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ABSTRACT:

This project is designed to c m reate a comprehensive, real-time health monitoring and emergency alert system using the Internet of Things (IoT). It aims to provide continuous monitoring of vital signs such as heart rate and body temperature, track the user's location via GPS, and detect potential dangers like falls, while offering both automated and manual emergency alert capabilities. The system is particularly useful for elderly individuals, those with medical conditions, or anyone requiring close health monitoring and safety measures. At the heart of the system is the ESP8266, a powerful Wi-Fi-enabled microcontroller that serves as the central hub for gathering and transmitting data from a variety of sensors. These include a heart rate sensor to monitor the user's pulse, a body temperature sensor, a GPS module for location tracking, a proximity sensor for detecting nearby objects or potential dangers, and an accelerometer to detect sudden movements or falls.

The ESP8266 collects data from all these sensors, processes it, and then transmits it wirelessly to the Blynk IoT platform, which serves as the primary interface for both users and caregivers. The Blynk platform allows users to visualize the sensor data in real-time through a smartphone app, enabling continuous remote monitoring. If a predefined threshold, such as a high heart rate or close proximity, is exceeded, the system automatically sends an email alert to emergency contacts. The alert contains details of the situation, including the user's current GPS location, so that immediate assistance can be provided. In addition to automated alerts, the system also features an SOS button. This allows the user to manually trigger an emergency alert at any time, sending an email with their GPS location to emergency contacts, even if no health threshold has been breached. This feature ensures that help can be summoned in cases where the user feels unsafe or is in a critical situation. Another key feature of the system is fall detection. Using the accelerometer, the system can automatically detect when the user has experienced a sudden fall. Upon detecting such an event, the system immediately sends an email alert with the user's GPS coordinates, ensuring rapid response in the event of an injury. The entire system is designed to be reliable, responsive, and easy to use. By leveraging IoT technology and real-time data transmission, this project enhances personal safety, especially for those who require constant health monitoring or live alone.

CHAPTER 1

INTRODUCTION:

The Women's Safety project is an innovative IoT-based solution designed to provide real-time monitoring, rapid alerts, and emergency assistance to enhance personal security. Utilizing the ESP8266 microcontroller as the central processing hub, the system integrates multiple sensors, including GPS for location tracking, a sound sensor for detecting distress signals, an accelerometer for fall detection, and a panic button for manual alerts. Together, these components offer a comprehensive approach to monitoring surroundings and ensuring prompt responses in potentially dangerous situations. The project's core objective is to empower women with a sense of safety, particularly when traveling alone or navigating unfamiliar areas. By continuously gathering data from the sensors, the ESP8266 monitors the user's environment and can detect situations that may pose a threat. For instance, if loud sounds indicative of distress are detected, the system automatically triggers an alert, providing the user's location to pre-configured emergency contacts. Additionally, the fall detection feature monitors for sudden movements, such as a fall or impact, which may signal a struggle or accident. In such cases, the system sends alerts with GPS coordinates, ensuring that help can arrive swiftly. The GPS module offers precise location tracking, enabling emergency responders or trusted contacts to pinpoint the user's location in real-time. This feature offers an additional layer of protection, allowing the user to call for help at any time. Each aspect of the system has been carefully designed to prioritize safety and ease of use.

The IoT-based monitoring and alert features are accessible via a smartphone app, allowing both the user and emergency contacts to track the situation remotely. If any sensor exceeds a set threshold, such as an abnormal sound level or a detected fall, an alert is generated automatically. The user-friendly interface and real-time notifications ensure that emergency contacts are always informed and can respond rapidly when needed. Beyond the core features, this Women's Safety project also incorporates long-lasting battery power and efficient data transmission, making it a reliable companion for personal security. Through continuous testing, the system has been optimized to minimize false alarms and maximize response accuracy, ensuring that every alert provides meaningful information for effective intervention. In sum, this project represents a critical advancement in personal safety technology.

1.1 PROBLEM STATEMENT:

Women's safety continues to be a significant concern due to the rising prevalence of harassment, violence, and other dangers, especially in isolated or unfamiliar environments. Despite advancements in safety technology, existing solutions such as mobile apps and handheld alarms often rely on manual activation or require the user to carry an additional device, which can be inconvenient or impractical during emergencies. Moreover, traditional systems often fail to provide real-time monitoring, proactive threat detection, or immediate alerts, leading to delayed responses and increased vulnerability. In critical situations, such as sudden attacks, falls, or moments of distress, women may not have the time or ability to access their phones or activate alarms. This limitation creates an urgent need for an integrated, wearable safety solution that ensures continuous protection and quick emergency communication without requiring active user intervention in every instance. This project seeks to address these challenges by implementing a smart women's safety system embedded within a wearable jacket. The jacket is designed to provide real-time safety monitoring and immediate emergency response using IoT-enabled technologies. It integrates key features such as GPS-based location tracking, an SOS button for manual alerts, sound sensors to detect distress signals, and accelerometers to monitor for sudden falls or impacts. At the core of the system is NodeMCU , which processes data from these sensors and facilitates automated alerts when potential threats are detected. These alerts include the user's real-time GPS location and are sent directly to emergency contacts, ensuring timely intervention. Additionally, the SOS button allows the user to manually activate an alert when they feel unsafe, offering an added layer of security. By embedding this functionality into a jacket, the solution eliminates the dependency on handheld devices, providing a discreet, always-available safety system that enhances the user's protection in everyday scenarios. This innovative approach bridges the gap between conventional safety tools and real-time emergency response systems, empowering women to navigate their environments with confidence and security.

1.2 POSSIBLE SOLUTION:

To address the challenges outlined in the problem statement, a possible solution involves the development of an integrated women's safety system embedded in a smart jacket. This system leverages the NodeMCU microcontroller, advanced sensors, and IoT capabilities to provide a proactive and reliable safety solution. It aims to detect threats, notify emergency contacts, and enable timely intervention in emergencies.

1. Multi-Sensor Integration: The jacket integrates sensors such as a GPS module, sound sensors, and an accelerometer, strategically embedded to monitor key safety parameters. These sensors detect distress signals, sudden impacts, and falls, ensuring comprehensive real-time monitoring of the user's environment and actions.
2. NodeMCU Microcontroller: The NodeMCU serves as the central hub for the system, managing sensor inputs, processing data in real-time, and executing predefined responses. Its built-in Wi-Fi module enables seamless communication with connected devices and cloud-based platforms.
3. Real-Time Monitoring and Threat Detection: The system continuously monitors inputs to identify emergencies, such as a sudden fall or distress signals. Advanced algorithms analyse sensor data to distinguish between normal activity and potential threats, minimizing false alarms.
4. Automated Emergency Response: Upon detecting a safety concern (e.g., a fall or loud distress sound), the system automatically triggers an alert. Alerts include the user's real-time GPS location and are sent to preconfigured emergency contacts, ensuring rapid assistance.
5. Manual SOS Alert: A dedicated SOS button allows the user to manually activate an alert, providing an immediate way to signal for help in emergencies. This feature adds a proactive layer of security for scenarios not covered by automated sensors.
6. Communication and Alert System: Equipped with Wi-Fi, the NodeMCU sends real-time notifications to emergency contacts, including situational details and GPS coordinates. Alerts can also be forwarded to emergency responders or monitoring systems for broader safety coverage.
7. User Interface and Feedback Mechanisms: A smartphone app serves as the interface for users, allowing them to monitor status, configure settings, and access alert

history. Feedback through audio signals or vibrations confirms successful alert activation, enhancing user confidence.

8. Customizable and Expandable Design: Users can personalize sensor sensitivity, alert thresholds, and notification settings to meet individual needs. The system's modular design enables future upgrades, such as adding new sensors or integrating AI-based threat prediction.
9. Energy-Efficient and Wearable Design: Lightweight and energy-efficient components ensure long battery life and all-day usability. The jacket's design prioritizes comfort and practicality, making it suitable for daily wear.
10. Scalability for Broader Impact: The system's architecture can be scaled to include additional features, such as voice recognition for verbal SOS commands. Integration with local law enforcement or emergency services can further enhance its effectiveness in critical situations.

This IoT-based smart jacket provides a discreet, effective, and reliable safety solution for women. By combining all capabilities with wearable technology, the system ensures real-time threat detection, quick alerts, and timely assistance, empowering users with enhanced personal security and peace of mind.

1.3 OBJECTIVES AND OUTCOMES:

OBJECTIVES:

- **To Understand** a smart safety device for women that integrates an SOS alert system, GPS tracking, heart rate monitoring, body temperature sensing, and proximity detection.
- **To Apply** an automate emergency alerts, providing real-time location and health data through IoT using the Blynk platform.
- **To Analyse** via email to a predefined contact when the SOS button is pressed or certain safety thresholds are breached. Then a seamless communication and monitoring in emergency situations through IoT and sensor data integration.
- **To Develop** a device that include a fall detection feature using an IMU sensor. When a fall is detected based on the XYZ acceleration threshold values, an emergency alert will be triggered.

OUTCOMES:

- **Able to develop** a Comprehensive IoT-Based Safety System with Automated Alerts. The device will be developed to integrate an SOS alert system, GPS tracking, and health monitoring, automatically sending emergency alerts and real-time data to predefined contacts through the Blynk platform.
- **Able to design** and Implement Fall Detection Using IMU Sensors. A fall detection feature will be designed using IMU sensors, triggering immediate alerts based on XYZ acceleration thresholds to notify contacts in case of a fall.
- **Able to apply** Continuous Health Monitoring and Safety Threshold Alerts. The device will monitor heart rate and body temperature in real-time, automatically triggering alerts when abnormal thresholds are detected, ensuring timely intervention during emergencies.
- **Able to analyze** and Communicate Real-Time Location and Sensor Data. The system will continuously analyze and send real-time GPS location and sensor data to predefined contacts, enabling seamless communication and monitoring during emergency situations.

