

An Affordable, Portable Wearable Safety System for Real-Time Emergency Alerts and Location Tracking using Arduino, GPS, and GSM Technologies

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Abstract— The paper introduces a Personal Safety Device (PSD) for girls, designed for live location tracking and emergency SMS. The system uses an Arduino Uno microcontroller and GPS for accurate location detection. In case of an emergency, users can activate a push-button mechanism and send an SMS to pre-defined contacts. The device has a rechargeable lithium-poly battery and a power management system for long-lasting function. Its rugged design ensures precise location tracking and sturdy communication even in dense urban landscapes. This inexpensive, user-friendly solution could be a lifesaver for vulnerable individuals, particularly women. The paper reviews and evaluates the performance using real-world scenarios and integrates hardware and software algorithms. This work contributes to the growing literature on personal security technologies and provides a cost-effective solution for rapid deployment in urbanizing areas to improve community safety.

Keywords— Personal Safety Device (PSD), Arduino Uno, GPS, Emergency SMS, Push-button mechanism, Real-time GPS coordinates, Lithium-poly battery, Power management system, Location tracking, Signal interference, User-friendly, Vulnerable women safety.

I. INTRODUCTION

The creation would be a safety device that would message the user's friend, family or local police. It will also help the suitable girl or personals during her dilemma and continue to keep the some aware. This way of connecting the dots simplifies location tracking. 848 Indian Women are Harassed, Raped n Killed Daily!! according to statistics. In order to best fight this, we created a strategy where women can self-administer any ambiguities. The day when in more media the success of women will shine rather than harassment, that would be an online long. For a well groomed 21st century, self defence and self protection become the first priority which can be achieved with the help of our user friendly and affordable safety device provided with GPS Tracking And Alert System. The contemporary urban landscape, while full of opportunities, often presents a challenging and complex environment for personal safety. Though technology has many benefits, it can also create new vulnerabilities that leave people more open to various threats. In an emergency conventional safety precautions may not always be available or dependable because they often rely on infrastructure or smartphone apps. It is therefore essential to have personal safety solutions that are quick to set up, potable, and easily deployable.

This essay offers a fresh perspective on personal safety by emphasizing a transportable, reasonably priced gadget that can offer instant support in an emergency. An Arduino Uno microcontroller, a NEO-6M GPS module, and a SIM800L GSM module are just a few of the widely available and reasonably priced parts that the system uses to track the user's location in real-time and send SMS messages to pre-programmed emergency contacts. The device's simple design eliminates the need for complex user interfaces or smartphone connectivity, ensuring swift and effective implementation even in situations where conventional means of communication are unavailable or impractical.

The device's small size and ease of integration into wearable accessories encourage discreet operation and user-friendliness. A Li-Po battery and power management module ensure the device's operational lifespan by ensuring effective and secure energy distribution. SMS transmission over 2G cellular networks offers wide compatibility with mobile services and dependable communication in various geographical locations. The system is a useful tool for people looking to improve their personal safety, especially in urban areas where network coverage is usually dependable.

The paper explores the functionality and hardware design of the suggested safety system, providing a thorough analysis of its strengths and weaknesses. It also investigates the possibility of scaling up and downsizing by using different microcontrollers in upcoming versions, like the ESP32 or Arduino Uno. The study also examines the potential effects on personal safety, particularly for people living in urban areas.

Innovation in GPS and GSM technologies, along with the emergence of the IOT, have created new avenues for the development of effective and portable personal safety devices.

When designed properly, these devices can communicate with emergency contacts or authorities in real-time and provide location updates, allowing for quicker response times in potentially fatal situations. These devices have the potential to be widely adopted due to their portability and simplicity of use, particularly among vulnerable populations such as women and children.

This study describes the creation and implementation of a portable safety device for girls that uses GSM and GPS to deliver emergency SMS alerts and real-time location tracking. The device, which is inexpensive and easy to use, enables the user to instantly notify pre-configured emergency contacts in an emergency by just pushing a push button. It is a more dependable and convenient option because it doesn't require complicated applications or a continuous internet connection on a smartphone.

The goal of this research is to create a device that can function well in urban settings where there are significant safety risks, in response to the growing demand for dependable personal safety solutions. The gadget can be useful for improving women's personal security, particularly in situations where prompt intervention is essential.

