapping or murder cases, the relatives of the victim and police come to know about the incidence after several days or sometimes even after several weeks. Till that time investigation process for the police becomes difficult and chances of saving the person also reduces. This paper presents a review of various existing systems or devices that provide solution to personal security issues and a new improved personal security system is also presented overcoming the drawbacks of various already available systems or devices in the market.

Most of the security solutions are built using wearable technology. Wearable technology covers a broad area of devices, these devices are becoming popular because they are devices are also becoming wearable because of ease in their usage in comparison to smartphones. A professor at Georgia Tech, Starner found a thumb rule for accessing devices called the magic two-second rule. If you can't get to a device within two seconds, he says, your use of it goes down exponentially. Even today, smartphones have trouble meeting that standard. By the time we extract them from our skinny jeans, swipe, type a pass code, and find our way to whichever app we wanted, the moment has usually passed. As many times existing solutions fail to prove useful in case of danger due to unavailability of internet or device is lost or broken or it fails due to some technical fault. This paper presents an improved personal security system which will overcome these drawbacks.

This paper proceeds as follows: Section 2 presents the study of several existing security systems and devices. Section 3 analyzes the present systems critically based on different parameters. Section 4 presents the proposed model with its working. Section 5 presents the conclusions of this paper.



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II. EXISTING SYSTEMS

Existing Systems can be divided into categories as:

A. EXISTING SYSTEMS DESIGNED AS A DEVICE

The paper[1] proposed a system resembling a normal belt . It comprises of Arduino Board, GSM / GPS module , screaming alarm and pressure sensors. When the threshold of the pressure sensor crosses, the device gets triggered automatically. Immediately the location of the victim will be tracked by GPS and help message will be sent to three pre-registered contacts and one to police control room every two minutes with updated location. For defence purpose a screaming alarm unit is placed which will get activated and will call out for help and along with this it is also capable of generating electric shock which can prove really helpful to the user in danger.

The paper[2] proposes a security system which will be fitted to the girls sandals. This system gets activated by tilting the sandal. As soon as girl tilts her sandal, hooter will be blown indicating that help is needed to the people around and also electric shock is generated which is given to person harassing the girl. And then SMS will be sent to her relatives and friends along with police helpline including the location traced using GPS .

The paper[3] presents, design and implementation of a system which comprises of Smart phone which is connected to a Smart Band through Bluetooth Low Energy (BLE). The smart band communicates with smart phone through a specially designed application that acts an interface between the device and the phone. The data directed by the smart band such as the pulse rate, temperature of the body along with the motion of the body is continuously monitored by the application which is pre-installed in the phone. In cases of danger, the app directs the smart phone to perform the following tasks : Sends message to the family members along with the co-ordinates ,co-ordinates is sent to nearest police station requesting immediate action and also sends information to people in near vicinity requesting public attention.

The paper[4] presents a safety electronic system for women which is placed inside public transport vehicles such as cars, buses and auto-rickshaws as number of molestation cases against taxi drivers are increasing. This electronic system is integration of LCD display, keypad, GPS, GSM and embedded board to control and interconnect all these. As journey begins passenger can enter her friend or relative mobile number, he/she is going to get updated with the details of female passenger journey. The details will include the drivers name, mobile number, vehicle registration number and the secure pin generated by passenger and all this is sent by SMS to her friends and relative's .This system also provides facility to add destination this can prove very helpful in police investigation if any mishappening occurs. If the passenger gets down before the destination then an option is also provided to terminate journey called as end of journey which is executed and validated using secure pin, which driver will not be aware of.

The paper[5] proposes a GPS and GSM based vehicle tracking and women employee security system, that consists of a GPS device along with a specialized software which track the location of the vehicle and also this information is immediately sent as a SMS to the company special team and nearby police station . This complete system is helpful for ladies travelling alone for late night shifts ,providing security even inside the vehicle.

This paper[6] proposes a device called as “Suraksha” . This is easy to use device and as the name of device suggests this device is very helpful in providing security to women. It is triggered by using voice command, by pressing a switch and if shock level crosses threshold (i.e force is measure and it crosses threshold like if thrown with force). When the lady is in danger , it will immediately send the message including current location to the police, via the transmitter module and registered numbers via a GSM module.