CHAPTER 2

HARDWARE AND SOFTWARE REQUIREMENTS

Following are the hardware requirements of our model

2.1 HARDWARE REQUIREMENTS

2.1.1. ESP8266 Module:

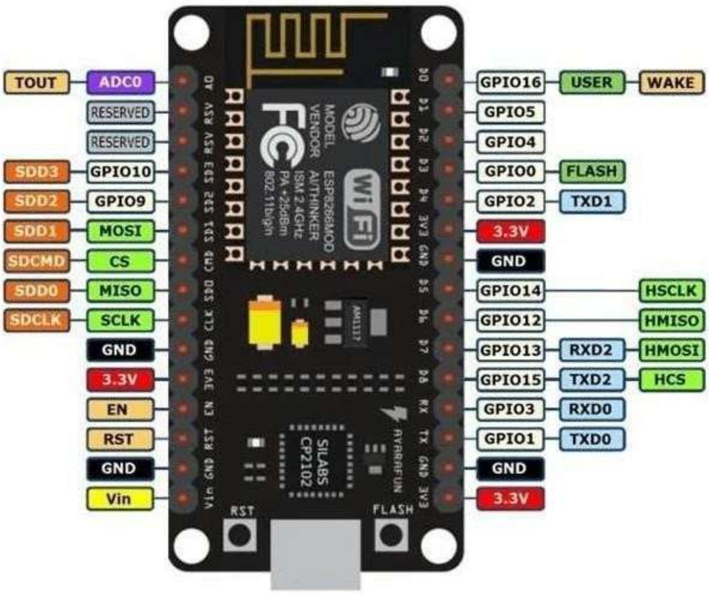


Fig:2 ESP8266 NodeMCU CP2102 Board

The ESP8266 is a versatile and popular Wi-Fi module renowned for its affordability, compact size, and ease of integration, making it a cornerstone in Internet of Things (IoT) projects. Originally developed by expert. if Systems, this module has revolutionized the way microcontrollers connect to Wi-Fi networks and interact with the internet. At the heart of the ESP8266 module is a highly integrated SoC (System-on-Chip) that combines a microcontroller unit (MCU) with Wi-Fi capabilities. This integration enables microcontrollers to easily connect to Wi-Fi networks, opening up a world of possibilities for remote monitoring, control, and data exchange. One of the standout features of the ESP8266 is its ability to operate in two main modes: station mode and access point mode. In station mode, the module connects to an existing Wi-Fi network, allowing devices to access the internet or communicate with other devices on the network. In access point mode, the ESP8266 itself acts as a Wi-Fi access point, enabling other devices to connect to it directly. Programming the ESP8266 is straightforward, thanks to its support for multiple development environments. The Arduino IDE is a popular choice among developers, offering a familiar and user-friendly platform for writing and uploading code to the module. Alternatively, developers can leverage Micro Python or NodeMCU to program the ESP8266 in Python or Lua respectively, providing additional flexibility and functionality. Despite its small form factor, the ESP8266 boasts impressive capabilities, including GPIO (General-Purpose Input/Output) pins for interfacing with external sensors, actuators, and other peripherals. This makes it suitable for a wide range of applications, from home automation and smart devices to industrial monitoring and control systems. In addition to its hardware capabilities, the ESP8266 ecosystem benefits from a vibrant community of developers and enthusiasts who contribute libraries, tutorials, and projects, further enhancing its accessibility and utility. This collaborative environment fosters innovation and encourages experimentation, driving the continued evolution of IoT technology. Overall, the ESP8266 module has become a cornerstone in the world of IoT, empowering developers to create connected devices and applications with ease. Its combination of affordability, versatility, and community support has cemented its status as a go-to solution for Wi-Fi connectivity in embedded systems.

➢ **USES:**

The ESP8266 module has a wide range of uses across various domains due to its versatility, affordability, and ease of integration. Some common uses include:

- **IoT Devices:** The ESP8266 is widely used in Internet of Things (IoT) projects for connecting sensors, actuators, and other devices to the internet. It enables remote monitoring, control, and data collection in smart home, industrial automation, agriculture, and environmental monitoring applications.

- **Wi-Fi Enabled Projects:** With its built-in Wi-Fi capability, the ESP8266 allows microcontrollers to connect to existing Wi-Fi networks or create their own access points. This makes it suitable for projects involving remote control, data logging, and real-time communication over Wi-Fi.

- **Home Automation:** The ESP8266 is popular in-home automation projects, where it can be used to control lights, appliances, HVAC systems, and security cameras over Wi-Fi. It enables users to remotely monitor and manage their home environment using smartphones or web interfaces.

- **Smart Agriculture:** In agriculture, the ESP8266 can be integrated into sensor nodes deployed in fields to monitor soil moisture, temperature, humidity, and other environmental parameters. This data can be used to optimize irrigation, crop management, and resource utilization for improved yield and sustainability.

- **Wearable Devices:** The small form factor and low power consumption of the ESP8266 make it suitable for wearable technology applications. It can be used to develop smart watches, fitness trackers, and health monitoring devices that connect to smartphones or cloud services via Wi-Fi.

- **Education and Prototyping:** The ESP8266 is often used in educational settings and prototyping environments due to its accessibility and ease of use with popular development platforms like Arduino IDE, Micro Python, and NodeMCU Lua. It provides an ideal platform for learning about Wi-Fi networking, embedded systems, and IoT concepts.

- **Industrial Monitoring and Control:** In industrial settings, the ESP8266 can be deployed for remote monitoring and control of equipment, processes, and infrastructure. It enables predictive maintenance, asset tracking, and real-time data analysis for improved efficiency and reliability.

2.1.2. GPS:

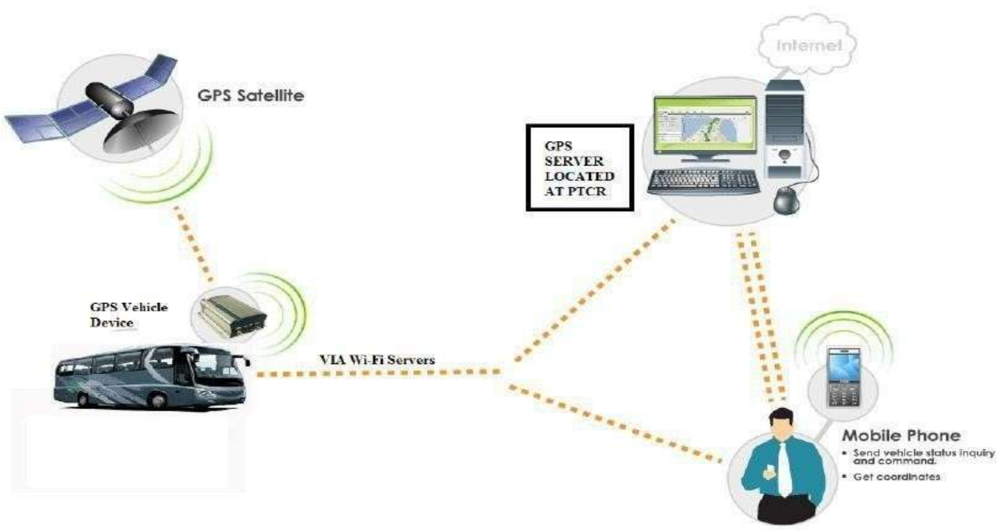


Fig:3 GPS MODULE

The GPS NEO-6M satellite positioning module is a compact and versatile GPS receiver designed to provide accurate positioning, velocity, and time information to various electronic devices. Developed by u-blox, a leading provider of positioning and wireless communication technologies, the NEO-6M module offers high performance, reliability, and ease of integration, making it suitable for a wide range of applications, including navigation systems, asset tracking, fleet management, and IoT devices. At the heart of the NEO-6M module is a state-of-the-art GPS receiver chipset that utilizes signals from a network of global positioning satellites (GPS), operated by the United States government. These satellites transmit precise timing signals and location data, which the NEO-6M module captures and processes to determine the device's exact position on Earth's surface, typically with an accuracy of a few meters. One of the key features of the NEO-6M module is its support for multiple satellite navigation systems, including GPS, GLONASS (Russia's global navigation satellite system), and Galileo (Europe's global navigation satellite system). This multi- constellation support enhances the module's positioning accuracy and reliability, especially in challenging environments such as urban canyons or dense foliage, where signals from individual satellite constellations may be obstructed or degraded. The NEO-6M module communicates with the host device using standard serial communication protocols such as UART (Universal Asynchronous Receiver-Transmitter) or USB (Universal Serial Bus).

This enables seamless integration with a wide range of microcontrollers, single-board computers, and other electronic devices, allowing them to access precise positioning and timing information provided by the GPS module. Furthermore, the NEO-6M module offers advanced features such as automatic antenna switching, low-power operation, and support for Assisted-GNSS (A-GNSS), which accelerates the time-to-first-fix (TTFF) by providing additional satellite ephemeris data over cellular networks. These features make the NEO-6M module well-suited for battery-powered applications requiring efficient use of power and rapid acquisition of satellite signals. The GPS NEO-6M satellite positioning module is a highly capable and versatile GPS receiver that provides accurate positioning, velocity, and timing information to electronic devices across various industries. Its compact form factor, multi- constellation support, and advanced features make it an ideal choice for applications demanding precise and reliable satellite positioning capabilities.

➢ **USES:**

GPS, or Global Positioning System, is a satellite-based navigation system that provides accurate location and time information anywhere on Earth. It has numerous applications across various industries and everyday life. Some common uses of GPS include:

- **Navigation:** GPS is widely used for navigation in vehicles, ships, aircraft, and smartphones. It provides real-time location information, route planning, and turn-by-turn directions, helping users navigate to their destinations efficiently and safely.

- **Mapping and Surveying:** GPS technology is essential for mapping, cartography, and land surveying applications. Surveyors use GPS receivers to precisely determine the coordinates of points on the Earth's surface, facilitating the creation of accurate maps, geographic information systems (GIS), and land-use planning.

