

## An Enhanced and Secured Wireless Environment using Swept Frequency Capacitive Sensing

A. Babu Karuppiah, R. RajaRaja, N. Shiny Ponmani and C. S. Meenakshi  
Velammal College of Engineering and Technology, Madurai, India

**Abstract:** Women empowerment brings equality for women in all aspects of life. But still 35% of women experience sexual or physical violence across the world. To bring down this value, many devices are designed to send emergency messages when the alert button on the device is triggered which becomes impossible during many situations. This proposal aims to develop a portable system that triggers automatically on the type of touch of the intruder. The method uses an Arduino board and a GSM modem forming the user-friendly, automatic, portable and a light weight pendant. The user's fabric attached with silver plated nylon act as the triggering element. When a person touches the fabric, Swept Frequency Capacitive Sensing (SFCS) distinguishes the intruder's touch of forceful grab from our loved one's normal sense of touch. Once the nature of grab sense is detected, the pendant makes multiple calls to the mobile phone numbers that are previously configured. Results show that the proposed method provides a simple and an effective security mechanism for women to safeguard themselves from intruders.

**Key words:** Conductive fabric, arduino board, gsm modem, swept frequency capacitive sensing

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### INTRODUCTION

The world and the technology are so advanced in this 21<sup>st</sup> century. But the violence against women has been increasing day by day across the world. The 35 % of women experience sexual or physical violence across the world. The 30 % of women worldwide experience sexual abuse by their partners. The percentage can vary between different regions and country but these statistics explain the safety level of women in our society. Violence is not only prevalent against women but also with children. The range of child sexual abuse ranges from 7.6% for boys to 19.7% for girls (Pereda *et al.*, 2016). The abuse of women or child can occur at home, schools or organization which can be mostly avoided with proper supervision. But when it comes to the society or outside environment, the harassment has to be avoided with the help of any devices.

When the pages of the newspaper are turned the cases of sexual assault, molestation, harassment trafficking etc. hit the headlines. One of the main reasons for violence against women is the mentality of considering women inferior to men. This is due to the upbringing culture and the thoughts of the men in this society. Time has changed but still the attitude towards women has not changed. Sometimes, children or women are kidnapped and are forced to involve in abusive work against their interest (Stevenson *et al.*,

1992). In that case, the victims have to be rescued from that dire situation in order to avoid the after effects.

The sexual abuse of children and women undergo both physical and emotional effects which is so traumatic. Psychological or emotional abuse is nothing but the use of tactics to instill fear in the victims and make them feel unsafe about their society. Severe physiologic response to trauma-related stimuli is established among women who have Post-Traumatic Stress Disorder (PTSD) as a result of child sexual abuse (Amitay *et al.*, 2016). The overall impact of the abuse depends on the degree of stress and the way of coping up with the stress. The biological and psychological systems are also affected by chronic stress and trauma (Swim sek *et al.*, 2016). This can destroy the physical health of the victim. Now the problem is to protect women against physical and emotional abuse. In order to protect women and to provide a safer environment some preventive measures can be followed. Conducting several school programs to enlighten the children about harmful scenarios and using gadgets like pepper spray, stun gun can be done to protect women from strangers are few preventive measures to mention. In spite of all these methods it is the women who need to protect themselves from the threat posed against them. Lots of methodologies exist in order to protect women under stressful situations which are explained as follows.

The android app discussed by Pawar *et al.* (2014) is called SCIWARS (Spy Camera Identification and Women Attack Rescue System). It is an intelligent system that is used to avoid any kind of attacks on women by detecting the presence of spy cameras. Another app related safety system designed by Dongare *et al.* (2015) is activated by recognizing the voice of the user. The activation keyword is already stored in the android application. The first step the intruder will do is to close the mouth of the victim refraining them from calling for help. In that case the use of this app is not possible. The third android based app called Sauver is created by the team of Bramarambika and Kumar (2015). This application is designed to make calls and also to send messages when a button is pressed. Kumar and Kumar (2014) designed the fourth android based app called IPROB. If any PROB (problem) is suspected using the Android app, some notification will be raised for user's response. If there is no response from the user, respective actions will be taken. All the above four methods concentrate on the use of a distinct mobile app. But, this facility is not feasible for non-smart phone users.

