



Arduino Based Smart Shoe System for Women Safety, Defense and Integrated Intelligent Tracking

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Abstract: *In this paper a smart safety shoe for women has been presented by authors. The whole system uses GPS and GSM modems, electric shock circuit and Arduino microcontroller board. GPS receiver works as the detector, it fetches the location of the concerned accident in the form of latitude and longitude. GSM sends the latitude and longitude information as a SMS to 5 predefined numbers with the help of programmed microcontroller. It also sends a phone call to one phone number. Microcontroller works as the backbone of the system. Whole system can be activated by just a single press of panic button. Hardware representation of the system has also been presented in this paper. That shows overall compact assembled system inside a ladies shoe sole for greater reliability of stated work. Real time processing of data's is presented in various figures.*

Keywords: *Women Safety, IoT, Live Streaming, GPS, GSM, Smart Shoes, Arduino*

1. INTRODUCTION

In today's scenario women safety has come out as an important matter of concern, for people and also for law enforcing authority. The no of women harassment and eve-teasing cases has risen by many folds due to the greater disclosure of women in every part of life. Number of physical harassments of women in schools, work places or even in public transports is soaring daily. It has become a societal crisis in many countries. In spite of implementing so many rules and regulations for women, it doesn't stop thieves, assaulters or molesters to misbehave with women. This work by authors tries to define a self-sufficient solution of the women safety question. From several years law enforcement agencies and common people are searching for built-in technologies to control these cases. Several devices are there to help this problem.

According to Indian perspective there are mobile apps in the market developed for the safety of women specifically designed for android or iOS, some of which have paid premium features that may help to save a life in threatening situations, for example, apps like 'VithU', 'Smart Shehar' etc. allows one to send SOS alerts to the listed contacts by just pressing the power button of the phone twice or even take the picture. It also sends the GPS location of the incident or where the victim is present. Problems associated with these smart phone applications are that, if a

woman gets into any trouble then she might not be able to use her hands to activate the app and send her location because in most cases the attacker firstly grab victim's hand and close her eyes too. Apart from several mobile apps some built in smart devices are there for safety of women. Such like a smart self-defense watch for women safety [1] which uses Atmega 328 Microcontroller and has GPS module inside it to detect the location and display it on the watch, it also comprises a voice recognition module that saves the audio inside a sim card and sends it to the nearby police station that can be further used as evidence. Concept of this watch is undoubtedly a good concept but practically it is difficult to assemble all the modules in a small watch which are described in the work.

Above all the electric shock circuit which has been described in the work can be very dangerous for the victim and it seems not user friendly as it can in turn harm the victim itself. Maximum situations attacker will firstly try to grab the hand of victim, that time it is quite difficult for the victim to tap the switch. 'SHE- Society Harnessing Equipment' is an anti-rape device having sensors and shock circuit board attached to the ladies inner wear. The circuit is placed near the bosom because women are attacked there first, in case of eve-teasing or rape [2]. Smart belt, system was designed with a portable device. It comprises of Arduino board, screaming alarm and pressure sensors. When, the threshold of the pressure sensor crosses, the device will be activated automatically. The screaming alarm unit will be activated and will start blowing alarm asking for help [3]. Smart shoes for women

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safety use GPS, GSM modules, a shock circuit and a camera, which are interfaced with Raspberry Pi board and Arduino [4]. If the victim is facing any kind of danger, she can immediately make use of this device, embedded in their shoe to escape from the dangerous situation and even harm the attacker. The fundamental problem of all this devices and technologies are that they are not physically viable. It is difficult for a woman to use an innerwear or a belt or watch with so many devices on it.

