

# Implementation of a Microcontroller Based GSM Alert Distress System

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## ABSTRACT

GSM Based Distress System implements the applications of the GSM service. Using microcontrollers, an automated control and emergency alert system is set up such that it acts as a safety system in times of distress. The main concept of this project is to create a distress system that alerts locally and remotely through SMS the security officials as well as emergency contacts of the person in danger about the current situation of things as a means of ensuring or providing security to the person in danger. The design of a distress system is essential because security cannot be over emphasized. An average person should feel safe walking down the street at whatever hour and not have to worry about being jumped at in an attack. This paper is aimed at implementing a GSM based distress system ensuring the safety of people in general. The GSM based distress system will promptly alert security personnel when a person is in danger, accurately determining the location of the attack before it happens. The system consists of an Arduino Microcontroller, the GSM, and GPS Modules. The Arduino will be programmed to store the emergency contacts of each of the people as well as the number of the security personnel closest to the scene of the attack. The GPS will provide the location of the victim. At the complete integration of the components, the result is a fully functional distress system.

**Key words:** Distress system, Micro controller, GSM Module, GPS Module.

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## 1. INTRODUCTION

The cases of violence, specifically in the areas of rape and domestic violence has caused people to live their lives in fear of the next man thus limiting them to only a number of activities, restricting their movements in certain parts of the city to the bright hours of the day and putting a restriction on their ability to freely express themselves particularly in terms of dressing. The inability of a person to match up the strength of an attacker during an attack led to the implementation of various technological safety devices which have provided some sense of security for the people. With a few victims revealing experience due to the multitude of social experiences, rape remains a contentious issue.

Security is the state of being shielded from threat, risk, or injury and Rape is a crime that dehumanizes the victim. Sexual abuse requires immediate and serious action on the part of the family, institutions, civil society organizations, the government and the international community if we ever want to ensure a society free of violence for all.

The GSM Based Distress System will improve the ability to track cases. The alarm system provides an emergency system for easy location of potential victims in the hands of an attacker. The objectives are to design and construct a GSM based distress system that allows humans to promptly alert security personnel when in danger. To provide vital information required in tracking and rescuing a person in distress using the GPS module and to implement the designed system.

An alarm system is a means of alerting the appropriate authorities' audibly or visually of an occurring problem. A GSM based distress system on the other hand is a simplified means of alerting the appropriate authorities of an occurring problem with a single touch of a button. This device is programmed to provide a means of security alert for people in times of trouble using an Arduino microcontroller, GSM and GPS modules [2]

The GPS module is an inexpensive piece of hardware or electronic circuit attached to a device to enable it receive location updates from the GPS Satellite (Kodavati et al., n.d.). The GPS module gives accurate location of the person in distress.

Arduino is control equipment which makes use of the C++ programming language to program codes that are required for the proper functioning of the device. C++ is an object-oriented programming language which is by default the language the Arduino uses for its operations. The microcontroller defines the entire functioning of the device.

## 2. Related Works

[10] proposed a device called FEMME which works in synchronization with the smart phone using the Bluetooth as the wireless medium. This device is programmed to record audio, send an SMS to pre-saved contacts, and make an alert call when triggered.

[5] proposed a safety alarm system called the smart girls security system. This system was designed in resemblance to a belt consisting of an Arduino board, GSM and GPS modules, screaming alarm and pressure sensors.

[2] proposed a security system designed for women in distress called “Suraksha”. The device is programmed to send a distress message to the cops and numbers registered for emergency purposes along with the location of the female in time of the attack.

[11] proposed an emergency response situation recognizing device called IPROB, an All in one Intelligent Safety System for Women Security. The system is activated by shaking the device beyond the predefined threshold value. Once activated, the device takes an audio recording to determine if the situation is an emergency one.