II. RELATED WORK

Researchers have used different methods to solve this problem and we have read their papers and works. Our focus is mainly to provide a proper solution with suitable safety systems for women's.

D.G Monisha et al. [1] have worked on FEMME Application including video and audio recorder. This device gets activated and sends instant location with a distress message to the police pre-set numbers through a GSM module. For software development they implemented Java for frontend SQL for backend and embedded kit and for hardware they used GPS module(GYGPS6MV2) GSM (SIM900) ARM 7 board with controller (LPC2129). Anjali Akuskar et al. [2] proposed a simple safety system They used PIC16F877, which is one of the most advanced microcontroller from Microchip, GSM that divides each 200 kHz channel into eight 25 kHz and GPS module. It receives radio frequency signals from satellites and ground station when the button is pressed by women on her mobile phone.

S. Sasikumar et al. [3] have worked on a system using Arduino microcontroller and ESP32P camera which is integrated with Arduino and used as primary evidence in the investigation of high risk situations. they also used GSM SIM 900A for developing the communication to the main control unit.

RAJINI R et al. [4] and Purva Lande et al. [9] have worked on this project using ATmega8 microcontroller. It contains a panic switch as well as shock generator. So whenever panic switch is pressed the device gets activated. The audio and video recorder will start to capture the live incident and as it also includes GPS and GSM modules it sends location co-ordinates to the police.

S. Hima Keerthi et al. [5] and her team worked on Arduino (ATMEGA 328P) microcontroller and for software they used Arduino compiler with C programming language. In their project, in the sim holder of the GSM module, they inserted a sim from any network with a compatible frequency. Underneath the Arduino board there is a button that when pressed, resets the device. They receive the signal from the surrounding towers. As an

indication, the LCD displays a message. then the person in emergency will press Arduino's push button and it will send msg to predefined number and by using GPS we can track the person.

G. C. Harikiran et al. (2016) [6] have worked on RFID technology along with GSM and GPS classifications. The development was done with a radio frequency identification (RFID) reader the main idea of the prototype is to scan the RFID reader and send the information of the location and msg from the GSM with the help of GPS and this information which is received by GPS module is sent to the AT89C52 microcontroller (MCU), and the information received by the microcontroller will be sent as an SMS to the contacts stored in it, and the entire simulation is performed in proteus datasets.

Shirly Edward.A, Assistant Professor et al. [7] have made GSM based safety device. When the device is turned on it is set to its "Default mode". The LCD displays some message. In this mode, when the GSM module receives a message from a user, the device originates a call to the user from whom it originally received the message. also it contains push button for sending current location coordinates via GPS and it send specific message to predefined trusted contacts and after doing all processes we get to know the location where the person is in danger and we can take further actions.

A. A. Pande et al. [8] have worked on women's safety android-based app with integration hardware. The hardware which is developed is arranged with the Bluetooth module and pressure switch. When initially the button is pressed the Bluetooth which is connected to the mobile phone sends the information and the android app which is developed sends the location of the women where the women need help with the GPS location provided by the mobile and SMS will reach the victims family members and policemen which is stored in the mobile.

S Pradeep et al. [10] have made a prototype using implementation of Arduino, GSM SIM 900A and GPS module. This project includes the utilization of Arduino, movement sensor, signal, and a straightforward program. At the point when switch is on that will triggers the alert and through GPS it will track the location and via GSM module the alert will be sent to the police and some contacts and they have used adapters for ac/dc conversion and for software requirements they had used Arduino IDE with Embedded C language.

V. Mareeswari et al. [11] have developed an embedded system for women integrated with an android app. Here the system works with RL8 (Renesas Microcontroller) along with a voice kit that is integrated with SQL databases. This device operates with voice commands without any physical push button and sirens a buzzer at the location and sends an alert mail to the police and family members.

We referred to the work of Pallavi Deshpande et al. (2019) & (2021) to guide the structure, format, and flow of this paper for conference publication. While their studies informed our organizational approach, no direct content or references were used, ensuring the originality of this work

III. EXISTING SYSTEM

Several existing systems and devices aim to enhance personal safety through location tracking and alert mechanisms, much like the proposed portable girl safety device. However, these existing systems have certain limitations when compared to the proposed solution.