Author of this paper have tried to solve the problem with a built in smart, off the shelf, compact device inside a lady’s shoe. As proposed in these work, smart shoes for women safety comprises GPS and GSM modems & electric shock circuit. Inside this system GPS receiver works to detect the location of the incident with the help of satellites in the form of latitude and longitude data. GSM module will send a predefined SMS along with latitude and longitude data with the help of microcontroller. The microcontroller processes the whole information for sophisticated use. The GSM modem sends a particular SMS; like “I am in a trouble” and also sends the current location of the device to the predefined 5 mobile numbers. When a woman is in any kind of critical situation then the system can be activated by just pressing the panic button. To activate the whole system the victim has two options; first one is by pressing her pendant, which has a panic switch, but if the molesters or assaulters grabs her and lock her by both hands, she would not be able to press her pendant then she can choose the second option. Second option is to press the switch, which is located inside her shoe. If any woman finds any trouble or in any kind of hazardous situation, she can immediately make use of the device, studded inside her shoe to escape from that situation and also to inform her dear ones or guardians about her situation. Victim can even harm the attacker by using the current shock which released from the other pair of the shoes. This projects a women safety shoe that not only helps women take care of themselves but also help them be fearless. This project makes use of GPS, GSM modules, a shock circuit and Arduino.

At present days women are not safe enough in spite of considering women as equal as men. Authors came to know about so many cases regarding women harassment and rape in recent times, and the number of cases increases day by day. To control this type of crimes there needs a device where women can save themselves. Women safety shoe is that kind of shoe or device with which women can save them. Intention of this paper is to introduce the users with a GPS, GSM technology based smart shoe that has an electric shock circuit, a pendant and along with some extra features. Section 2 of this paper contains the methodology and working principle of this device, section 3 has the system architecture, section 4 has the hardware modeling and its description and output with discussions in the section 5.

2. METHODOLOGY

Here in this paper authors tried to overcome the difficulties present in the existing technologies that have already been discussed earlier. The shoe represented here is practically user friendly for day-to-day life. The best part of this device is its compact structure. All the modules, power source and devices are engraved

inside the shoe sole, making it a practically viable and user friendly for any woman’s daily life. In this gadget a pendant is also present. If a woman faces any kind of trouble then she can start and active the whole system just pressing a switch which is located in that pendant. A supplementary switch has also been added in the shoe, so that she can press that switch which is located in the shoe by just using her feet. It is useful if the victim is not able to use her hand because sometimes the attackers might lock her both hands and close her eyes too. As an added layer of security, a feature has been incorporated that when the victim activates the switch then it will automatically send a particular SMS to any 5 predefined phone numbers and also it sends a phone call to a predefined phone number.

When the victim will activate the whole system then it will send her location to the allotted phone numbers using a text message, with latitude and longitude details. Receiver of the message can easily trace the location of the victim using Google Map [14] and provided latitude and longitude data with a single click. It is not always necessary that the location of incident remains static in that same location. Sometimes molesters can drag the victim to any other location. In that time if the phone numbers which are allotted sends any SMS to that “shoe” then it will automatically navigate her real time current location and will send the details as latitude and longitude to that number.

For defense purpose an electric shock system has also been incorporated inside device, which resides to the lower part of the shoe. For that when the girl will be trying to get rid of eve teaser, she can easily use this electric shock. And though the output is in the lower side of the shoe sole and far from her feet that’s why she cannot be affected by the shock. If any call comes from the predefined phone numbers to the shoe, it will be automatically received using GSM module. Caller can listen to the real time ambient sounds at the place of incident.

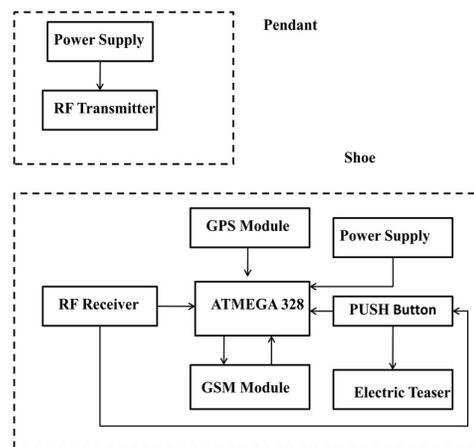


Figure 1: Block diagram of the device (Shoe and Pendant)

