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Electronic clothing development using boost converter circuit and GPS-GSM module using Arduino

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ABSTRACT

Despite constant research and development of safety technologies for women, most novel technologies lack affordability and effectiveness. In our research, we investigated the existing technologies and developed an electronic jacket equipped with electric nodes which protects the victim by electrocuting the assailant. External help plays a key role in victim recovery and protection and hence our model also notifies the registered contacts, when the victim is attacked. The results support that the jacket can effectively shock the assailant by incorporating a boost converter circuit and send notifications when the system is initialized by the victim.

Keywords: Arduino Nano, GPS, GSM, Boost Converter, Women's Safety

1. INTRODUCTION

Numerous scientific innovations and modules have been created in the past decade to ensure women safety. We observed that the lack of safety and protection from harassment is a major barrier to gender equality. Long commutes, poorly lit and low-security public areas and transit are all common situations wherein people are more susceptible to crime and violence. Our model aims to act as a protection mechanism from physical abuse and provides an emergency alert system to notify registered contacts of the victim's predicament. The jacket makes use of Arduino Nano along with a GPS-GSM module and a boost converter circuit. Unlike other previous models, our model aims to provide affordability, feasibility and address certain user safety concerns ignored previously. Our model has metal nodes which conduct electricity upon coming in contact. The insulated vest also ensures protection of the user from the charge, providing the user a feeling of security.

1.1 Problem Statement

Most victims of abuse find themselves to be helpless and unable to make effective use of communication methods to communicate the emergency. Victims may also lack the ability to physically defend themselves from the attacker.

1.2 Literature survey

The safety of women has contributed great stress and anxiety, in the minds of the person and their family. The significance of the problem has increased in recent times, leading to various solutions.

[1] The paper proposed by Dr. Maya Nayak [1] and colleagues suggest using Raspberry pi along with GPS GSM, a shock module, a camera and a buzzer. The GPS GSM module is used to send the location and the alert message, the shock module is used to provide security while the camera is used to record the incident as evidence. The use of three switches acts as a great contingency measure and avoids accidental powering on of the circuit.

[2] In the paper by Sagar Pawar and colleagues, Arduino has been used along with a shock module, GPS GSM, buzzer and pressure sensors. The use of the shock module and the buzzer is the same as [1], but in this case the message is sent over IOT rather than standard SMS. Another innovative inclusion was the role of pressure sensors to confirm the presence of threat on the user, but this might not cater to all forms of assaults.

[3] In the paper by Madhavi K. Kadam and colleagues wearable jacket technology is used in conjunction with GPS GSM, Raspberry Pi, camera and a buzzer. The cameras are used to store evidence while the GPS and the GSM is used to send the location.

This paper does not have a shock module.

2. METHODOLOGY

Along with emergency GPS-GSM support, we have integrated the shock module in a manner which ensures it covers a large area of the jacket. Additionally, we incorporated internal insulation to prevent self-shock.

The model can be divided in 2 parts– the jacket and shock module, and GPS-GSM system.

2.1 Jacket and shock module

This section is used to shock the assistant in self defense, it does not consist of any computing parts/ microcontrollers. Once executed, this module imparts a shock to the assailant when he/she makes contact with the victim.

1. Shock Module: We used a boost converter circuit, which works on the tendency of an inductor to resist changes by increasing or decreasing the energy stored in the magnetic field. It incorporates a 4V rechargeable battery as the power source. It is capable of stepping up voltage, using an inductor, in our model the voltage increases from 4V to 2400V with a current of 5-6 mA. The shock imparted is not fatal by any means[4], however it can incapacitate the assistant.

2. Internal Insulation: Insulating is necessary to prevent self shock to the user, this is achieved by incorporating insulating materials on the inside of the cloth. In our prototype cotton plus rubber fabric tape has been used to achieve this.

3. Jacket: To maximize the safety it is necessary for the shock module to cover the majority of the cloth(jacket in our case). To achieve this, the jacket consists of various external conducting nodes which are connected internally with the boost converter circuit. Much like the power lines, the current is imparted when 2 or more nodes are connected via a conductor, which can be the hand of the assailant.

4. Switches and battery: Our model makes use of switches to turn on the shock module as and when required. It is recommended to have at least 2 switches for the boost converter circuit to prevent self harm due to malfunctioning.

In our case the shock module will be powered using a 4V lead acid battery. All the electronics except the wiring are sealed in a waterproof box. The box can be detached and the jacket can be washed or used as a normal jacket.

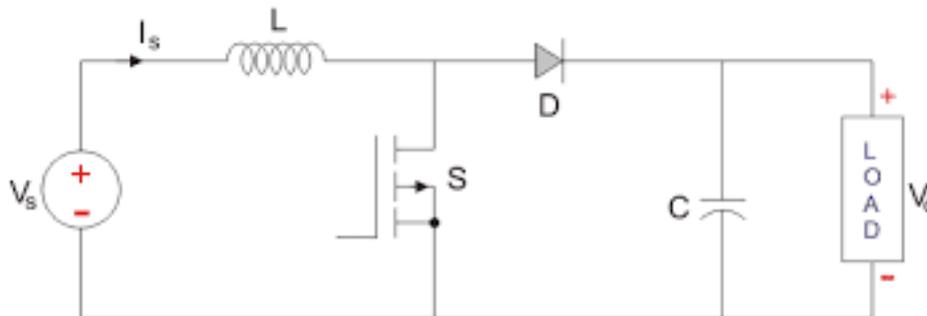


Figure 1: Schematic of a Boost Converter Circuit[5]

2.2 The GPS-GSM

A GPS- GSM system is used for alerting the authorities and the family/friends. It sends an alert message via SMS with the location once the emergency button is pressed. It consists of the following major parts:

1. GPS Module: It receives information about the latitude, longitude, altitude, UTC time, etc. from the satellites in the form of an NMEA string. This string needs to be parsed to extract the information that we want to use, in our case as a Google Maps link. In our prototype, the GPS used is S1216F8 with an antenna. The following commands are used to interface the GPS with the arduino.