Below are a few examples of such systems:

➤ Mobile Phone Security Applications:

- bSafe:

An app for personal safety that enables users to send emergency alerts with location information to selected contacts.

- Life360:

An app designed for locating family members in real-time and sending emergency alerts when needed.

➤ Wearable Safety Devices:

- Nimb Ring:

A smart ring that has an SOS button built in. When pressed, it sends an alert to emergency contacts with location data.

- Athena:

A small wearable device that clips onto clothing and, when pressed, sends location-based alerts to set of contacts.

Disadvantages of Existing Systems Compared to The Proposed System:

➤ Dependence on smartphones and internet:

- Existing safety apps need smartphones with internet. While proposed system works without smartphones, ensuring reliability.

- Cost:
 - Expensive wearable safety devices and GPS trackers are out of reach for many, with subscription services escalating costs.
- User-Friendliness:
 - Current systems require complex app navigation or specific actions for alerts; simpler push-button system suggested for emergencies.
- Battery Life and Power Management:
 - Limited battery life pose risks in emergencies. Proposed Li-Po system prolongs operation.
- Benefits Of The Systems Proposal:
- Economical And Available:

The suggested system is cost-effective and constructed from commonly found parts, ensuring it is affordable and accessible to a wide range of people.

- Autonomy From Smartphones:

It operates without dependence on smartphones or the internet, only needing basic cellular connection for sending SMS notifications, guaranteeing operation when smartphones are not accessible.

- Simple Interface:

The device uses a single push-button activation, making it easy and fast to use in emergencies.

- Optimized For Urban Environments:

The system is designed to handle GPS signal challenges often encountered in urban areas with dense infrastructure.

- Increased Battery Life:

The Li-Po battery, along with power management, guarantees longer operational periods, decreasing the necessity for frequent recharges.

IV. METHODOLOGY

In order to ensure dependable operation in urban settings, a multi-step process combining both hardware and software components was used in the development of the portable girl safety device with real-time location tracking and alerts. The system's main architecture combines GPS and GSM technologies with an intuitive user interface to deliver emergency alerts that are precise and timely. The steps that comprise the creation process of the device are as follows:

A. System Architecture and Design

The Arduino Uno microcontroller is the core of the system architecture, renowned for its versatility, ease of use, and cost-effectiveness, ensuring a user-friendly and compact design.

The primary components of the device include:

- Arduino Uno:
 - Coordinating actions between the GPS module, GSM module, and push-button interface, the Arduino Uno acts as primary control unit. Shown in Fig 1.



Fig 1. Arduino Uno

➤ GPS Module (NEO-6M):

- Using an accurate latitude and longitude sensor, the GPS module (NEO-6M) tracks a user's location in real time. To continuously update the user's location, this module establishes a connection with the Arduino.



Fig 2. GPS Module (NEO-6M)

➤ SIM800L GSM Module:

- Sending SMS messages with GPS coordinates to pre-configured emergency contacts is the responsibility of the SIM800L GSM Module Shown in Fig3. Text messaging functionality is enabled by the SIM800L by connecting it to the cellular network.

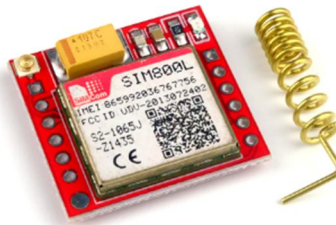


Fig 3. SIM800L GSM Module

➤ Push Button

- By pressing the push button Shown in Fig 4, which acts as the interface, the user can trigger the emergency alert with just one press.



Fig 4. Push Button

➤ Li-Po Battery and Power Management Module

- To power the device, a rechargeable lithium-polymer battery is used. A power management system Shown in Fig 5 is installed to guarantee continuous operation during emergencies and to extend the battery's lifespan.



Fig. 5 Power Management Module

B. Hardware Setup

Careful Selection and integration of hardware components ensured effective communication and power efficiency. Serial communication was used to connect the GPS module to the Arduino Uno for receiving location data constantly, while the SIM800L GSM Module was set up to send SMS alerts using AT commands. The Arduino was wired to the push button through a digital input pin, and when the button was pressed, it activates the SMS alert sequence As Shown in Fig 6 & Fig 7. The power management, module was used to connect the Li-Po battery and provide a steady power supply to the system.