[3] Proposed a security system for employed women using the GSM and GPS vehicle tracking system as a safety prerequisite due to cases of rape by drivers, colleagues, bosses etc. Upon activation by the push of a button located in a strategic point within the company vehicle, the woman’s position is located on Google maps and then the GSM device gets the Automatic vehicle location device values and transmits the data via SMS to the police department alongside images which an android device located inside the vehicle is programmed to take. The system is divided into vehicle unit, emergency button, company unit, android device and technical unit, each unit performing different functions in relating the message to the authorities thereby ensuring the safety of the workers.

[15] proposed a device called “TOUCH ME NOT-A Women Safety Device” designed as a security gadget in a button structure. The button can be appended to the dress and when squeezed, it plays out the activity of alarming contacts including the close relative or companion just as the police. The gadget empowered with the GPS framework will have the option to send [15]

A system that models a design of android application which helps the customer setback in hazard was proposed by [6]. This application empowers customer to make bundles where he/she can share photos, chronicles or various reports and even can converse with the social event people or individuals. [6] The knowledge assisted in the design of this project.

[7] proposed in a paper titled Biosensor based Women Security System using GSM and GPS, a security system mostly founded on biosensor & its application to shield ladies from harm. At the point of danger, the biosensor joined to them in wearable watch will alert the ladies' family members, neighbors & the police to discover where they are at serious risk. [7]

[8] proposed the design of Wearable Technology for Personal Security. The project work focused on this security aspect, so that one will not feel powerless. Various sub modules such as GSM, GPS, memory card, shock circuit, buzzer and camera are part of the proposed Raspberry Pi-3 Based [8]

[4] Proposed a system in a paper titled “Vehicle Health Monitoring System Using ARDUINO and IOT” portrays the implementation of a model system used to secure efficient constant details, motor warming, and fuel pipe blockage. The use of the Arduino was significant in the implementation of the project work [4].

[14] proposed a device containing numerous components such as the GPS receiver, the shock circuit, the buzzer, the spray mechanism, the webcam, the pulse rate sensor, and the Raspberry pi-3 module. The paper was titled Internet of Things Based Women Tracking and Security with Auto-Defender System [14].

### 3. Theoretical Review

#### 3.1 Methodology

The Alarm system comprises of: The Control Subsystem and The Emergency Alert Subsystem. The Control Subsystem comprising of a button and the Arduino Nano microcontroller, allows the user to remotely activate the alarm system, creating a line of communication with the emergency alert subsystem. The Emergency Alert Subsystem comprises of both the GSM and GPRS module. It is activated by the touch of the control button and implemented by the Arduino codes programmed on the microcontroller itself, signaling the beginning or presumption of an attack. Once activated, the GPS module collects the location of the victim, the GSM module which houses the S.I.M card, sends the predefined message to the established contacts.



Fig 1 Block diagram showing the interfacing of the modules with Arduino

As shown in the diagram above, when the button on the device is pushed, a signal containing the GPS location is sent; the GSM sends a message to the emergency contacts. The output of the microcontroller is transmitted wirelessly by using GSM module to connect to the receiver’s mobiles and server. Arduino will need to connect to the GSM interface server to be able to prompt the sending of the automatic messages. To do this, a serial connection port is required. This server contains a database with the appropriate emergency contacts based on each region as well as the default message to be sent and to whom.

Co-ordinates	Location	Contact 1	Contact 2	Contact 3
180N1255S	Yaba	09023896001	08104456781	08023456982
582N346S	Surulere	08153896231	08033896203	09098962301
782N234S	V.I	09045637834	08023574533	08154232876
654N456S	Costain	07082345678	08099933366	07062356789
567N347S	Ikeja	08134768392	08001234678	07068349264

**Table 1: Table showing a sample of the Database Model**

### Emergency Alert Subsystem

#### GSM/GPRS Module

A GSM/GPRS module is a circuit used to create a path of interaction between a mobile and a GSM system. The SIM900 is a complete Quad-band GSM/GPRS solution in a SMT module which can be embedded in applications [1].