This shoe consists of GPS module, GSM module, shock circuit, 433rf transmitter and receiver, Arduino nano, battery, charging circuit and switch. The basic idea of this device is to send SMS and phone call along with the location to the emergency contacts by pressing any emergency switch which is located on the pendant and in the shoe. Here a shock circuit is used in this device which produces a shock of 600KV that is sufficient to harm the assaulter and gives enough time to escape for the victim. The main controller used in this project is an Arduino Nano microcontroller. GPS and GSM modules connected to microcontroller, and also connected to a 433 RF receiver and its triggering is provided by a RF transmitter, assembled inside the pendant. A 3.7v, 2000 mAh battery has been used as power supply for operation of the whole system.

3. SYSTEM ARCHITECTURE

The system comprises different components as discussed in the previous sections. Here in this section authors tried to enlighten the system architecture of the device. Internal microcontroller other modules and circuit diagrams are thoroughly presented here. The main part of the system is microcontroller; here in this device Arduino Nano has been used as the microcontroller. Arduino is an open-sourced, off-the-shelf, compact platform used for manufacturing and programming of small-scale electronic devices.

The Arduino is a very popular, low cost, light weight programmable microcontroller board. Arduino boards can be accessed with the use of a simple USB cable to upload the program, and the software of the Arduino, namely Arduino IDE, uses a simplified version of C++, making it more accessible than other microcontroller boards to the researchers. In this paper authors have used Arduino Nano 3.0. Arduino Nano 3.0 is shown in the Figure 2. It is a 30 pin board having ATmega328 as microcontroller embedded inside it. From Figure 3 it can be seen that Arduino Nano has 14 digital I/O pins, 8 Analog reference pins and has a clock frequency of 16MHz [5], crystal oscillator of frequency 16 MHz is used for this purpose. With large number of I/O ports it is possible to connect large number of sensors to Arduino boards.

Arduino Nano can be powered by simply with a Mini type - B USB and it has an operating voltage of 5V. Recommended input voltage for Arduino is 7-12 V. It can also be powered using external power source or battery.

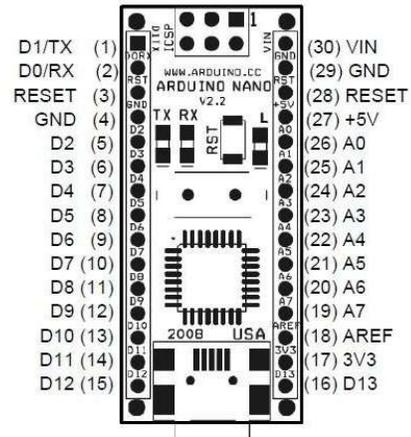


Figure 3: Pin diagram of Arduino Nano [10]

Using 6-20 V unregulated external power supply or 5V regulated external power supply. Power source is automatically selected to the highest voltage source applied. ATmega328 microcontroller provides several interesting communication features for having communication with a PC or another Arduino or server or cloud or any other microcontroller board. From figure it can be seen that there are two digital pins D₀ and D₁ for typically dedicated use of transmission (Tx) and reception (Rx) purpose. D₀ and D₁ pins are available with UART TTL serial communication. Tx and Rx LEDs are present on the Arduino board. They will flash when the data is being transmitted via USB connection to and from the computer. ATmega328P has 32 KB flash memory for storing code.

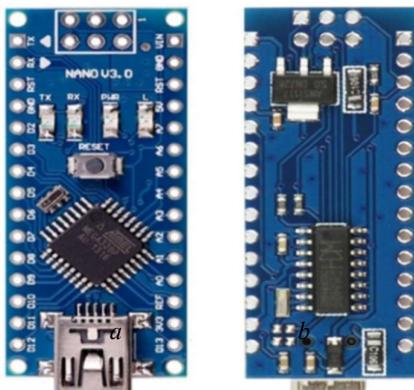


Figure 2: (a) Front view of Arduino Nano 3.0 (b) Back view of Arduino Nano 3.0 [10]



Figure 4: SIM800L GSM module (Front View)

SIM800L GSM [11] module has been used in this system. The SIM800L module has total 12 numbers of pins that perfectly interfaces it with the outside world. It is basically used for sending messages and to make and receive calls. The module consists of a helical antenna which acts as the means for making and receiving calls and messages. The operating voltage of SIM800L is 3.4

V to 4.4 V. Micro SIM slot is provided with this module for inserting SIM card. It also has LED status indicator.