Then the Serial monitor code is uploaded into the Arduino Uno As Shown in Fig 8

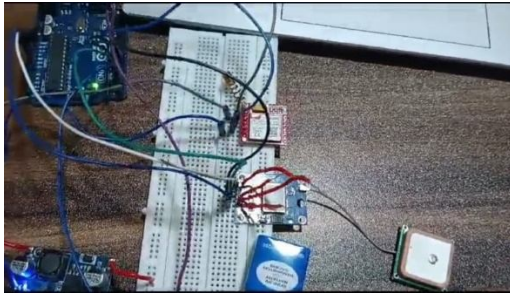


Fig 6. Hardware Setup Upper Look

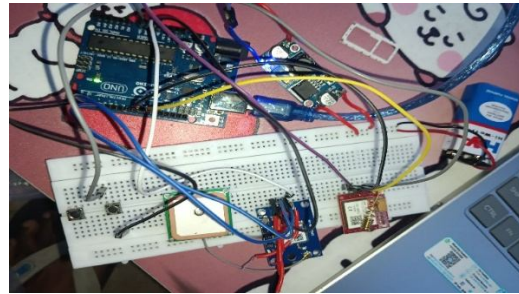


Fig 7. Hardware Setup Overall Look

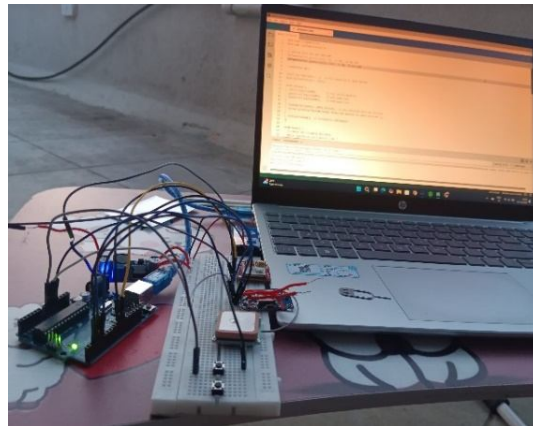


Fig 8. Code Upload in Arduino

C. Software Development

The software development process involved writing the Arduino sketch to handle the coordination between the GPS and GSM modules, as well as managing the emergency alert functionality As Shown in Fig 9.

Key aspects of the software implementation include

GPS Data Acquisition

The system constantly reads GPS data to obtain the user's real time location. The data is processed to extract the relevant latitude and longitude coordinates, which are then formatted into message.

SMS Alert System

.When the push button is activated, the Arduino instructs the GSM module to transmit an SMS with the GPS coordinates. AT commands are employed for initiating communication with the SIM800L module and transmitting message to the predetermined emergency contacts.

Error Handling

To address issues in urban areas like weak GPS signal or GSM network problems, error-handling features were added to the software to attempt SMS delivery again if there is a failure or signal dropout.

Power Optimization

The software features power-saving routines that activates a low-power state for the device when not in use, while maintaining quick response time for when the button is triggered.

```

32 Serial.println("GPS signal acquired!");
33
34 // Retrieve GPS data
35 double latitude = gps.location.lat();
36 double longitude = gps.location.lng();
37
38 Serial.print("latitude: ");
39 Serial.println(latitude, 6);
40 Serial.print("longitude: ");
41 Serial.println(longitude, 6);
42
43 // Here you would call the function to send SMS with latitude/longitude
44 // sendLocationSMS(latitude, longitude); // Replace with actual SMS function
45 } else {
46   Serial.println("waiting for GPS signal...");
47 }
48
49 buttonPressed = false; // Reset button press flag
50
51 }
52

```

Serial Monitor x:

```

Message (Enter to send message to "Arduino Uno" on "COM5")
New Line 9600 baud

sGPGL5,1827.38261,N,17353.08660,E,0.0160,1.00,A,A*63
GPS signal acquired!
Latitude: 18.459714
Longitude: 73.594452
GPS signal acquired!
Latitude: 18.459714
Longitude: 73.594452
GPS signal acquired!
Latitude: 18.459714