This paper[7] presents a Self Defense System for women safety resembling a Smart Watch. In emergency situation, as witch that is located on the watch or band can be pressed and location information is sent as SMS alert to a few predefined emergency numbers And soon help is on its way. In case if the caretaker wants to know the present location



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of the lady then he/she can do so by sending a SMS to the SIM number of the lady which contains a secret password. Then this system responds to such request by sending back a SMS containing location information in terms of Latitude and Longitude. It also contains a shock mechanism to produce non-lethal electric shock in emergency situations to deter the attacker.

The proposed system in paper[8] can be implemented as an android application or using Arduino based board. This all in one intelligent security system provides the tool for intrusion detection inside the home where senior citizen, handicapped person or women living alone and after detection of intrusion it takes necessary preventive measure action to ensure safety, the tool to detect the spy camera placed at hotel, changing room and inform the user about the same, and hence provide safety from capturing the offensive photograph or videos and also provides the area zone modules to provides the child security and surveillance such as the child abuse .

This paper[9]proposes a system which uses ARM controller and android application in which both the device and the smart phone are synchronized using Bluetooth, hence both can be triggered independently. Device is designed using ARM controller to which GSM, GPS, Bluetooth and RF detector are interfaced.The device gets triggered in case of emergency situation by pressing the switch once and then with a distress message ,location information is also sent to the pre-set numbers using GSM module. And when the switch is pressed twice the device along with sending message will record audio of the incident using an audio recorder . When the same switch is pressed for a longer time it places a call to the police by GSM modem and sends the message with the location information of the user which is located using GPS(UBLOX) . The audio is recorded using audio. A hidden camera detector is also present which will detect if any hidden camera is present ensuring privacy , this works by using RF interface. In this the RF signal is interrupted and so camera is detected . In this paper , an Android Application is also used which also used to find and send location of victim to selected numbers by the user and also a phone tracking feature is also added using which person can locate its misplaced mobile phone . This app is activated by pressing volume button. And performs same function as hardware part when it is pressed once , twice and for a long time . The 4 different icons used in this application are the women safety ,SOS message, video recorder, hidden camera.

B. EXISTING SECURITY SYSTEMS AVAILABLE AS WEARABLE DEVICES IN THE MARKET

Artemis is a smart jewellery which comes in three different designs . When a person sense danger he/she can just tap the device three times to activate it. The device then starts audio recording and calls emergency contacts of the user to let them know user location. If device gets activated by accident it can be deactivated via person smartphone.

Safelet is fashionable bracelet that notifies your contacts about where you are. You activate bracelet by clicking on the button located on it. The bracelet is connected to a smartphone via Bluetooth and is equipped with microphone so the attack can be audio recorded which can also be used as evidence during the court trial.

A small pendant called Amulyte can be worn on a necklace. It can be activated by pressing its help button and it comprises of an embedded microphone and a speaker which allow two-way communication. You can actually talk to your emergency contacts and give them know even more information during the potential assault.

The React Sidekick is a low-energy, wearable Bluetooth safety device that pairs with a safety app. It can be worn on a clip, keychain or snap hook and gets activated by pressing the emergency button. Like other safety gadgets this one will also notify the preset contacts and let them know where the user is.



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III.CRITICAL ANALYSIS

Based on parameters such as triggering method , shortcomings and cost , critical analysis of above nine papers is carried as shown in Table 1.