The next intelligent security system proposed by George *et al.* (2014) consists of two cameras and a processor to implement subsystems like Chaotic situation analysis, Gender detection and Facial expression recognition which detects fear of women by differentiating smile, anger and fear. It is difficult to focus on a particular woman at crowded places. The researchers Kumari *et al.* (2014) have discussed about an eve teasing gadget is to save women from strangers. This device is not only used for avoiding eve teasing but also used for healthcare systems. This is done with the help of an electric shock circuit which is independent and it is not attached anywhere in the victim's body or cloth. It takes more time to trigger the circuit and can also be misused by wrong hands.

Kumar *et al.* (2014) has discovered a security device in the form of a watch which has many features to help women in emergency situation. The device consists of a PIC microcontroller, GSM and a GPS module. The security system involving two concepts called ZigBee and android is suggested by Joshi and Varade (2015). This device starts tracking the location of the victim using GPS and sends alert messages to the police control room using GSM when it is triggered. Idachaba (2011) explained a system to track the location of the kidnapped persons. The main components are a GPS module and a GSM module. The GPS continuously tracks the location of the victim and stores the last five GPS readings on the microcontroller and sends it through GSM once triggered. A security system is presented by Bhilare *et al.* (2015) for employed women. The abuse of employed women by the drivers or colleagues in the cab is avoided using this security system. The next safety device is designed in the

form of a watch or band by Vijaylaxmi *et al.* (2015) and the panic button will be placed in the band. It also consists of GPS facility. Shaik and Jhani (2014) implemented a security system also in the form of a watch or band which uses the concept of RFID and GSM. This device starts to work only when it is triggered. Prashanth and Singh (2015) composes a GSM module to make a call to the nearby police station under emergency situations. This security system in the form of a watch with an alert button is proposed by Hussain (2014). The technology used in this system is RFID where RFID tag is embedded in the watch. Revolar's 'magic button' is a tiny wearable device which helps the users to stay safe. It is a non-violent way in providing security to the users. If the user is in danger, they can press this magic button which in turn sends alert messages along with information of the location to the selected loved ones with the help of a mobile application.

The last nine methods work on the principle of triggering the device by pressing an alert button. Under stressful situations, it becomes difficult for the user to search and press a button. The device starts to work only when the manual trigger is provided in the form of an emergency button. If that manual trigger is not provided, then the entire motive of the device gets spoiled and the device is of no use to the user and also cannot provide the guaranteed safety to women.

## **MATERIALS AND METHODS**

The most frequent technique used in the above methodologies is the usage of an alert button. This alert button is triggered to make a call or to create a SMS to the configured number. But these methods need a manual effort of triggering the button in order to start working. Under stressful situations, it is difficult for the user to make physical contact with the button. This problem is solved in this proposed method as it does not require any manual effort. The device (i.e. pendant) will be automatically triggered when the intruder makes contact with the victim's fabric.

The block diagram of the crony pendant is picturized in Fig. 1. The main components used are woven conductive fabric, Arduino board and GSM shield which are explained briefly. The woven conductive fabric is a touch sensor. The conductive textiles are made with strands of silver plated nylon which are woven into a textile. The fibers (nylon) used are generally non-conductive and is coated with a conductive material (silver). This woven conductive cloth can be ironed and it will be discolored over a period of time.

The Arduino board used is Arduino Uno that provides 14 digital I/O pins where six of these inputs can

