Survey Paper on Cognitive Apprehensive Device

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***Abstract*—In modern world, safety of women has become an area of serious issue because women are physically assaulted and raped. With the increase in the number of rape cases reported, people from different spheres have tried to reduce this problem in some way or the other. Technologists and engineers taking inspiration from this problem built wearable devices some of them are artemis, safelet, cuffs and many more. Jewelry like wearable devices have to some extent helped women to combat any attack on them. These small wearable devices seem to be a boon in the modern world and are a very important invention. Using these devices can help protect society, especially women giving the sense of safety anytime and anywhere.**

***IndexTerms*— Accelerometer, Arm Cortex Mo+ Nordic 51288, Bluetooth low energy, Wearable security device**

I. INTRODUCTION (HEADING 1)

Jewelry has been an integral and almost essential part of all cultures—prehistoric to contemporary period. Jewelry with special powers is also part of folklore and mythology. That the modern technology can indeed endow jewelry with special abilities is the premise for this project. Today with advances in affordable miniaturization technologies and societal acceptance of wearable technical gadgets, it is possible to make jewelry that can incorporate sensors, actuators, and wireless communication chips to enhance human experience in daily lives. This is Cognitive Jewelry. This wearable device has a technology that can help offer you that sense of security no matter where you are. This device is formulated for the society, especially for the safety of women, which is a major concern in today's life. The device provides flexibility and choices for the wearer.

II.RELATED WORK

Until today many devices exist which which made to ensure the safety of any individual, like, for example, as stated by Nudnik and Loriga [8], one of these products was ProeTEX. European project ProeTEX was led to incorporate wearable devices to improve safety and efficient disaster management techniques. This led to generation of "smart garments". In these garments, wearable senses were integrated to monitor physiological parameters, position and the activity of the user. The major algorithms that are used can be used as a major reference to design a model, which deals with the incorporation of different wearable sensors in different jewelry. The reason behind choosing a jewelry over a garment is to be cost effective. Jewelry can be worn for several days but a garment cannot be worn for several days continuously. Our device incorporates optimal use of various modules such as a Bluetooth Low Energy, an Accelerometer, and a handheld device. Each of these modules, serve a different yet pre-defined task, which decide the overall functionality of the device. We will look at the different areas where these modules work one by one.

ARM Cortex M0

Our major component used here is the microprocessor ARM Cortex Mo+. This microprocessor serves as the CPU to the device, so it carries out all the basic calculations that are required. This microprocessor uses a RFID i.e. Radio Frequency Identification, which works as a System-on-Chip (SoC). Additional information regarding SoC can be gained on the webpage [24]. This webpage gives a concise report of the Radio Frequency Identification (RFID) System-on-Chip (SoC). It describes the architectural features of the chip. The chip incorporates a 32-bit ARM Cortex M0 CPU that is highly capable of being flexible with much needed application performance. It supports the Bluetooth Smart protocol stacks. The flexible 31-mapping scheme make it an ultra-low power consumer and makes it much more compatible with other Nordic microprocessors. This type of microprocessor is much needed to the design of the jewelry, as it will be incorporating minute impulses to response with an alert required by the user.

As stated by Stephen Brewster [1], Mobile and wearable computers present input/output problems due to lack of interaction techniques. The deals were generating new ways to interact with the day-to-day usable wearable devices. The article gives the major inspiration for introduction of gesture recognition design in the model. It also backs the major design motive for the device that is the safety issue. An assessment of a range of diverse audio designs showed that the sounds reduced task completion time, perceived annoyance, allowing users to walk closer to their preferred walking speed. Secondly, it also depicts a sonically enhanced 2D gesture recognition system used on a belt-mounted PDA. Evaluating the system showed users' gestures were more precise when dynamically guided by audio-feedback.

We need to ensure that the microprocessors are typically algorithmically correct to carry out precise calculations and to log in a

rather profound data. To ensure that the data is profound, Steve Mann, Jason Nolan and Barry Wellman [2] have proposed the use of Sousveillance or say inverse surveillance. Different wearable computing devices generated varied kind of responses, and allowed collection of data in different situations. Visible sousveillance regularly called for counter-performances by front-line surveillance workers. The combination of sousveillance with surveillance generates new kind of information in a social surveillance situation.

Now, at same time it is also important to program these algorithms suitably. The webpage [25] portrays the software development around a Nordic semiconductor environment. It shows the usage of nRF51 series versatile single board development kit by nRF51 DK and nRF51 dongle. It is used to design specific task oriented algorithms to make the microprocessor in the desired way. The software tools help a lot to reach the goal to design the perfect model. The extra development tool chains and the mobile app development environment helps the microprocessors interact with mobile in a much easier and an effective way.