**Fig 2 SIM900 GSM/GPRS Module [1]**

### Control Alert Subsystem

#### 3.1.1 The Arduino Nano

The device makes use of an Arduino Nano which is programmed to store the emergency contacts of each of the people and the number of the security officials closest to the place of incidence. Arduino Nano allows for simplicity of the device built. It is an Atmel ATmega 328 microcontroller operating at 5v/16Mhz. The device consists of 14 digital I/O pins and 8 Analog

input pins. The Enhanced Universal Synchronous Asynchronous Receiver Transmitter (EUSART) module in the Arduino is used to communicate with GSM and GPS module. The message with peripherals is continuous I/O communications [13].

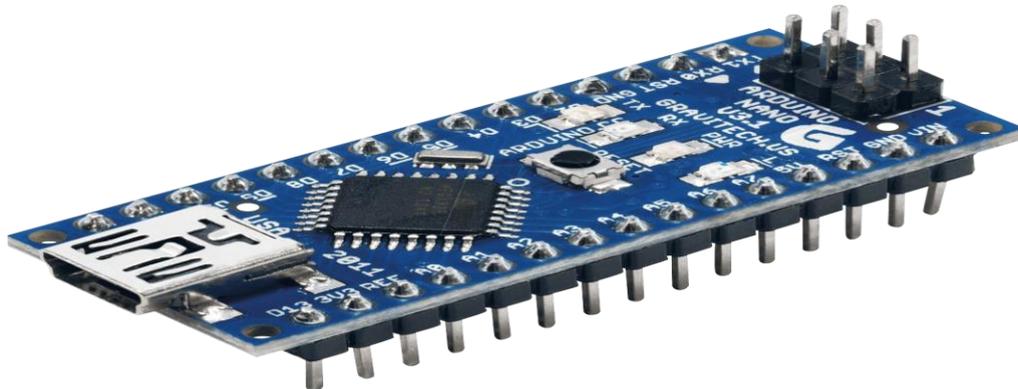


Fig 3 Arduino Nano [9]

### 3.1.2 Arduino IDE 1.8.5

This is an open source Arduino software that makes it easy to write and upload codes to the board within the real time environment. It runs on windows, Mac and Linux. The majority of components are written in javascript for easy editing and compiling. The codes are stored within the cloud thus providing an extra level of redundancy.