- **Emergency Response and Disaster Management:** GPS plays a crucial role in emergency response and disaster management operations. Emergency services, such as police, fire, and medical personnel, use GPS to locate and reach accident sites, natural disaster areas, and remote or inaccessible locations quickly and efficiently.

- **Fleet Management:** GPS is utilized in fleet management systems to track the location, speed, and movement of vehicles in real-time. This helps fleet operators optimize route planning, monitor driver behaviour, improve fuel efficiency, and enhance overall logistics and transportation efficiency.

- **Outdoor Recreation:** GPS devices are popular among outdoor enthusiasts for hiking, camping, hunting, and other recreational activities. Handheld GPS units or GPS-enabled smartphones provide users with accurate location information, trail maps, and waypoints, enhancing safety and navigation in remote or unfamiliar environments.

- **Geotagging and Location-Based Services:** GPS technology enables geotagging of photos and videos, allowing users to associate precise geographic coordinates with multimedia content. Location-based services (LBS) utilize GPS data to offer personalized recommendations, location- aware advertisements, and social networking features based on users' current or past locations.

- **Precision Agriculture:** In agriculture, GPS is used for precision farming techniques such as variable rate application of fertilizers, pesticides, and irrigation water. GPS-guided tractors and equipment can precisely target specific areas of fields based on soil characteristics, crop health, and yield potential, leading to increased productivity and resource efficiency.

- **Aviation and Aerospace:** GPS is integral to aviation and aerospace navigation systems, providing accurate positioning, guidance, and tracking for aircraft, satellites, and spacecraft. GPS receivers are used in aircraft for navigation, flight planning, air traffic control, and landing approaches.

2.1.3. HEART RATE SENSOR:

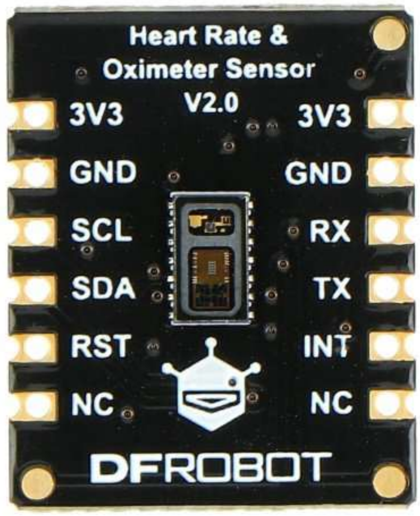


Fig:3 Heart rate sensor

The MAX30102 is an integrated sensor module designed for measuring heart rate and blood oxygen saturation (SpO2). It combines a pulse oximeter and a heart rate monitor in a compact, low-power package. It is commonly used in wearable health devices and medical applications to monitor a person's vital signs.

- **Working Principle:** The heart rate sensor works on the principle of photoplethysmography (PPG), where LEDs emit light into the skin. Blood vessels absorb and reflect this light, with the amount of reflected light varying with blood volume. A photodetector captures the reflected light, and fluctuations in this light correspond to the heartbeat. The sensor processes these fluctuations to calculate the heart rate.
- **Types of Heart rate sensor:**
  1. **Optical Heart Rate Sensors (Photoplethysmography - PPG)**
     Uses light-emitting diodes (LEDs) to shine light through the skin, and a photodetector measures the reflected light to detect changes in blood volume with each heartbeat. Wearable devices like smartwatches and fitness trackers (e.g., Apple Watch, Fitbit).
  2. **Electrocardiogram (ECG or EKG) Sensors**
     Measures the electrical activity of the heart by detecting voltage differences

generated by the heart's electrical impulses using electrodes placed on the skin. Medical-grade equipment, portable ECG devices, and advanced fitness trackers.

3. **Chest Strap Heart Rate Monitors**

   Uses electrical sensors (similar to ECG) placed around the chest to detect electrical signals from the heart. These sensors send data wirelessly to a connected device. Sports and fitness devices, often used by athletes for accurate heart rate monitoring during intense exercise.

4. **Ballistocardiograph (BCG) Sensors**

   Detects the mechanical movement of the body caused by the heart's pumping action (vibration), which is then analyzed to determine the heart rate. Used in medical equipment and research for monitoring heart rate and cardiovascular health.

5. **Piezoelectric Heart Rate Sensors**

   Uses piezoelectric materials that generate an electric charge when subjected to mechanical stress caused by blood flow in arteries. Medical devices, including wearable health monitors and non-invasive cardiovascular systems.

6. **Capacitive Heart Rate Sensors**

   Measures changes in capacitance (the ability to store an electrical charge) caused by the expansion and contraction of the blood vessels with each heartbeat. Used in advanced wearables, such as smart clothing or medical devices.

➢ **Applications:**

- **Wearable Health Devices**: Used in fitness trackers and smartwatches to monitor heart rate and SpO2 levels.
- **Medical Devices**: For monitoring the health of patients, especially in non-invasive and continuous health monitoring scenarios.
- **Fitness Monitoring**: Helps users track their heart rate during exercise and assess their fitness levels.
- **Sleep Monitoring**: Used in some devices to monitor heart rate and SpO2 during sleep.

- **USES:**

1. Fitness and Sports Tracking: In fitness trackers and smartwatches, heart rate sensors continuously monitor the user's heart rate during physical activities, helping individuals stay within their target heart rate zones for optimal exercise performance. Athletes use heart rate data to adjust the intensity of workouts and prevent overtraining by ensuring their heart rate stays in a safe range.
2. Health Monitoring: People with heart conditions or other chronic illnesses use heart rate sensors to monitor their health, detect irregular heart rhythms, and take timely action if necessary. Healthcare providers use wearable heart rate sensors to monitor patients remotely, enabling early detection of health issues and improving patient care, especially in elderly or high-risk individuals.
3. Sleep Monitoring: Heart rate sensors are used in sleep trackers to monitor heart rate variability, which helps assess sleep stages and overall sleep quality. A stable heart rate is often a sign of good sleep, while fluctuations may indicate sleep disorders.
4. Medical Diagnostics: In medical settings, ECG sensors detect electrical signals from the heart, helping diagnose conditions such as arrhythmia, heart attacks, and other cardiac abnormalities. Optical heart rate sensors are often paired with pulse oximeters to monitor both heart rate and oxygen saturation (SpO_2), critical for managing respiratory conditions like asthma, COPD, or COVID-19.
5. Personal Safety: In wearable devices (such as smart clothing or smartwatches), heart rate sensors can trigger an alert if an abnormal heart rate is detected (e.g., heart rate too high or too low), providing early warnings of potential health issues. In wearable devices like jackets, heart rate sensors can be used to monitor stress levels or sudden changes in heart rate that may indicate distress or danger, triggering an emergency response.
6. Sports Rehabilitation: After surgery or injury, heart rate sensors help track recovery progress by ensuring the individual does not exert themselves too much during physical therapy or rehabilitation exercises. In sports medicine, these sensors help measure when athletes reach their aerobic or anaerobic threshold, aiding in personalized training plans.

7. Research and Clinical Studies: Heart rate sensors are used in clinical trials to monitor cardiovascular responses to new drugs, exercises, or treatments. Behavioral and Stress Studies: Researchers use heart rate sensors to study stress, anxiety, and emotional responses, as changes in heart rate often correlate with mental and emotional states.
8. Virtual Reality (VR) and Gaming: Some gaming systems and VR experiences use heart rate sensors to adjust game difficulty based on the player's heart rate, creating a more immersive and personalized experience. Stress Management in VR: Heart rate sensors are integrated into VR systems to monitor and adjust experiences in real-time to help reduce stress or anxiety in users.

2.1.4. BODY TEMPERATURE SENSOR:

Fig 4: Body Temperature sensor

A body temperature sensor is a device designed to measure the temperature of the human body. It is commonly used in health monitoring systems to track body temperature, which is a key indicator of health status. These sensors can detect fevers, infections, or abnormal body temperature levels, providing valuable data for medical diagnoses or wellness assessments.

- **Types of Body Temperature Sensors:**

1. Thermistors: These are temperature-sensitive resistors whose resistance changes with temperature. As the body temperature changes, the resistance of the thermistor varies, and this change is measured to calculate the temperature. Widely used in thermometers and medical devices for measuring body temperature.
2. Infrared (IR) Sensors: These sensors detect infrared radiation emitted by the body, particularly from the forehead or ear. The sensor converts this radiation into a temperature reading. Non-contact thermometers used in hospitals, clinics, and homes for quick temperature checks.
3. Thermocouples: Thermocouples work by measuring the voltage difference that occurs when two different metals are joined at one end and subjected to temperature changes. Used in medical instruments and industrial temperature sensors.
4. RTDs (Resistance Temperature Detectors): Similar to thermistors, RTDs use a material (usually platinum) whose resistance increases with temperature. They are more accurate and stable than thermistors. Medical and industrial applications requiring high precision.

- **Applications of Body Temperature Sensors:**
  - Fever Detection: Used to detect fever in medical settings, helping identify infections or illnesses.
  - Health Monitoring: Commonly found in wearable devices to continuously monitor body temperature for health and wellness.
  - Medical Devices: Integral in clinical thermometers, both contact (oral, rectal) and non-contact (infrared).
  - Childcare: Used in thermometers for infants and children to monitor body temperature safely.
  - Wearable Devices: Incorporated in smartwatches and health trackers for continuous temperature monitoring.