Figure 5: NEO-6M GPS module 6500

To serve the purpose of GPS module the u-blox NEO-6M Global Positioning System (GPS) module [12] has been used in this device. It's a very economical and high performance 24 pin GPS module available in the market. It comprises of a ceramic patch antenna above all, it has one MS621FE-compatible rechargeable battery for backup and EEPROM for storing configurations. The module works well with a DC input in the 3.3 to 5V range. FS100A RF Transmitter – receiver module [13] is used for wireless purpose of the system.

FS 100A works at 433MHz frequency, it is one of the cheap and easy to use RF modules for all wireless systems. These modules can be used only in pairs and only simplex communication is possible. The module could cover a minimum of 3 meters to 30-35 meters practically in a normal test condition. Operating voltage of FS100A wireless module is from 3V to 12 V. The system is rechargeable. Rechargeable battery has been added to the system for smooth operation. Li-Po (Lithium Polymer) rechargeable battery of 3.7 V and 2000 mAH has been used in this device. Circuit arrangements for both the shoes are presented here in the figure. Figure 6 represents the right shoe and Figure 7 represents the left shoe.

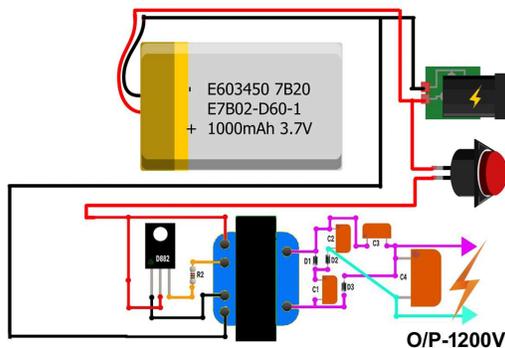


Figure 6: Circuit diagram for right leg shoe

Right shoe is studded with shock circuit arrangements for self-defense purpose of the victim. One can easily activate the shock arrangements by just pressing a push button switch, residing inside sole of the left shoe.

Left shoe is entirely for safety and tracking purpose. Arduino Nano, which works as the main part of the system has been engraved inside the lower part of left shoe. GPS, GSM modules, Rx and Tx module and a mic has also been attached with the microcontroller and studded inside the left shoe. It is also a push button activated circuit. In both the shoes Li-Po batteries are used for power supply.

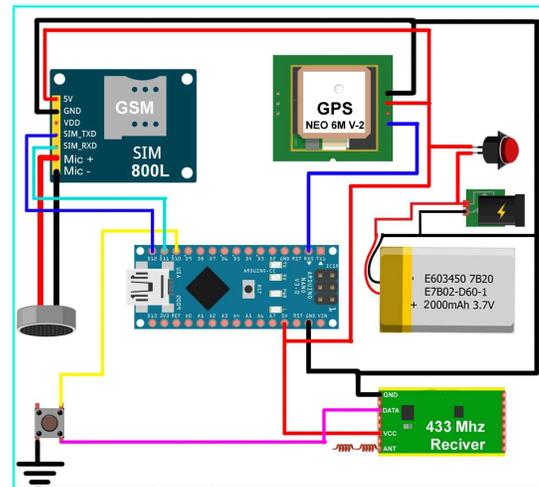


Figure 7: Circuit diagram for left leg shoe

4. HARDWARE MODELLING

As mentioned in the introduction section the main purpose of this work is to answer the question of portability and off-the shelf use of smart safety systems. It can be seen most of the device, proposed or designed earlier, by the researchers are not user friendly. This smart shoe is capable to serve the need of ready to use device in the market. In figure the ready to use, off the shelf prototype of the device is presented. The push button switches can be seen in red colour at the sole of both the shoes. No external wires, connections and batteries are needed



Figure 8: Shoe prototype presentation

While using the device. Each and every module such as microcontrollers, GPS, GSM and batteries are engraved inside the sole of the shoes. In Figure 9 the inner view of the shoe sole can be seen. Only the left shoe is shown here for visual purpose.