Bluetooth Low Energy(BLE)-nRF51822

The next component for our study is the Bluetooth. Our research on various papers related to Bluetooth Low Energy (BLE) indicates that BLE is a better choice than Classic Bluetooth for several reasons. The paper [5] explains SPP (Serial Port Profile) application for Classic Bluetooth and SPPLE for BLE, their configuration and functionality will help evaluate the Classic Bluetooth and BLE technology that can be used to connect devices wirelessly in an industrial setting. SPP (Serial Port Profile) is used to the Bluetooth module, which has been used to set up virtual serial ports and to connect the two Bluetooth, activated or enabled devices.

The SPPLE profile is similar to SPP profile except that it uses LE transport instead of BR/EDR transport. Spectrum Analyzer was used to capture the Spectrums and to show that the data of the spectrum transmissions for SPP and SPPLE applications, which uses both Bluetooth and BLE, stacks and which shows the behavior of both the technologies. The graphs obtained from the spectrums show that for a particular frequency band the energy consumption for BLE is less than the Classic Bluetooth. Hence, Classic Bluetooth can be used for applications that require the transmissions of a continuous stream of data thereby eliminating cables for data updating and sending files on servers. On the other hand, BLE has the capability of sending data in episodes as when required over a certain frequency. Hence BLE is used in battery powered energy harvesting sensors in industries and when in monitoring applications. In addition, BLE has several applications in various fields such as security, medicine, communication etc.

Some of the applications are as below:

This paper [3] [4] demonstrates the adaptable nature of a BLE WSNs and the low power consumption which is possible to be achieved with BLE devices for noise detection applications by employing networking protocols. The authors have taken into consideration the London Bridge Station where there is redevelopment-taking place. To monitor noise levels, we need high sampling rate and low power consumption so the WSNs which are developed uses Bluetooth Low Energy (BLE) which is most suitable for this application. Bluetooth Classic has higher power consumption and hence limits the battery life of the technology being developed. On the other hand, Bluetooth Smart, which is also called The Bluetooth low energy (BLE), has a low power consumption and a high communication range, which makes it more suitable for noise identification technology. BLE WSNs advantage of low power consumption allows integration of energy harvesting technologies such as energy vibration harvesters and solar cells to increase their span of life. However, accommodating such technologies in our device will not be cost effective. The paper [7] proposes to design a personal security authentication system. The authentication is done on a fixed device and the handheld device carried by every person provides the identity. It uses a Bluetooth Low Energy (BLE) Tag which operates on a coin cell battery and which tracks all of the low energy devices or any other devices which supports BLE in the vicinity and maintains a record of the tracking of when it entered and when it left the zone. This working of the BLE tag is employed in the application where the BLE Tag is embedded in the doorknob so only those persons who have the manual keys and Bluetooth Identification verification can open the door. The BLE Tag or the phone that supports BLE Tag provides the authentication. The paper [6][12] focuses on the widespread adoption of wireless technologies on medical applications which requires leveraging data transmission by using Bluetooth Low Energy (BLE) which link wireless sensors via radio frequencies to cell phones and computers.

The data obtained can be analyzed that can help physicians manage diseases better. In this paper, Bluetooth features two implementations, one is the Single mode and the other one is the Dual Mode. Single mode devices are compact radio communication units suitable for wireless medical monitors, which are very small and have low power consumption. Dual mode are radio communication devices that are targeted with handsets and personal computers. They are intended to become more popular than the Classic Bluetooth because they offer much more functionality and are not very expensive. We have also studied some other technologies comparing it to Bluetooth Low Energy (BLE) such as ANT/ANT+. The paper [23] gives a review about ANT/ANT+ and the basic difference between ANT and the two well established standards: Bluetooth Low Energy (BLE) and 802.15.4/4a. The transmission range and rate of ANT and BLE are equal. This paper talks about the advent of a new MAC protocol designed for wireless sensors. ANT (Advanced and Adaptive Network Technology) and ANT+, which are widely being used today in wellness and sports domain, focus on bandwidth optimization while keeping very low energy consumption. When being compared to BLE (Bluetooth low energy) device the battery life of a device following the ANT protocol is thrice as much and the frequency bandwidth is the same but its maximum payload size is lesser, moreover the number of channels a BLE could

support is much more than that supported by the ANT protocol.

3-Axis Accelerometer

The next component for our study is the Accelerometer. Our research on various papers related to Accelerometer indicates that 3-axis Accelerometer prove to be providing precise and profound data about the device's acceleration w.r.t time.