Reference Id	Triggering Methods	Shortcomings	Cost
[1]	When threshold of pressure sensor is crossed	Siren system needed for the help and also in bus or train device can get activated because of heavy crowd	Cost is High due to the hardware used
[2]	When a girl tilts her sandal	False activation probability is more	Cost is High as ARM7 and highly precise accelerometer is used
[3]	Pulse rate , temperature and motion of body monitored by an app	Depends on internet	Cost is very High as very precise sensors are used
[4]	Device fitted in vehicle and used for tracking passenger	All details needs to be entered which is time consuming	Cost is medium due to hardware used
[5]	Panic button inside vehicle	Dependency on internet and pressing of panic button	Cost is very High as Teltonika FM1100 device is used
[6]	Using switch , voice and shock	False activation may occur due to presence of sensors	Cost is very High due to presence of sensors
[7]	Using emergency button or by body tilt and when body temperature ,pressure crosses threshold value	Size is big for a wearable watch and false activation can occur	Cost is very High due to hardware used

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[8]	SOS button is used	Reaction time is more as needs to open app and then click on SOS option	Cost is very very high as different modules used
[9]	Emergency button is used in hardware and in App volume & power button pressed	Internet is required and dependency on pressing buttons for help	Cost is very High due to use of hidden camera detector

IV. PROPOSED SYSTEM

Our proposed system is divided into a wearable device like a wrist band or bracelet and a base station which is a personal computer:

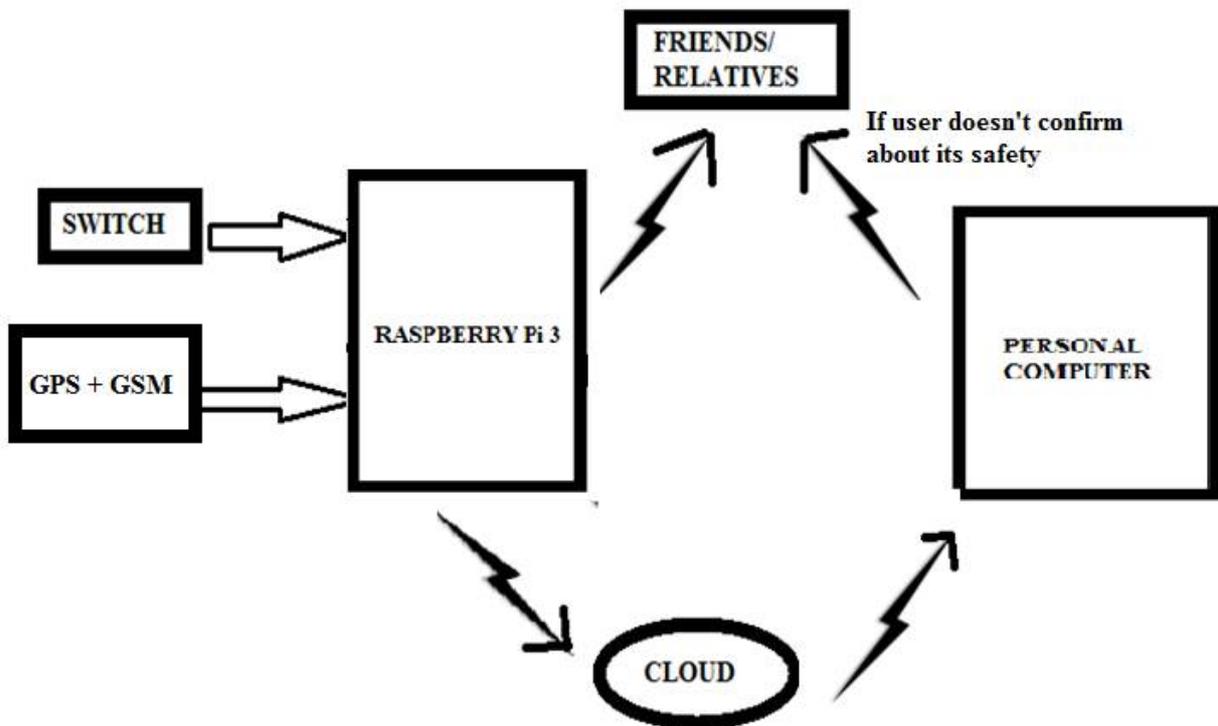


Fig. 1 Proposed system block diagram

The wearable device i.e the wearable band is built around Raspberry Pi3 module , it also consists of AI thinker A7 module comprising of both GPS and GSM on same module ,reducing the size of the wearable band and in case of danger it gets activated by pressing a switch . The location information of the user is getting transferred to Google Cloud from Raspberry Pi board after every two minutes. A safety timer is set with specified date and time , if user is able to change this date and time before timer elapses by logging into his/her Google account , then user is considered



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to be safe otherwise the stored data on cloud gets forwarded as email to the user's relatives and friends . This is all done by using Email scheduler ad-on which schedules the emails in Gmail by using spreadsheet.