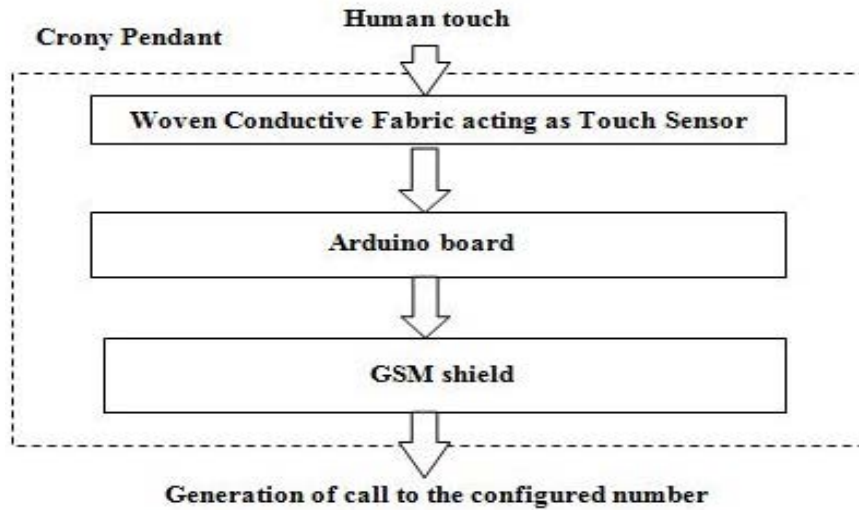


Fig. 1: Block diagram of crony pendant

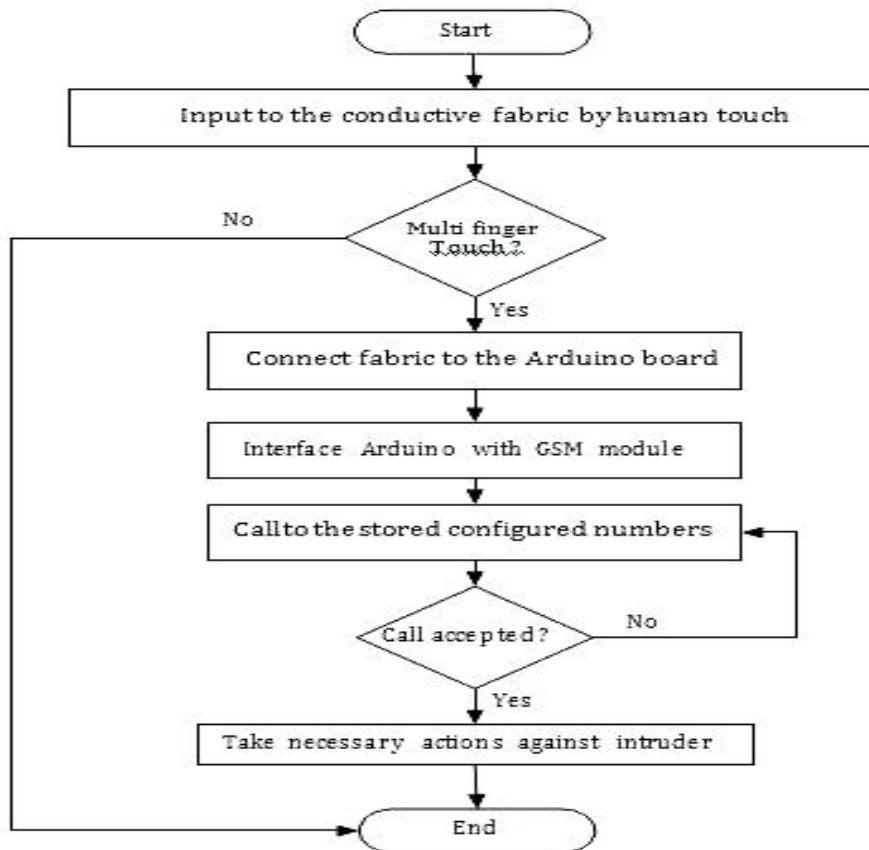


Fig. 2: Flow chart of crony pendant

produce Pulse Width Modulated (PWM) signals and analog inputs which can also be used as analog to digital I/O pins (Fig. 2). The Arduino Uno is a microcontroller board called ATmega328p. For programming the

microcontroller, the Arduino provides an Integrated Development Environment (IDE). This includes C and C++ programming languages. This Arduino board can be an interface to other expansion shields like GSM, Ethernet,



Fig. 3: Multi finger touch

etc. A GSM modem is a device with serial, USB or Bluetooth connection which can be used as a mobile phone. The data from the GSM modem is connected to the Arduino if the modem is enabled with TTL output pins. SIM card is inserted in the GSM module and made to wait for the blinking to stop until the SIM is connected to the network. To connect Arduino and GSM, GSM TX is connected to Arduino RX and GSM TX to Arduino RX. The working of the crony pendant is explained in Fig. 2.

The concept of capacitive sensing works as follows. When a conductive object is excited by an electric signal at a fixed frequency it causes the charges to move and produce an alternating current which is detected by the sensing circuit. The amount of current produced depends on the amount of capacitance.