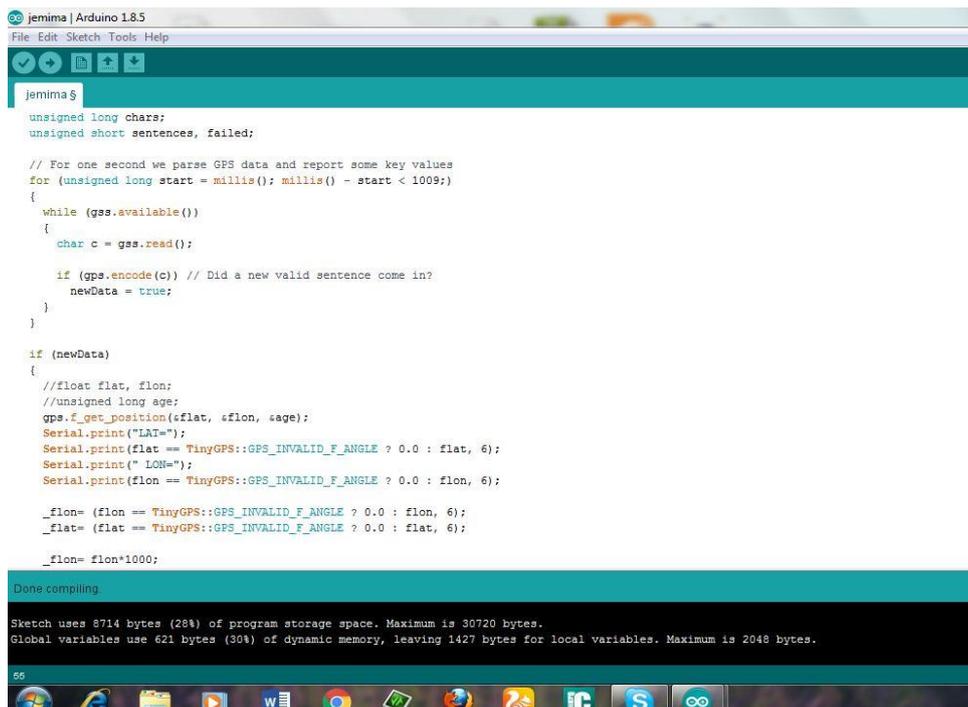


Fig 4 The Arduino IDE 1.8.5 window

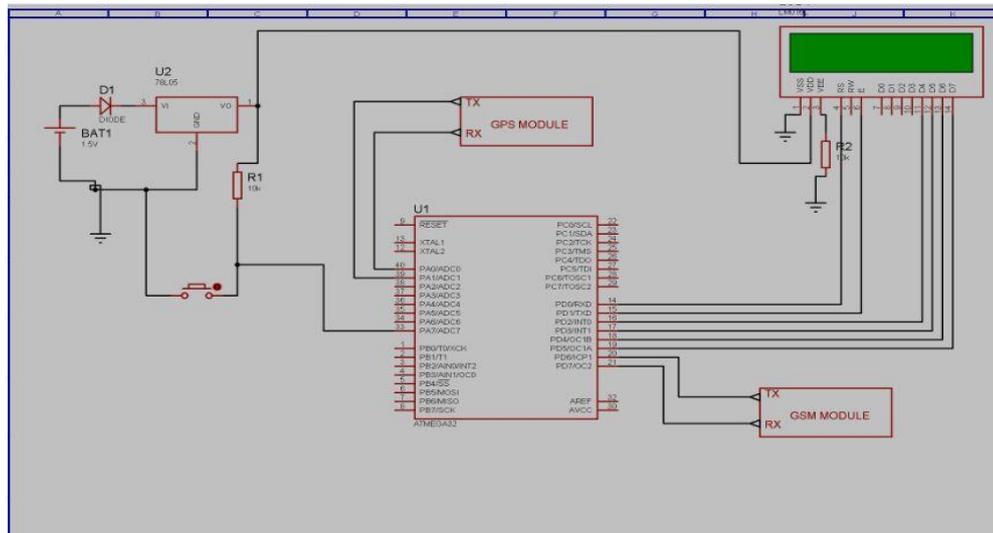


Fig 5 System Circuit Diagram

#### 4. Discussion

The paper provides a simplified design model for creating a distress system for people used to alert the police officials and predefined contacts during times of emergency or suspicious incidents. The distress system is made up of interconnected GSM, GPS modules and an Arduino microcontroller. The Arduino is programmed to control the entire working of the device acting as the heart of the device. The GPS, connected to the Arduino, takes the location of the person on activation of the device while the GSM module, connected to both GPS module and the Arduino sends the emergency message as it receives the instruction which is given by the press of the button.

##### Device Buildup:

The components of this alarm system were placed on a circuit board consisting of connecting wires, resistors, 2500mA batteries, GSM module and an Etisalat S.I.M card, GPS module and its antenna, the Arduino Nano etc. Each connecting cable was color coded thus allowing them to be easily distinguished. Since all the components of the system are split into smaller functional units, integrated and made to interoperate, a fault in one fragment will not pose so much problem on the overall system. The repair will only be done on such part alone.

##### Device Testing:

After identifying the components and their respective functions, a fully compiled code written using c/c++ language in the Arduino IDE 1.8.5 environment was uploaded to the Arduino microcontroller board via a COM1 serial port on the PC, then all other components were afterwards connected to the microcontroller board. This was done to prevent damage of the microcontroller board.