```

Fig 9. Overall Code and Output

D. Working Flow of Proposed Model

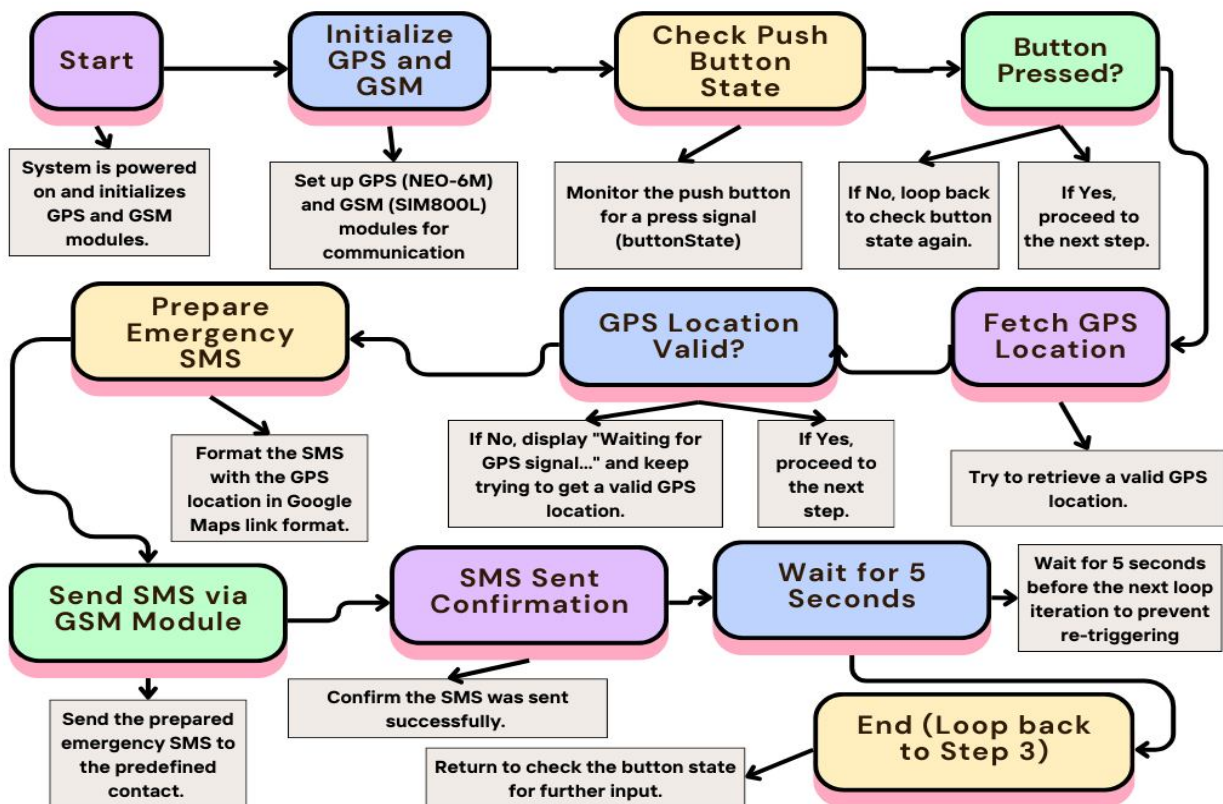


Fig 10. Working Flow of Proposed Solution

The flowchart shown in Fig.10 outlines the proposed system is an IoT-based emergency alert solution designed for women's safety. It operates by continuously monitoring a push button, and when pressed, it initializes GPS (NEO-6M) and GSM (SIM800L) modules to fetch the user's location. Once a valid GPS location is obtained, the system prepares and sends an emergency SMS with the location link via the GSM module to a predefined contact. The system confirms successful message transmission and waits briefly before resetting to monitor the push button again, ensuring continuous availability for emergency use. This design is aimed at providing a quick, reliable response during critical situations.