2.1.5. IMU SENSOR:

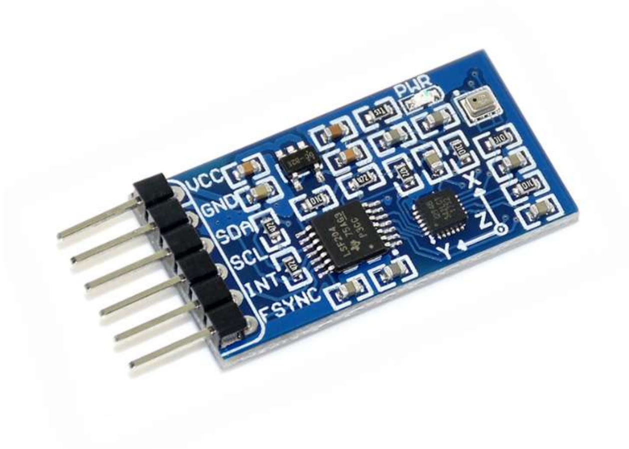


Fig 5: IMU sensor

An IMU (Inertial Measurement Unit) sensor is a compact device that measures and reports an object's specific force, angular rate, and sometimes the magnetic field surrounding the object. IMUs are widely used in various applications requiring motion tracking and orientation determination, such as robotics, drones, smartphones, and wearable devices.

- **Working principle:**

The working principle of an **IMU (Inertial Measurement Unit) sensor** is based on measuring motion and orientation using its internal components: an accelerometer, gyroscope, and sometimes a magnetometer. The accelerometer detects linear acceleration along three axes (x, y, z), including both dynamic forces (movement) and static forces (gravity). The gyroscope measures angular velocity or the rate of rotation around these axes, providing data about changes in orientation. If included, the magnetometer detects the surrounding magnetic field, helping determine the device's heading relative to Earth's magnetic north. These sensors work together to gather raw data, which is processed using algorithms such as Kalman filters or complementary filters to combine and refine the information. This data fusion eliminates noise and inaccuracies, producing precise outputs for orientation (pitch, roll, yaw), velocity, and acceleration. The IMU outputs these parameters in real time, making it essential for motion tracking and control in applications like drones, robotics, and navigation systems.

➢ Applications of IMU Sensors

1. **Consumer Electronics**: Smartphones: Screen orientation, gesture recognition. Wearable Devices: Fitness tracking and step counting.
2. **Drones and Robotics**: Stabilization and navigation. Path planning and obstacle avoidance.
3. **Automotive Systems**: Vehicle stability control. Inertial navigation for autonomous vehicles.
4. **Gaming and Virtual Reality**: Head tracking for immersive VR experiences. Motion controllers for gaming.
5. **Aerospace and Defence**: Aircraft and spacecraft stabilization. Missile guidance systems.
6. **Medical Applications**: Monitoring body movements for rehabilitation. Prosthetic limb control and gait analysis.

➢ Advantages of IMU Sensors

1. Compact and Lightweight: IMUs are small and easy to integrate into devices, making them ideal for portable and compact systems.
2. Real-time Data: Provides instant feedback on motion and orientation, crucial for time-sensitive applications like robotics and drones.
3. Versatile: Can be used in diverse environments such as air, land, and water for various applications like navigation, stabilization, and motion tracking.
4. High Sensitivity: Capable of detecting minute changes in motion or orientation.
5. Cost-effective: Advances in MEMS (Micro-Electro-Mechanical Systems) technology have made IMUs affordable and accessible for consumer electronics.
6. Low Power Consumption: Suitable for battery-powered devices like smartphones and wearables.

7. Sensor Fusion: When combined with algorithms, IMUs deliver highly accurate motion and orientation tracking by mitigating individual sensor errors.
8. Wide Application Range: Used in industries such as aerospace, automotive, medical, and gaming, demonstrating their adaptability.

- **Disadvantages of IMU Sensors**

1. Sensor Drift: Gyroscopes in IMUs can accumulate errors over time, leading to inaccuracies in orientation measurements.
2. No Absolute Positioning: IMUs only measure relative motion and cannot determine absolute position without assistance from external systems like GPS.
3. Environmental Sensitivity: Magnetometers, if included, can be affected by external magnetic interference, reducing accuracy in certain environments.
4. Calibration Requirements: IMUs often need careful calibration to ensure accurate performance, especially in precision applications.
5. High Computational Demand: Advanced algorithms like Kalman filters require processing power, which might not be feasible for low-resource devices.
6. Vulnerability to Noise: Vibrations and external mechanical noise can introduce errors in the readings, affecting reliability.
7. Cost for High-end Models: While basic IMUs are affordable, high-precision models with advanced features can be expensive.

- **Conclusion**

IMU sensors are indispensable tools in motion and orientation tracking across various industries. By integrating accelerometers, gyroscopes, and sometimes magnetometers, they provide accurate data on movement and orientation. Their versatility, compact size, and ability to operate in real-time make them essential components in applications ranging from everyday consumer devices to advanced aerospace systems. As technology evolves, IMUs continue to play a pivotal role in enabling smarter, more efficient devices.

2.1.5. PROXIMITY SENSOR:

Fig 6: IR Sensor

A proximity sensor is a type of sensor that detects the presence or absence of objects without requiring physical contact. It works by emitting a signal (infrared, ultrasonic, electromagnetic, or capacitive) and analysing the changes in the signal when it interacts with nearby objects. Proximity sensors are widely used in industrial automation, consumer electronics, automotive systems, and safety applications.

➢ **Working Principle of Proximity Sensors**

The working principle of a proximity sensor depends on its type, but the general mechanism involves the detection of objects without direct physical contact by emitting and receiving a specific type of signal. Below are the principles of commonly used proximity sensors:

1. **Inductive Proximity Sensors**: These sensors generate an electromagnetic field using a coil. When a metallic object enters the field, it induces eddy currents in the object, causing a change in the coil's inductance. This change is detected by the sensor to identify the presence of the object.
2. **Capacitive Proximity Sensors**: These sensors use an electrical field to measure changes in capacitance. When an object (metallic or non-metallic) enters the field, it alters the capacitance between the sensor and the object. The sensor detects this change to determine the presence of the object.
3. **Ultrasonic Proximity Sensors**: Emit high-frequency sound waves and measure the time it takes for the waves to bounce back after hitting an

object. The sensor calculates the distance based on the time-of-flight principle. If the object is within a predefined range, it is detected as present.

4. **Infrared (IR) Proximity Sensors**: Emit infrared light and detect the reflection from nearby objects. The intensity of the reflected light helps determine the object's presence and distance.
5. **Photoelectric Proximity Sensors**: Use a light source (e.g., LED) and a photodetector. Detect interruptions in the light beam or measure reflected light from an object to identify its presence.

➢ **Advantages of Proximity Sensors**

1. Non-contact Detection: No physical contact with the object, reducing wear and tear.
2. High Durability: Resistant to environmental conditions such as dust, water, and vibrations.
3. Fast Response Time: Suitable for high-speed applications.
4. Versatility: Can detect a wide range of materials depending on the type of sensor.
5. Low Maintenance: No moving parts reduce the likelihood of mechanical failure.

➢ **Disadvantages of Proximity Sensors**

1. Limited Range: Effective detection range is typically short (a few millimetres to centimetres).
2. Material Sensitivity: Some types, like inductive sensors, work only with certain materials (e.g., metals).
3. Environmental Interference: Performance can be affected by extreme temperatures, moisture, or electromagnetic interference.
4. Cost: High-precision or long-range sensors can be expensive.

➢ **Applications of Proximity Sensors**

1. Industrial Automation: Detecting objects on assembly lines or in robotic arms.

2. Automotive Systems: Parking assistance, collision avoidance, and object detection.
3. Consumer Electronics: Touchless controls, smartphone screen on/off functionality.
4. Safety Systems: Ensuring human safety by detecting objects or people in restricted areas.
5. Medical Equipment: Motion detection and non-contact switches.

2.1.6. SOS BUTTON:

Fig 7: SOS Button

An SOS button is a dedicated emergency button designed to send distress signals or trigger alerts in critical situations. SOS stands for "Save Our Souls" or "Save Our Ship", a universal signal for requesting immediate help. The button is commonly used in devices such as smartphones, wearables, vehicles, and personal safety systems.

➢ **Working of an SOS Button**

- **Trigger Activation**: When the SOS button is pressed, it sends a signal to initiate an emergency response. The response could include sending alerts, making a call, or sharing the user's location. Some systems require holding the button for a few seconds to prevent accidental activation.
- **Signal Transmission**: The button is connected to a communication module (such as GSM, Wi-Fi, or Bluetooth) that transmits the signal to predefined contacts or emergency services.
- **Location Sharing**: Devices with GPS integration send real-time location data to responders, enabling quicker assistance.

- **Emergency Notification**: A text message, email, or call is sent to emergency contacts, providing details of the user's situation and location. Advanced systems can also alert local authorities or nearby responders automatically.
- **Customizable Actions**: Some systems allow customization of the SOS function, such as selecting specific contacts or configuring the type of alert.

➢ **Applications of an SOS Button**

1. **Personal Safety**: Used by individuals (e.g., women, elderly, children) to alert family or authorities during emergencies like assaults, accidents, or getting lost.
2. **Vehicles**: Installed in cars for sending alerts during road accidents, breakdowns, or theft situations. Often integrated with GPS for precise location tracking.
3. **Medical Assistance**: Found in medical alert systems to help patients summon caregivers or healthcare professionals during emergencies like falls or heart attacks.
4. **Outdoor Adventures**: Useful for hikers, travellers, or sailors in remote areas to send distress signals in case of danger.
5. **Smartphones and Wearables**: Integrated into phones, smartwatches, or fitness trackers for quick access to emergency assistance.
6. **Industrial Safety**: Used in hazardous work environments to ensure worker safety by alerting supervisors in case of accidents.

➢ **Advantages of an SOS Button**

1. **Quick Emergency Response**: Enables users to send distress signals instantly, reducing response time in critical situations.
2. **Ease of Use**: Simple to operate, even by individuals in stress or panic. Often requires just a single press.

3. **Real-Time Location Sharing**: Integrated GPS ensures that responders receive accurate location data for timely assistance.
4. **Customizability**: Many systems allow users to configure emergency contacts and preferred actions, making the button versatile.
5. **Versatile Applications**: Useful across diverse scenarios, from personal safety to industrial and medical emergencies.