The paper titled – One Touch Alarm System for Women Using GSM [11] [10] describes about a one touch alarm system for women's safety using GSM. This helps to protect, identify and call friends or favorite contacts to help the one out of dangerous situations. Anytime a person senses danger, all they have to do, is hold on the button of the device. The device consists of a PIC microcontroller, GSM module, GPS modules. The system resembles a watch which when activated, tracks the place of the women using GPS (Global Positioning System) and sends emergency messages using GSM (Global System for Mobile communication), to SOS contacts and the police control room. Whereas our project does not need any manual interaction of the user to activate the device. It automatically senses insecure environmental conditions with a help of an accelerometer. It is a sensor used to detect when a person is being assaulted and this is in turn sent to the Bluetooth low energy (BLE) rather than using a GSM since the power consumption can be reduced largely and is much affordable when compared to GSM module. Another paper [22] [15] describes about an intelligent security system for women. This security system mainly consists of a monitoring device, the output of which is processed to identify insecure environments. This is identified using face recognition methods. Upon identifying unsafe environments system will send message to near-by control room and also turns on the alarms placed all around the area letting help from others. This system can be installed in public places such as railway stations, bus stands, foot paths and shopping mall, where women are commonly experiencing attacks. Our device uses the same principle but uses BLE and

3-axial accelerometer instead of face recognition methods and geared for an individual rather than an environment. Next, we researched a similar paper titled- Emergency Application for Women [14] [20], which depict an alert system for PROB detection using commercially available electronic devices to both detect the environment and surroundings and to alert the authorities. It uses an Android smart phone that has an internally placed tri-axial accelerometer. Next, data from the accelerometer is evaluated with several algorithms based position and threshold value is used to determine an unsafe environment. The threshold depends based on the parameters provided by the user such as weight, height, and level of activity. The algorithm adapts to the unfamiliar movements that a phone experiences. Our project too utilizes the tri-axial accelerometer, which is evaluated with a threshold-based algorithm, which uses parameters such as push, pull, kick and other such physical assaults done to a person for its activation. Similarly, a paper titled- A Review of Accelerometer- Based Wearable Motion Detectors for Physical Activity Monitoring [18] is a review of the wearable accelerometer-based motion and detectors. The accelerometer measurement, sensor properties and sensor placements are being given importance in building such a device.

Various research using accelerometer-based wearable motion detectors for physical activity monitoring and assessment, including movement classification, estimation of energy expenditure, position, detection of fall, and balance control evaluation, are also reviewed. This is the same process, which has been followed by our project to the various threshold values for the device to be activated by carrying out the accelerometer measurements and by determining the sensor properties.

Next, a paper titled-A Wearable Accelerometer Based Platform to Encourage Physical Activity for the Elderly [19] depicts the growth in the elderly people, which create immense pressure on the healthcare system to treat common geriatric problem. Preventive approaches like encouraging elderly people to take up and perform the physical exercises can decrease the risk of developing such diseases. In cases where diseases already have developed, further developments could possibly be eliminated. In this work, a wearable device to recognize user's movements is presented. The platform provides interactions with computer games designed to promote physical activity using tri-axial accelerometers. Our device which is also a wearable device, detects the motion using accelerometers which does not incorporate simple computer games but determines a threshold value by various trial and error methods to activate the device which makes it unique than the wearable device described above in the paper.

Another paper [17] recognizes the use of an accelerometer, present inside every cell phone, to predict the activity (walking, climbing, and sitting) of the owner. To implement this system labeled accelerometer data was collected from 29 users and then aggregated to predict the activity. The usage of a 3-axis accelerometer to measure the acceleration in all the three dimensions prompted us to take it up as one of our major components to help develop the system. The study of this paper helped us explore the greatly expanded domain while using a 3-axis accelerometer. Since our device also deals with gesture recognition, using an accelerometer, the various experimental results are a great asset.

The last paper titled- Activity Recognition using Cell Phone Accelerometers [13] [21] they have described and evaluated a system that uses phone-based accelerometers to perform activity recognition, which involves identifying the physical activity performed by the user. To implement this, they collected labeled accelerometer data from people as they performed everyday mundane activities such as climbing, jogging, walking, going up the stairs, standing, sitting, and then integrated this kind data into graphical data which are taken as examples that displays the user activity over 10- second intervals of time.

They then used the resulting data to induce a predictive model for activity recognition. Our project does not use a phone base accelerometer but uses 3-axis accelerometer, which recognizes a range of threshold for the bodily movement when assaulted. This 3-axis accelerometer determines the range of accelerator is better than to use a phone-based accelerometer since it is much

feasible than the latter.

"Suraksha", a device [16] [9] used to avert critical circumstances to empower women safety is a technological masterpiece. This article gives us a review of that device. This device uses voice recognition to be activated. It contains a GSM module as a component, which is self-sufficient to deliver messages to a smart-phone, and even the location can be tracked because of the usage of a GPS module. The greatest advantage of using such a device is its ability to deliver messages without the traditional usage of smart phones (at the user end), but by a single press of the button, but the inability to work without an actual physical contact is its greatest bane. This paper motivated us to develop the concept of building a device without any physical contact.

Some system, which is being devised, resembles a normal watch, but its functionality is far more. It has a GSM module and a GPS tracking module which is already installed, hence it does not require a smart phone (from the person at distressed end) to send messages, the GSM module is self- sufficient; moreover, the Global Positioning System module keeps track of the location. The only flaw that it contains is owing to its activation. It needs an actual press of the button to get activated, but that sort of time may not be available in a real life scenario, hence we came up with the ideology to develop a system with does not require any physical contact.

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