Figure 9: Inner view of the shoe while assembling

As said earlier the RF receiver is studded inside the left shoe, whereas, the RF transmitter has been used to activate the left shoe circuit. Transmitter activates as soon as victim press the push button located on the pendant. Transmitter has been fixed there inside the pendant.



Figure 10: Pendant (model) with push button switch

Supplementary push button switch has been provided in the left shoe, can be seen in figure. User can activate the whole system by using any of the switches. The shock circuit will be activated as soon as the user press the push button switch on the left shoe. From Figure 11 shock probes can be seen at the front of the left shoe.



Figure 11: Designed prototype of the smart shoe

5. SYSTEM OUTPUT AND DISCUSSION

System will start to work as soon as the user activates the push button located on pendant or at the right shoe. The system will send an SOS alert SMS to 5 pre-stored numbers using the GSM module used in this device. In figure it can be seen that the device sends a message 'PLZ HELP ME' to 5 numbers as stored by the user along with the latitude and longitude value of the present location of the victim. In this device victim's real time location can be tracked and traced.

It is possible if the show receives 'Send.Loc' message from any of the 5 pre-stored numbers. In revert to that SMS the device or the show will send its real time location, so that it can be tracked in a real time manner. The message also comprises the Google Map [14] link with which the receiver of the message can easily find the location of the victim using Google map [14] just in a click. In figure the Google map view can be seen. The device is also capable of calling, using the GSM module.

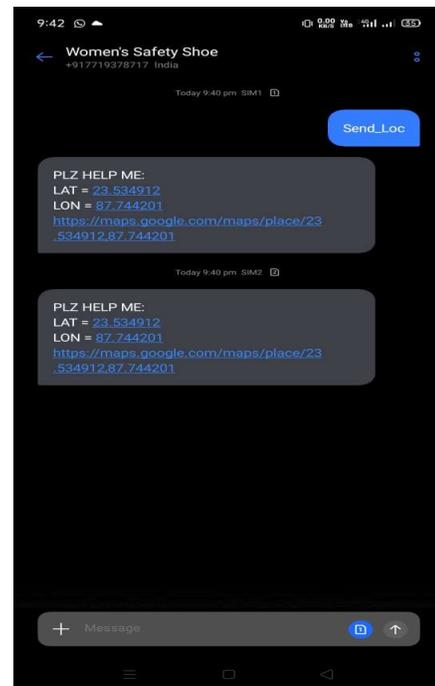


Figure 12: SOS Alert message

It can call one number among the 5 pre-stored numbers. A mic is connected with the GSM module and engraved inside the left shoe, so the receiver can easily listen to the sound of the location at which the victim is present and can help the victim.



Figure 13: Real time Google Map view of the location of incident



Figure 14: Automatic call alert

For self-defense purpose a 1200 V shock has been used here in this shoe. User can easily activate the Shock circuit by pressing the push button switch studded inside the sole of her right shoe. In figure we can see the shock arrangement, by just placing a wire in front of the shock circuit probes, attached in front of the right shoe.



Figure 15: Visual representation of shoe shock system

6. CONCLUSION

This smart safety shoe for women is a ready to use device for day to day use of women. As far as the extent of the knowledge of both the authors, no such off the shelf and ready to use device is present which can be used by women for safety purpose. In this device no such complex charging circuit is needed, nor any kind of wires can be seen from outside. The sole motive of this work has been to deliver a ready to avail and portable solution for smart women safety device.

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