- **Disadvantages of an SOS Button**

1. **False Alarms**: Accidental pressing can cause unnecessary panic or resource deployment.
2. **Network Dependence**: Requires a reliable communication network (GSM, Wi-Fi, or satellite) to send alerts. May not function in remote areas without coverage.
3. **Limited Functionality**: Basic systems might only send a single alert, lacking advanced features like location sharing or multiple contact notifications.
4. **Cost**: High-end devices with GPS and advanced communication features can be expensive.

- **Conclusion**

The SOS button is a critical feature in modern safety and emergency systems. Its ability to quickly send alerts and share real-time location data makes it invaluable for personal safety, medical emergencies, and industrial applications. However, ensuring proper customization, minimizing false alarms, and addressing network or battery dependencies are essential for maximizing its effectiveness.

2.2 SOFTWARE REQUIREMENTS

2.2.1 Arduino IDE:

Arduino IDE is a lightweight, cross-platform application that introduces programming to novices. It has both an online editor and an on-premise application, for users to have the option whether they want to save their sketches on the cloud or locally on their own computers. While Arduino IDE is highly-rated by users according to ease of use, it is also capable of performing complex processes without taxing computing resources. With Arduino IDE, users can easily access contributed libraries and receive up-to-date support for the latest Arduino boards, so they can create sketches that are backed by the newest version of the IDE.

The Arduino software is easy-to-use for beginners, yet flexible enough for advanced users. It runs on Mac, Windows, and Linux. Teachers and students use it to build low-cost scientific instruments, to prove chemistry and physics principles, or to get started with programming and robotics. Designers and architects build interactive prototypes, musicians and artists use it for installations and to experiment with new musical instruments. Makers, of course, use it to build many of the projects exhibited at the Maker Faire, for example. Arduino is a key tool to learn new things.

Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension.ino. The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information. The bottom right-hand corner of the window displays the configured board and serial port.

Arduino IDE benefits:

- **Multi-Platform Application:** Arduino IDE works on the three most popular operating systems: Windows, Mac OS, and Linux. Aside from that, the application is also accessible from the cloud. These options provide programmers with the choice of creating and saving their sketches on the cloud or building their programs locally and upload it directly to the board.

- **Board Management:** Arduino IDE comes with a board management module, where users can select the board, they want to work with at the moment. If they wish to change it, they can do so easily from the dropdown menu. Modifying their selection also automatically updates the PORT info’s with the data they need in relation to the new board.

- **Straight forward Sketching:** With Arduino IDE, users can create programs called sketches that are built with a text editor. The process is a straight forward one thought has several bells and whistles that make the experience more interactive.

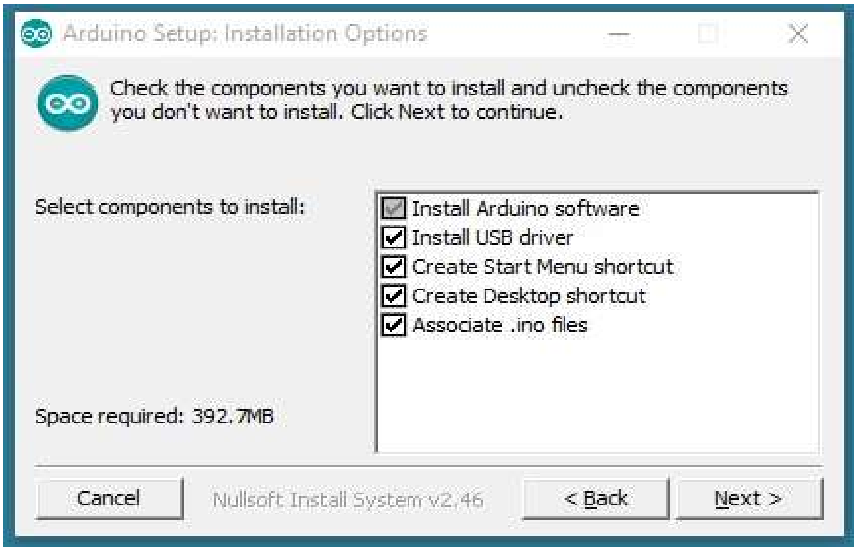
- **Project Documentation:** Arduino IDE offers programmers the option to document their projects. This function allows them to keep track of their advancements and any changes they make every time. Apart from that, documentations allow other people to easily employ the sketches to their own boards.

- **Simple Sketch Sharing:** Aside from saving and archiving sketches and uploading them to the board, Arduino IDE is also capable of sharing sketches (available only on the cloud version). Each sketch is given its own unique URL that users can share with their colleagues and fellow
Arduino hobbyists. The recipient then has access to the code; they can save it in the cloud sketchbook or download it for their own use.

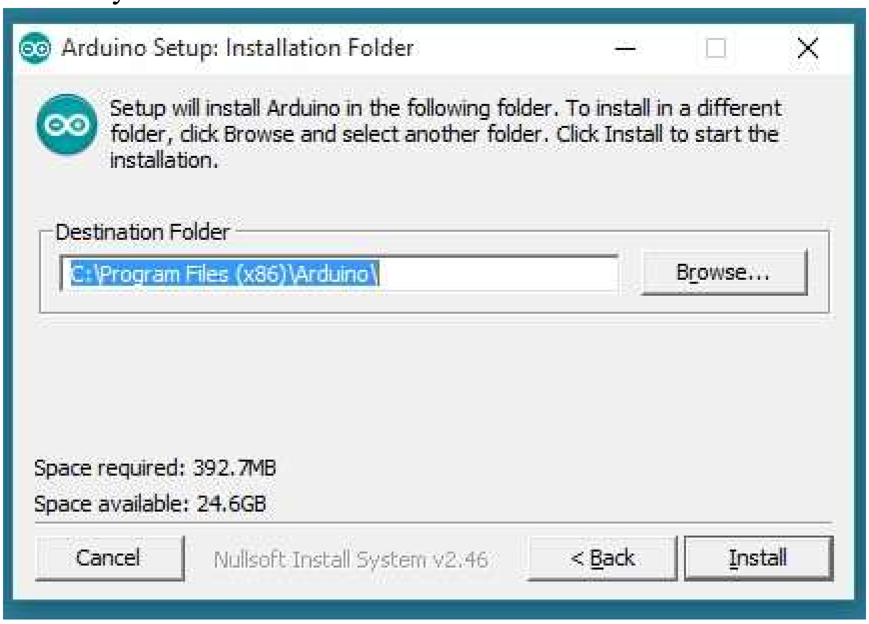
- **Vast Library:** Arduino IDE has more than 700 libraries integrated. These were written and shared by members of the Arduino community that other users can utilize for their own projects without having to install anything. This enables programmers to add a different dimension to their sketches.

Installation guide:

Get the latest version from the Arduino website (www.arduino.cc). The current version is Arduino 1.8.5. User can choose between the Installer (.exe) and the Zip packages. When the download finishes, proceed with the installation and allow the driver installation process. Select the components to be installed during the installation process which is as shown below.



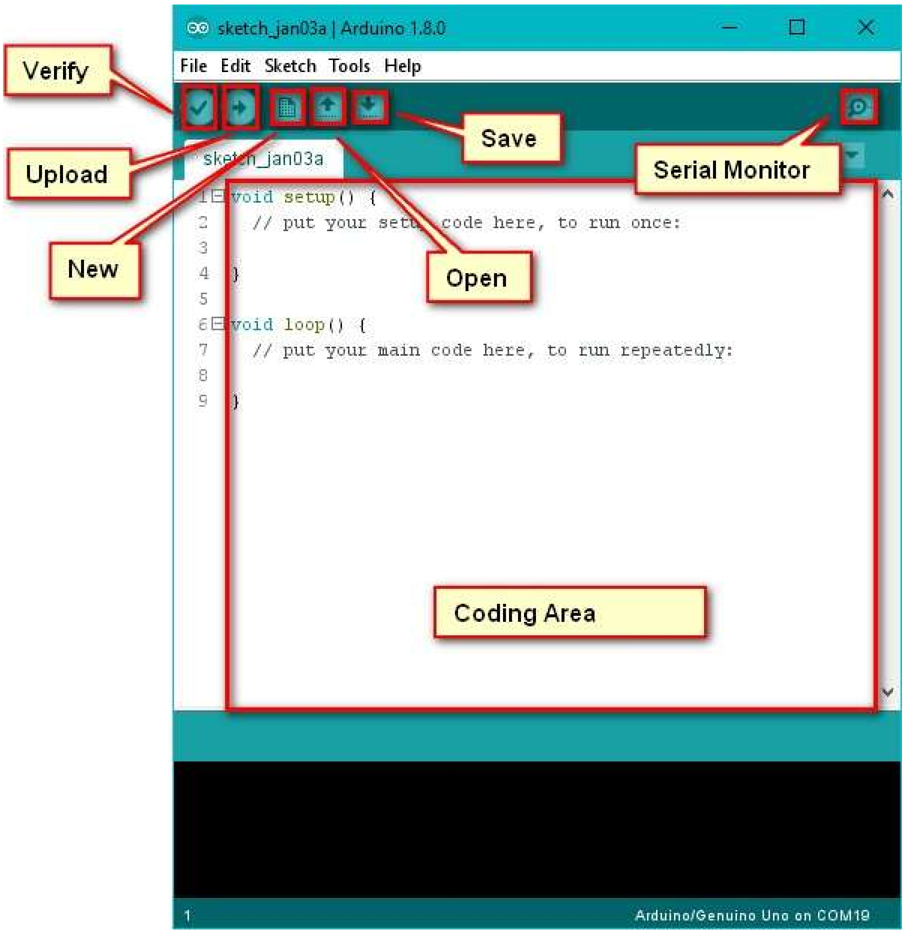
Choose installation directory



The process will extract and install all the required files to execute properly the Arduino Software create sketches that are backed by the newest version of the IDE.