##### 4.1.1 Hardware Testing:

Each of the hardware modules were tested as they were acquired and confirmed to be good and usable for this project. Also, during each of the stages of construction, the modules were tested and each was confirmed to work as required independently. All the components were carefully coupled together and visual inspection was done in ensuring that there were no mistakes in the connections. Every likely short and open circuits faults were checked by using a multimeter to check for continuities in the path of the circuits where needed and discontinuities where contacts were not required.

##### Software Debugging:

The programs as well as the scripts written for the software were tested and every possible bug was corrected during each stage in the development. Both the compilation time and the run time errors were checked and corrected. The exception errors in the software were handled carefully and correctly.

Overall, the software applications were developed to be foolproof and really user friendly. This was achieved through sophisticated built in tests embedded in the applications.

#### 5. Results and Conclusion

##### 5.1.1 System Performance:

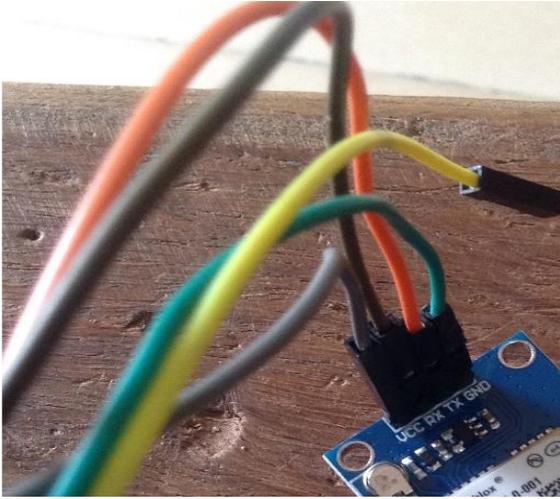
At the complete integration of the components, the result is a fully functional distress system

##### 5.1.1.1 Power Supply Unit:

Both the control and emergency alert subsystem consisting of the GSM module, GPRS modules are powered by a battery. The on/off power button helps to conserve the battery.

**5.1.2 Interconnection of Components:**

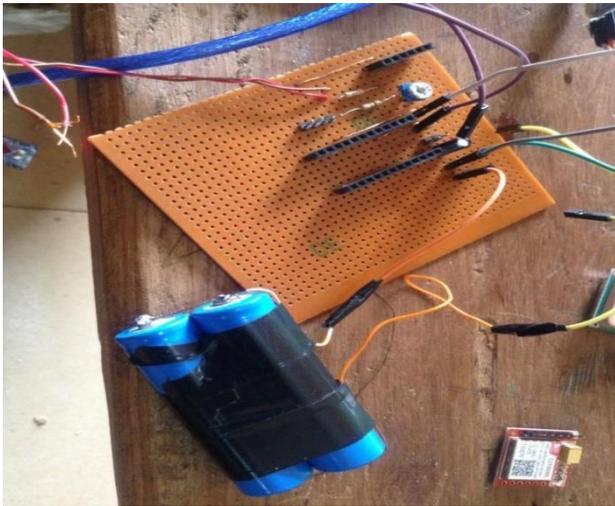
The components were interconnected by color coded connecting cables which allowed the connections to be distinguished, avoiding a wrong connection from one point to the other.



**Fig 6 Color codes of connecting wires**



**Fig 7 Diagram showing how the Arduino is connected and programmed**



**Fig 9 Sample of emergency message**



**Fig 8 Diagram showing the beginning of connection**



**Fig 10 Completed hardware system close-up**

## 5.2 Conclusions

The designed project work shows that a distress system using GSM and GPS modules is possible and a measure towards reducing the amount of rape cases can be made available. The components required to achieve this are small and low cost materials which can be coupled together to provide a means of safety for people. The GSM technology is becoming more flexible as it is the major component used in technologically advanced projects such as this one, its flexibility benefits allowing messages preprogrammed on the Nano Arduino to be sent as quickly as possible. It can be concluded that the system helps to support gender equality by attempting to provide a safe environment for the people in the society.

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