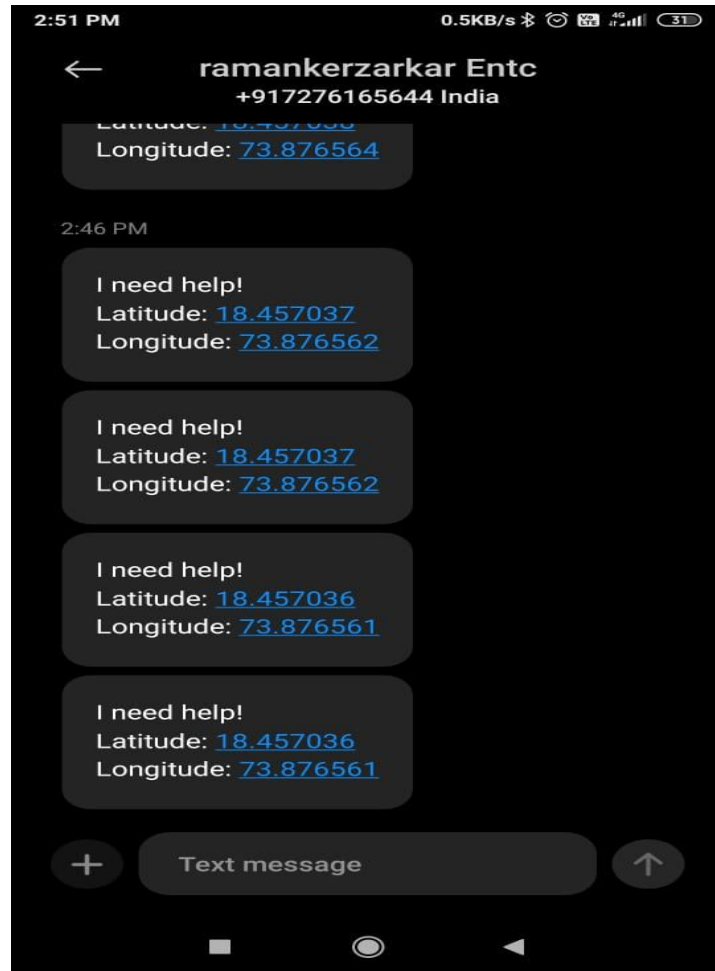


Fig 11. SMS Received After Push Button Pressed

V. RESULT AND ANALYSIS

Women Safety System is Arduino Uno, GSM SIM800L module, GPS NEO 6M and a push button-Based; it will send GPS coordinates rapidly through SMS when the function of pressing that button. The efficiency of the system is accessed on several parameters like GPS Signal Acquisition time, SMS delivery speed and performance in varied environmental conditions.

- Key Outcomes:
- GPS signal acquisition: The system successfully acquires GPS coordinates in open areas within 30 seconds with an accuracy of between approximately 5 and 10 meters.
- SMS Dispatch: By pressing this button the system sends your GPS coordinates to a predefined emergency contact in all situations. A standard SMS would take between 5 to 10 seconds depending on the GSM network strength and availability.

Here we share the image shown in Fig.11 which shows us as to what kind of SMS that you will receive once you push the button then boom it means your System is running and transmitting location data, when its most important Emergency situation.

VI. CONCLUSION

This paper presented the girl safety system which provides real-time location tracking by integrating GPS and GSM modules. Because of its intuitive design, it can be accessed at crucial times. Performance reviews demonstrates its dependability in delivering messages quickly and with accuracy. Additionally, the project creates opportunities for future improvements that will improve the system's long-term viability and scalability, such as cloud integration, power optimization, and advanced communication protocols. This project tackles societal problems and establishes the foundation for upcoming personal safety initiatives.

FUTURE WORK

Advanced Communication Technologies

- Integrating alternative communication methods such as 4G/5G or Bluetooth to improve the reliability and speed of sending emergency alerts, especially in areas with weak GSM signals.

Mobile Application Integration:

- Creating a mobile app companion that syncs with the device, enabling family members or authorities to monitor the user's live location, check previous alerts, and get push notifications on their smartphones.

Geo-Fencing and Automatic Alerts

- Enabling geo-fencing features means the device will send alert automatically when the user exits a predetermined safe area without requiring any manual input.

Shrinking In Size And Design For Easy Wearability

- Making the device smaller to increase its compactness and integrating it into wearable items like smartwatches, bracelets, or pendants for additional ease and secrecy.

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- [14] International Journal Of Computing and Digital SystemsISSN (2210-142X) Int. J. Com. Dig. Sys 2021 E-archana.ratnaparakhi@viit.ac.in, pallavi.deshpande@viit.ac.in, gauri.ghule@viit.ac.in <http://journals.uob.edu.bh> A Framework for Segmentation and Classification of Arrhythmia Using Novel Bidirectional LSTM Network Archana Ratnaparkhi1, Pallavi Deshpande1 and Gauri Ghule1