Coding window

The program/code is written the coding area. Embedded C is the most preferred language whereas other programming languages are also supported. The programming window is as shown in the fig

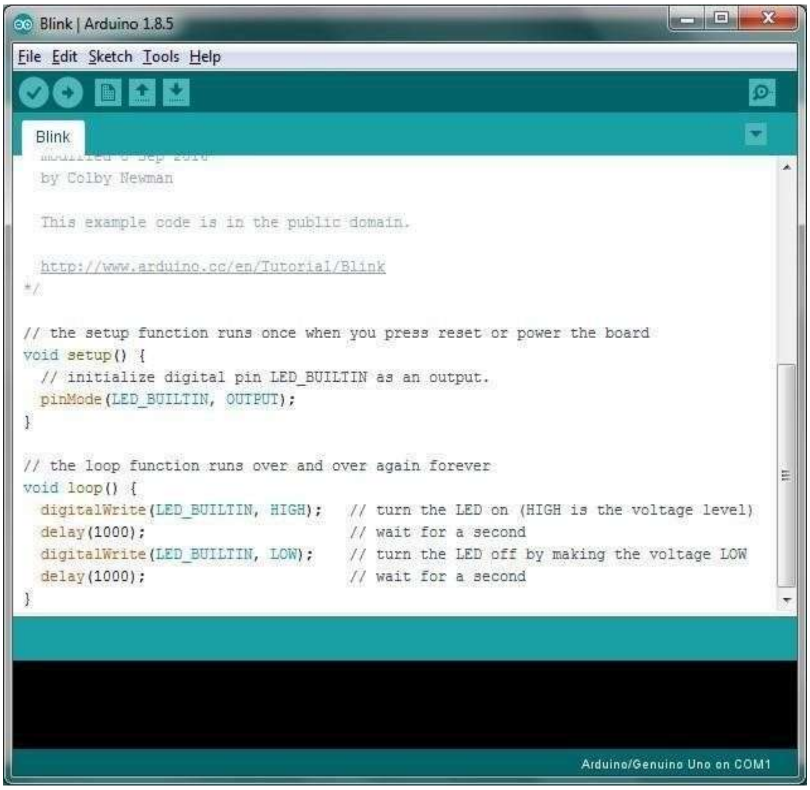


Programming window

- **Verify:** Checks the code for errors and compiles it.
- **Upload:** Compiles the code and uploads it to the configured bored.
- **New:** Creates a new sketch.
- **Open:** Presents a menu of all the sketches in your sketchbook. Clicking one will open it within the current window overwriting its content.
- **Save:** Saves the sketch.

- **Serial monitor:** Opens the serial monitor.

A basic example program is as shown in the figure below



2.2.2 BLYNK PLATFORM

Blynk is a comprehensive Internet of Things (IoT) platform that simplifies the creation and management of IoT applications. It offers tools and services for connecting hardware, visualizing data, and building user interfaces. With its robust features, Blynk is widely used in DIY projects, commercial IoT solutions, and educational applications.

- **Key Components of Blynk**

1. **Blynk Mobile and Web Dashboard**: A user-friendly interface where users can design custom dashboards to monitor and control their devices. Features widgets like buttons, sliders, graphs, and gauges for interacting with hardware. Accessible via mobile apps (iOS and Android) or a web browser.
2. **Blynk Cloud**: A central server that connects your hardware to the mobile app or web interface. Handles data exchange between devices and ensures real-time synchronization. No need to manage or maintain a server—Blynk provides a reliable cloud infrastructure.
3. **Blynk Libraries**: Pre-built libraries available for various microcontrollers like **ESP8266**, **NodeMCU**, **Arduino**, and **Raspberry Pi**. These libraries simplify the integration of hardware with the Blynk ecosystem by handling communication and functionality.
4. **Hardware**: Supports a wide range of microcontrollers and hardware platforms, such as:
    - ESP8266, ESP32
    - Arduino
    - Raspberry Pi
    - NodeMCU
    - These devices act as the physical layer for collecting data and executing commands.

- **How Blynk Works**

1. **Hardware Connection**: Connect sensors and actuators to your microcontroller (e.g., ESP8266 or Arduino). Use Blynk libraries in your microcontroller's code to enable communication with the Blynk Cloud.
2. **Cloud Integration**: The Blynk Cloud serves as the intermediary between your hardware and the user interface. The microcontroller sends sensor data to the cloud, and commands from the app are sent back to the hardware.
3. **User Interface**: Design a custom dashboard in the Blynk app or web platform. Use widgets to visualize sensor data, control actuators, or trigger alerts.
4. **Real-Time Monitoring and Control**: Monitor live data (e.g., temperature, heart rate) and control devices remotely (e.g., turn on/off lights). Notifications and alerts can be set up based on specific conditions.

- **Features of Blynk**

1. **Drag-and-Drop Dashboard**:Customize dashboards using widgets for intuitive control and monitoring.
2. **Event Handling**: Set triggers and actions, such as sending notifications when thresholds are crossed.
3. **Automation**: Configure rules for device interactions without manual intervention.
4. **Multi-Device Support**: Manage and monitor multiple devices from a single account.
5. **Data Storage**: Store historical data in the cloud for analysis and reporting.
6. **Energy System**: Use "Blynk Energy" (a credit system) to add widgets and features.

- **Applications of Blynk**

1. **Smart Home Automation**: Control appliances, lighting, and security systems.
2. **Health Monitoring**: Track vital signs such as heart rate and temperature using wearable devices.
3. **Agriculture**: Monitor soil moisture, temperature, and automate irrigation systems.
4. **Industrial IoT**: Monitor machinery and automate workflows in factories.
5. **Education**: Teach IoT concepts through hands-on projects.

- **Advantages of Blynk**

1. **Ease of Use**: Intuitive platform suitable for beginners and professionals.
2. **Wide Compatibility**: Works with numerous hardware platforms and sensors.
3. **Cloud-Based**: No need for local server management.
4. **Scalability**: Supports both personal projects and commercial IoT deployments.
5. **Real-Time Operation**: Enables instant communication between devices and users.

- **Disadvantages of Blynk**

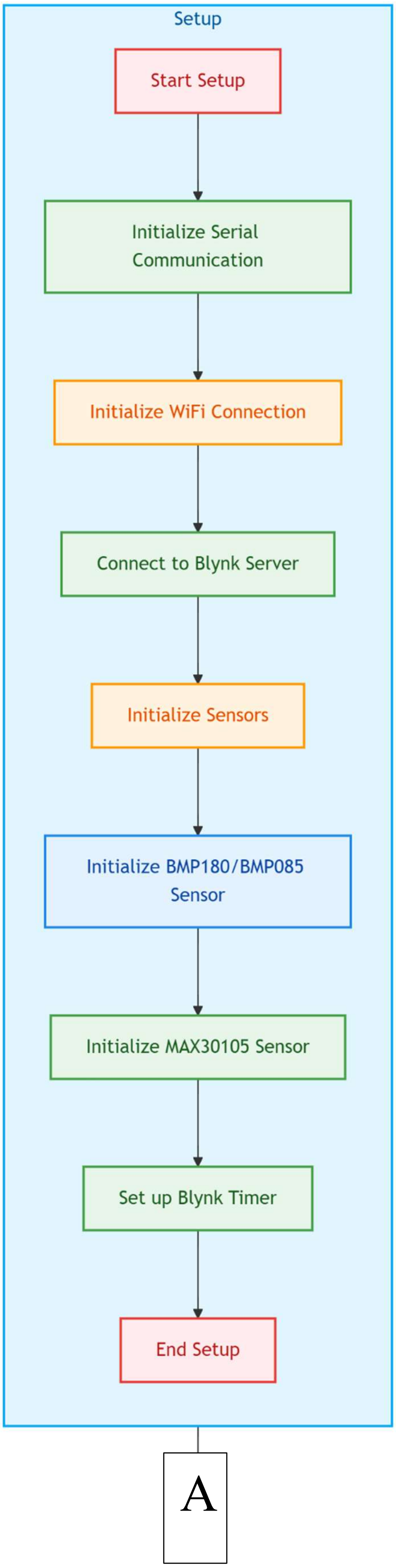
1. **Internet Dependency**: Requires a stable internet connection for operation.
2. **Energy Credits**: The free tier has limitations; advanced features may require purchasing credits.

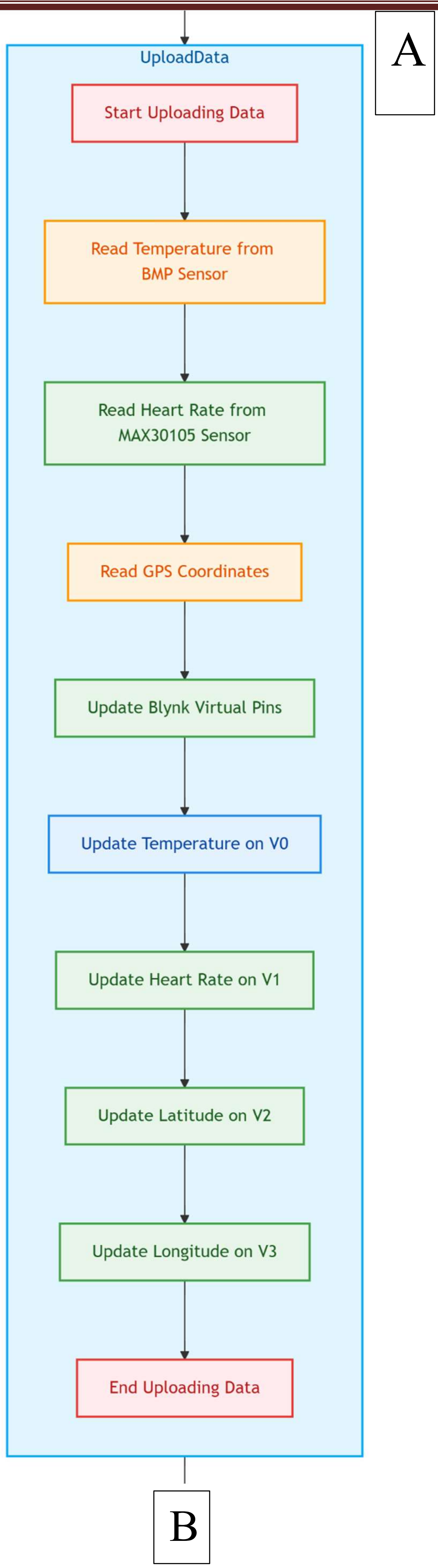
3. **Learning Curve**: Customizations and integrations may require some programming knowledge.
4. **Reliance on Third-Party Cloud**: Dependent on Blynk's infrastructure unless a private server is set up.