The amount of capacitance generated depends on the distance between the target and the sensor. This technique is simply used to find the touch sense. But in order to differentiate various types of touch, a concept called Swept Frequency Capacitive Sensor (SFCS) (Sato *et al.*, 2012) is used. SFCS works on the same principle like capacitive sensing but the object is excited by electrical signal at different frequencies. That is, the conductive object will respond differently at different frequencies. So, the result obtained is made multitude of data at different frequencies from which the various touch senses can be differentiated.

When an intruder tries to misbehave with the victim by pulling the fabric, the crony pendant is triggered which makes the GSM shield connected to the Arduino board to make alert calls to the mobile number which is configured earlier on the pendant.

The woven conductive fabric is connected to the victim's fabric and it acts as a sensor (triggering element). This fabric is also connected to the pendant worn by the victim. This pendant is composed of Arduino board and a GSM modem. When the cloth is grabbed by the intruder, the Arduino board is provoked which in turn activates the

GSM to make a call to the preprogrammed number. In order to differentiate various hands gestures like single finger touch and multi fingers grab SFCS is used (Fig. 3).

## RESULTS AND DISCUSSION

**Step 1; multi finger touch:** The pieces of woven conductive fabric acting as a sensor are connected to the inputs of Arduino board. The circuit is designed in a way that it will charge the capacitor to a threshold value. The circuit will be triggered when the multi finger touch as shown in Fig 3 crosses the threshold value. This is indicated by the glowing of LED on the right. LED indicates that the circuit is on.

**Step 2; reading the input values of touch sensor:** In order to read the touch values on the fabric, the Arduino board is connected to the Bluetooth module. The transmitter and the receiver of Bluetooth are connected to the receiver and transmitter of Arduino. Then using a mobile app the phone and the Bluetooth module is connected through Bluetooth. After establishing the connection, the values of touch is read on the phone as shown in Fig 4.

**Step 3; connecting gsm and arduino to make calls:** The GSM modem is connected to the Arduino board by simply connecting the transmitter output of Arduino to the receiver input of GSM modem. Similarly the transmitter output of GSM modem to the receiver input of Arduino. Now when the input is triggered the device makes a call to the configured number as shown in Fig 5. The call is repeated for each and every minute until the connection is interrupted. First a call is made to the primary configured number then to the secondary configured number. This cycle is repeated until the circuit is disrupted.

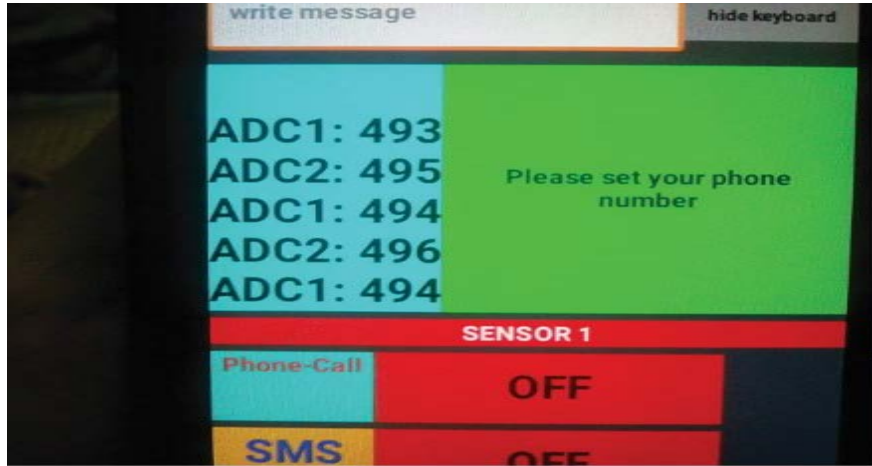


Fig. 4: Values of touch sensor on mobile phone



Fig 5: Working of GSM modem

## CONCLUSION

The results show that the idea of using woven conductive fabric (attached to the cloth) as a sensor is concealed from the outside world when compared to the gadgets used in the existing methods. And also embedding the Arduino board and the GSM modem in the form of a pendant makes the device user-friendly and portable. The user is able to call for help without any manual trigger under dangerous situations which shows the pendant is an automated system. The results prove the fact that the performance of the proposed system is decisive as the pendant is not triggered for all touch senses but only for grab sense. When the sensor is triggered the GSM makes a call to the two of the configured numbers in a cyclic manner with an interval of 1 min. Therefore there is no possibility that the call is unnoticed at the other end (person whose mobile number is configured).

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