- AT = checking connection between arduino and the module
- AT+CMCF = message format
- AT+CMGS = sending message

2. GSM Module and SD card: The GSM module houses an active sim. The active sim in the GSM module acts as a messaging module which sends a message to the phone numbers entered in the code or in the SD card(optional). We will be using standard SMS over the internet since SMS connectivity is easier to achieve.

3. Arduino Nano: Arduino Nano will be the microcontroller used. It was preferred over Raspberry Pi since it's more economically feasible while checking all the requirements.

4. Buzzer: A buzzer is used to sound an emergency alarm, alerting the surroundings of the victim. The buzzer will be turned on once the emergency switch is pressed.

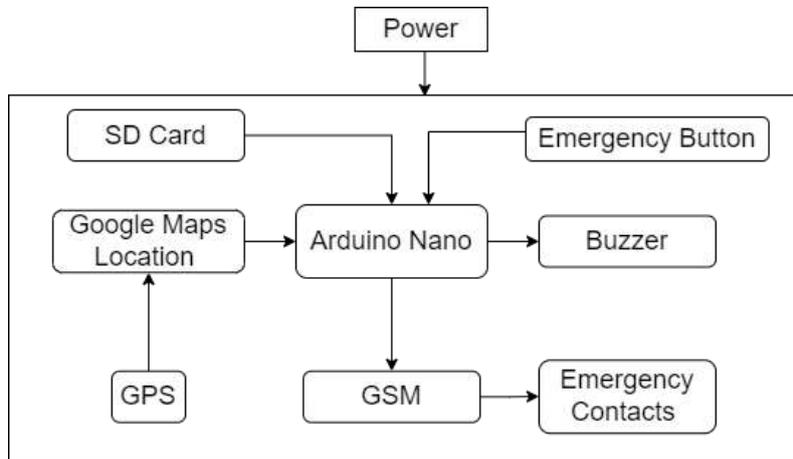


Figure 2: Flow of Operations of the GPS-GSM module

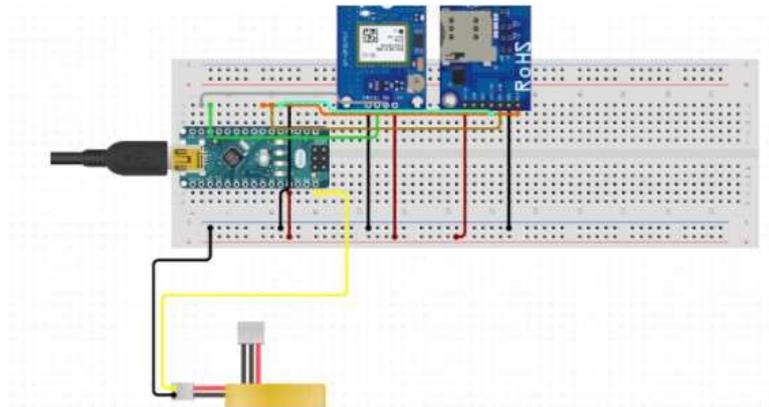


Figure 3: Circuit Diagram of the GPS GSM module

3. RESULT

The jacket is a wearable that is designed for safety and has hidden electric conducting nodes which give an electric shock of around 2400V on full charge and a current of 5-6 milliamperere. The shock circuit is powered using a 4V lead acid battery and whenever the jacket is touched it gives a shock to any assailant. The jacket has suitable insulation inside to prevent self shock to the user's body. Once the emergency switch is pressed, it also activates the emergency buzzer on the jacket and sends the current location of the user to family members in the form of a google maps link using the GPS-GSM module. As a safety measure the jacket has two accessible switches to turn on the shock circuit and one for the GPS GSM module.



Figure 4: GPS GSM Module Working Prototype



Figure 5: Demonstration of Shock Module- the pair of scissors acts like the hand of the assailant

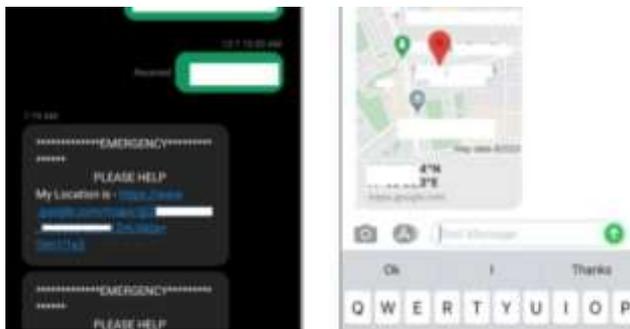


Figure 6: Emergency Message from the Working Prototype



Figure 7: Prototype of the Jacket



Figure 8: Prototype of the Jacket

4. FUTURE SCOPE

The product can incorporate systems which disable unethical use of the product, for example harming an innocent civilian using the product. This can be achieved by using heartbeat or pressure sensors along with appropriate technology to support it. An interface between smart watches or smart phones and the jacket can also be created. A camera can also be incorporated to record the evidence which can be used during investigation. This product can be incorporated with other types of clothing like shirts, trousers and be commercially sold.

5. CONCLUSION

Our electronic jacket can effectively help women from abuse and harassment by electrically shocking the assailant. The jacket can also successfully notify authorities and loved ones in case the user is in danger. Therefore increasing the security of the user exponentially and making sure that the user feels safe in almost all scenarios.

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