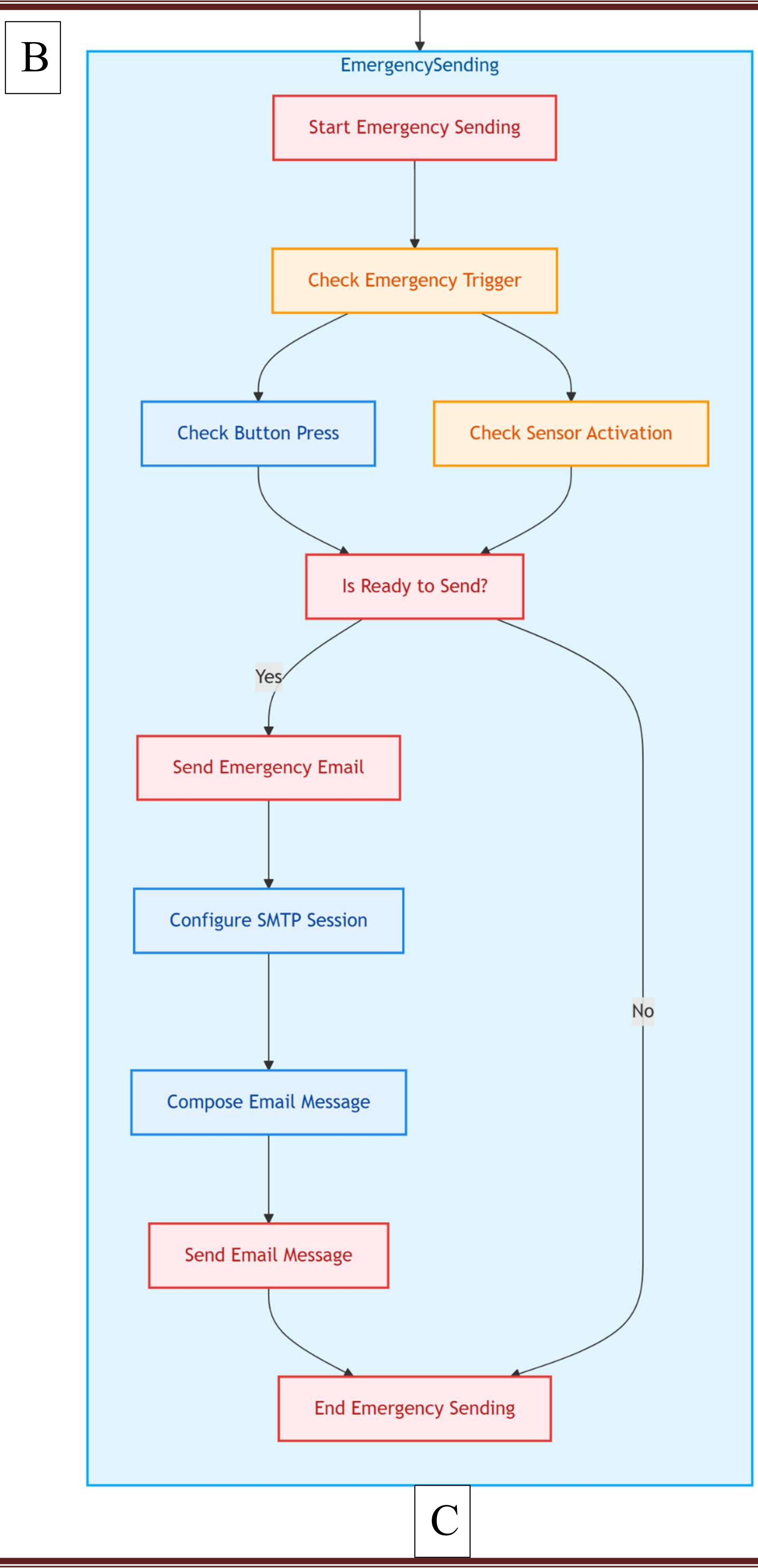
- **Why Choose Blynk?**

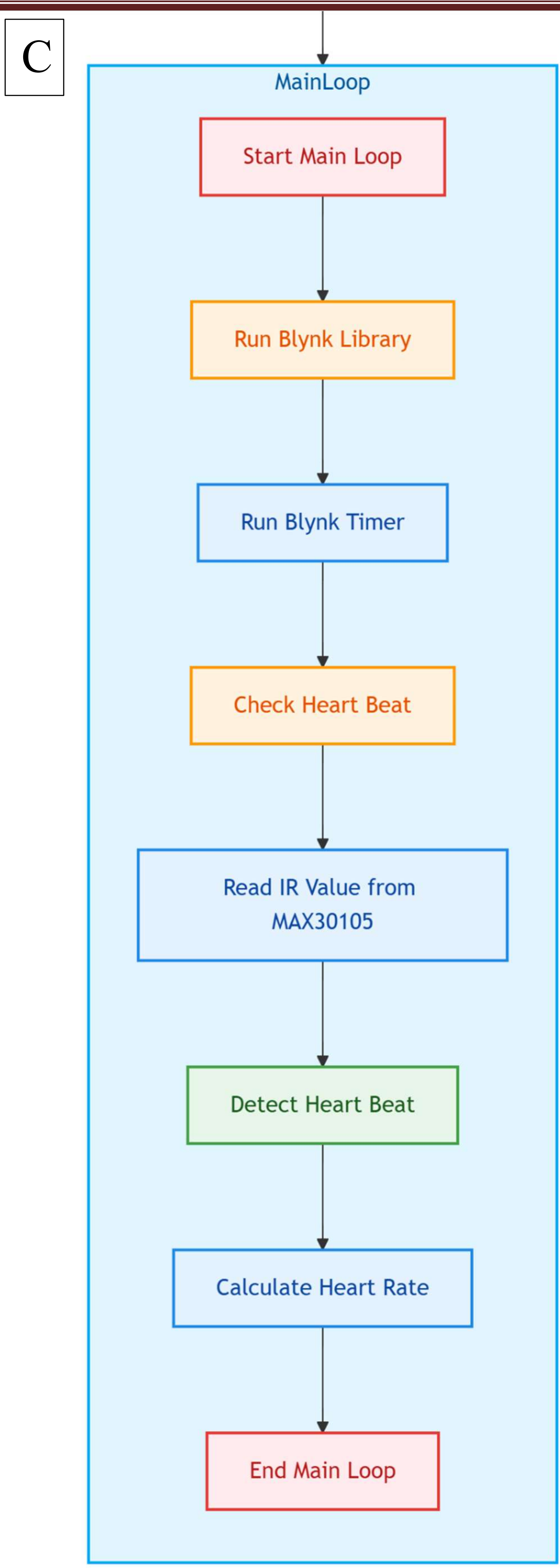
Blynk is a powerful tool for anyone looking to develop IoT solutions. Its simple drag-and-drop interface, extensive hardware support, and reliable cloud services make it a go-to platform for both enthusiasts and professionals. Whether it's automating your home, monitoring health parameters, or building a commercial product, Blynk provides the flexibility and tools required to succeed in the IoT domain.

2.2.3. FLOW CHART:




A
UploadData
Start Uploading Data
Read Temperature from BMP Sensor
Read Heart Rate from MAX30105 Sensor
Read GPS Coordinates
Update Blynk Virtual Pins
Update Temperature on V0
Update Heart Rate on V1
Update Latitude on V2
Update Longitude on V3
End Uploading Data
B


B
EmergencySending
Start Emergency Sending
Check Emergency Trigger
Check Button Press
Check Sensor Activation
Is Ready to Send?
Yes
No
Send Emergency Email
Configure SMTP Session
Compose Email Message
Send Email Message
End Emergency Sending
C


C
MainLoop
Start Main Loop
Run Blynk Library
Run Blynk Timer
Check Heart Beat
Read IR Value from MAX30105
Detect Heart Beat
Calculate Heart Rate
End Main Loop

CHAPTER 3

METHODOLOGY AND WORKING WITH BLOCK DIAGRAM

The methodology of building of the model is as follows

3.1 METHODOLOGY

The methodology outlines the systematic approach to designing, developing, and deploying a wearable safety jacket equipped with ESP8266, GPS module, heart rate sensor, temperature sensor, IMU sensor, proximity sensor, and an SOS button. The primary goal is to enhance women's safety by providing real-time monitoring and automated alert mechanisms in emergencies.

1. Problem Definition and Objective

- Challenges Identified:
  - Lack of reliable real-time alert systems during emergencies.
  - Difficulty in identifying health issues, sudden falls, or proximity threats promptly.
  - Limited accessibility to immediate assistance.
- Objective:
  - To develop a wearable safety jacket that integrates multiple sensors for monitoring, analyzing, and transmitting critical data in emergencies.

2. System Design

- ESP8266: Serves as the central microcontroller to process sensor data and manage communication.
- GPS Module: Tracks the user's real-time location.
- Heart Rate Sensor (MAX30102): Monitors pulse rate for abnormal activity detection.
- Temperature Sensor: Measures body temperature for health monitoring.
- IMU Sensor: Detects falls or sudden movements indicative of emergencies.
- Proximity Sensor: Identifies threats or nearby objects indicating potential danger.