The base station which is a personal computer or laptop will prove useful in non-availability of internet as during this time Raspberry Pi is unable to forward the location information to the cloud and the information gets lost. To solve this issue, Kalman Filter is used which will predict the next possible location of the user and this information is sent to Google cloud. If no input is received within three minutes ,Kalman filter starts performing and predicted next possible location of the user is stored onto the cloud.

On basis of analysis of already existing security systems , a new improved personal security system is proposed overcoming the shortcomings of existing systems .Main elements of this proposed system are discussed below . Raspberry Pi3 module is the third generation Raspberry Pi. When compared to the Raspberry Pi 2 it has 1.2GHz 64-bit quad-core ARMv8 CPU which makes it faster , 802.11n Wireless LAN ,Bluetooth 4.1 , Bluetooth Low Energy (BLE). Raspberry Pi 3 allows interaction with the Google cloud by using its inbuilt Wi-Fi.

AI Thinker A7 module support quad-band GSM/GPRS include 850, 900, 1800, 1900MHZ and also GPS. GPS satellites circle the Earth twice a day in a precise orbit. Each satellite transmits a unique signal and orbital parameters that allow GPS devices to decode and compute the precise location of the satellite. GPS receivers use this information and trilateration to calculate a user's exact location. GSM digitizes and reduces the data, then sends it down through a channel with two different streams of client data, each in its own particular time slot. The digital system has an ability to carry 64 kbps to 120 Mbps of data rates. The data obtained in form of coordinates are converted and sent via GSM to the pre-registered mobile numbers of friends and relatives of the user Cloud Storage is a cloud computing model in which data is stored on remote servers accessed from the Internet, or "cloud." It is maintained, operated and managed by a cloud storage service provider on storage servers that are built on virtualization techniques. In proposed system Google cloud is used for storing the location information of the user.

Email Scheduler for Gmail allows scheduling email messages inside Gmail with the help of a Google Spreadsheet. We can write our messages at some other time and Gmail will send them later at your specified date and time. A draft email is created by attaching link of the document having the location information. In this add-on we specify date and time for forwarding that email to user's friends and relatives if user is unable to change that specified time before it elapses indicating user is in danger.

Kalman Filter is a set of mathematical equations that provides an efficient computational (recursive) means to estimate the state of a process, in a way that minimizes the mean of the squared error. The filter is very powerful in several aspects: it supports estimations of past, present, and even future states, and it can do so even when the precise nature of the modelled system is unknown[10]. Kalman filter is used to predict the next possible location of the user when internet is not available avoiding loss of data.

V. CONCLUSION

With rapid increase in crime rate around all over the world requirement for various safety methods is also increased . Engineers and App developers are developing different Embedded security devices and smartphone apps. This paper reviewed various security systems which is helpful for different incidents of crime. Also , critical analysis of these various systems on some important parameters as triggering method , shortcomings and cost of the complete system is done and on basis of this analysis a new improved Personal security system is proposed . The key objective of this proposed system is to overcome the drawbacks of already available security systems as loss of data during unavailability of internet and if device doesn't gets activated on time of requirement because of any unavoidable reason as it gets broken or lost or user is not in state of activating the device then any security device becomes useless . The proposed system will make use of Kalman filter to predict the next possible location of the user during unavailability of internet and also location information of user is stored on Google cloud.



ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

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Website: www.ijareeie.com

Vol. 6, Issue 2, February 2017

Personal security is a critical issue in today's time. Many times, the relatives of the victim come to know that the victim is in some danger (kidnap, murder, rape, etc) after many days or even after many weeks. This also increases complications in the process of police investigation and locating the victim becomes difficult. This proposed model implementation will prove very helpful for personal security purposes ensuring complete security.

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