- **Software Tools**:
    - Arduino IDE: For programming the ESP8266 microcontroller.
    - IoT Platform: For visualizing real-time data and transmitting alerts.
    - SMTP Protocol: To send email notifications.

3. Integration and Component Setup

- Sensor Configuration:
    - Connect all sensors to the ESP8266, ensuring proper calibration:
        - Heart Rate Sensor: Configured to detect pulse changes exceeding normal thresholds.
        - Temperature Sensor: Programmed to identify sudden changes in body temperature.
        - IMU Sensor: Monitors accelerations and rotations to detect falls.
        - Proximity Sensor: Detects objects or threats within a predefined range.
    - Integrate the GPS module to transmit location data with alerts.
    - SOS button is configured as a manual interrupt trigger for emergencies.
- Circuit Design:
    - Develop a compact and efficient circuit layout for seamless integration within the jacket.
    - Ensure power management using a rechargeable Li-ion battery.

4. Programming and Communication

- Code Implementation:
    - Write Arduino code to:
        - Read and process sensor inputs.
        - Compare sensor data against predefined thresholds.
        - Trigger alerts when thresholds are exceeded or when the SOS button is pressed.
- Data Handling: Collect and analyse sensor data for abnormalities. Include GPS coordinates in alerts for precise location tracking.
- Communication Protocol: Configure ESP8266 to transmit data securely to IoT platforms and emergency contacts.

5. Alert Mechanism

- Automated Alerts:
    - Triggered by:
        - Abnormal heart rate.
        - Sudden temperature drop or rise.
        - Detection of a fall via the IMU sensor.
        - Proximity sensor identifying a nearby threat.
    - Action: Send an email alert containing GPS location and event details to a specific email ID.
- Manual Alerts via SOS Button:
    - On activation, an immediate email alert is sent with GPS location, overriding sensor-based triggers.

6. Wearable Design and Implementation

- Jacket Assembly:
    - Integrate sensors, ESP8266, and supporting components into the jacket lining for comfort and durability.
- Ergonomics and Safety:
    - Ensure lightweight and weatherproof construction.
    - Provide clear access to the SOS button for user convenience.

7. Testing and Validation

- Component-Level Testing:
    - Validate the functionality of individual sensors and the ESP8266 module.
- System Integration Testing:
    - Test real-time data collection, processing, and email alert mechanisms under various scenarios.
- Field Testing:
    - Simulate emergency situations to evaluate the system's responsiveness and reliability.

8. Deployment and User Training

- User Manual:
  - Provide a detailed guide on operating the jacket, interpreting alerts, and maintaining the device.
- Training Sessions:
  - Educate users on using the SOS button and understanding system functionality.

9. Maintenance and Scalability

- Regular Firmware Updates: Update ESP8266 firmware to enhance functionality and add features.
- Scalability Options: Integrate additional sensors or features, such as GSM modules for SMS alerts.
- Hardware Maintenance: Design modular components for easy replacement and repairs.

3.2 BLOCK DIAGRAM:

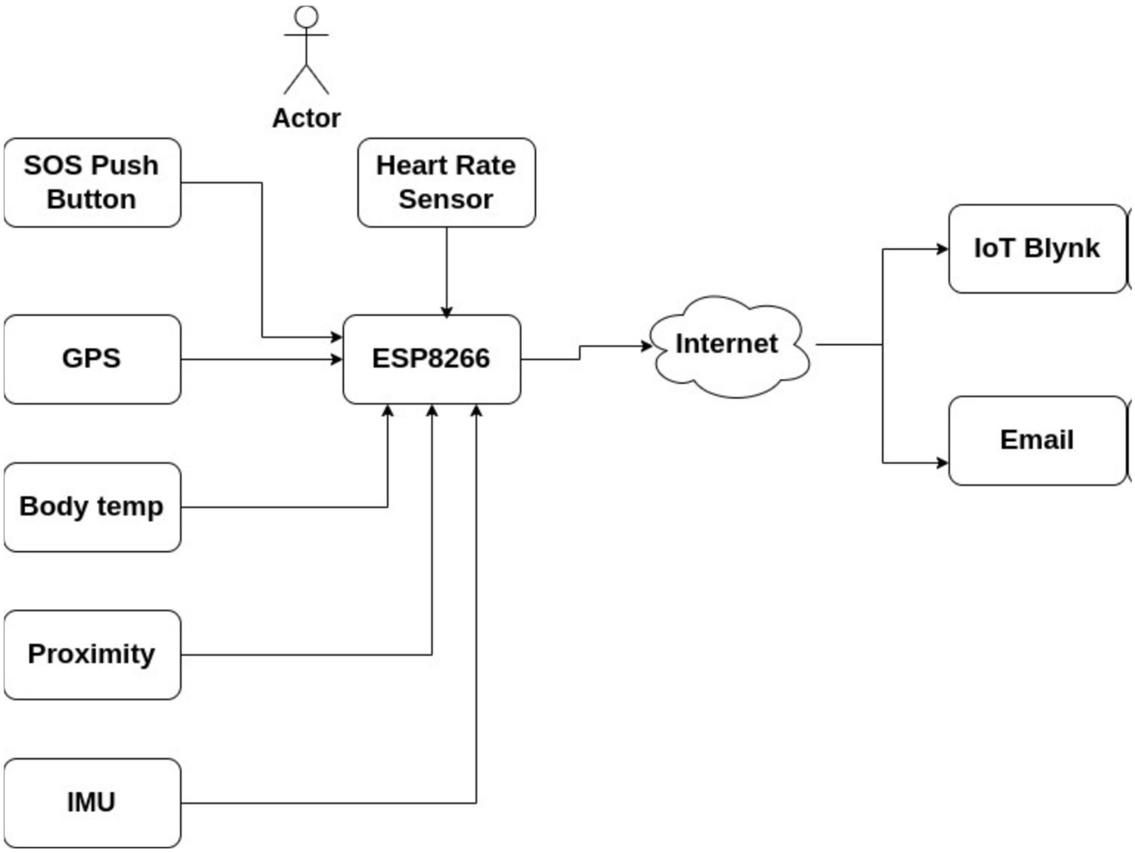


Fig: 11 Block diagram

The block diagram of the Women Safety Jacket project provides a visual representation of the system's components and their interactions. At the core of the system is the ESP8266 microcontroller, which acts as the central processing unit, responsible for managing data from various sensors and executing predefined functions based on the inputs received. The heart rate sensor and temperature sensor are used to monitor the user's vital signs, providing real-time data to the microcontroller. If these sensors detect abnormal conditions (e.g., an elevated heart rate or abnormal body temperature), the microcontroller triggers an alert. The IMU sensor (Inertial Measurement Unit) is employed to detect any sudden movements or falls, which are critical in identifying potential emergency situations. If the system detects a fall, an email alert is automatically sent to the designated emergency contact, along with the user's GPS coordinates obtained from the GPS module. The proximity sensor continuously monitors the surrounding area for any threats or dangerous objects within a specified range. If a threat is detected, the system activates a response to alert the user or automatically trigger an emergency notification. The SOS button serves as a manual activation point, allowing the user to trigger an emergency alert by pressing the button. When activated, an immediate email is sent with the user's location details, notifying the designated emergency contact.

All sensor data is processed and analyzed by the ESP8266, and the relevant information, such as the user's location and the detected emergency, is sent to the specified email address. The system also has wireless connectivity via Wi-Fi to send and receive real-time data to an IoT platform for remote monitoring. The block diagram illustrates the seamless integration of these components, working together to provide comprehensive safety monitoring and emergency response in real time. The system combines sensor data, processing, and communication to ensure that the user is protected and can receive immediate assistance if needed.

CHAPTER 4

ADVANTAGES AND DISADVANTAGES

4.1 ADVANTAGES

- **Real-Time Monitoring**: The system continuously monitors the user’s health parameters, including heart rate and body temperature. This allows for proactive detection of any abnormal health conditions, ensuring early intervention and reducing the risk of health-related emergencies. The IMU sensor provides real-time detection of falls or sudden movements, which can be crucial in preventing serious injuries.

- **Automated Emergency Response**: In the event of an emergency, such as a fall, abnormal vital signs, or a detected threat, the system automatically triggers email alerts to a predefined list of contacts, including family members, friends, or emergency services. This automated response ensures that help is dispatched quickly, even if the user is unable to make a call themselves.

- **Proximity Detection**: The proximity sensor is a unique feature that helps detect nearby objects or potential threats. If someone is getting too close to the user, it can trigger an alert, either to the user themselves or to others monitoring the system. This function can help prevent physical assaults or unwanted attention, which is especially important for women’s safety in public spaces.

- **SOS Button for Manual Alerts**: The inclusion of an SOS button allows users to manually send an alert if they feel unsafe or in distress. This provides an additional layer of security, enabling the user to act quickly in situations where other sensors may not detect a threat, such as verbal or physical assault.

- **Location Tracking**: The integration of the GPS module allows the system to track the user’s location in real time. If an emergency occurs, the user's precise location is included in the alert, enabling emergency responders to reach the user faster, reducing response times and potentially saving lives.

- **Wearable and Comfortable**: The jacket is designed to be lightweight, comfortable, and easy to wear, making it practical for daily use. Unlike bulky wearable devices or separate equipment, the jacket provides a seamless solution for women who wish to prioritize their safety without being weighed down by additional gadgets.

- **Non-Invasive Health Monitoring**: Unlike traditional health monitoring devices, which may require manual input or periodic checking, this system works continuously and non-intrusively. It automatically tracks the user's health and environment, ensuring that no manual effort is required to activate the monitoring system.

- **Customizable Alerts and Sensitivity**: The system can be customized to suit individual preferences. The sensitivity of sensors and alert thresholds can be adjusted, ensuring that the system works according to the user's specific needs, whether they are more concerned about health monitoring or threat detection.

- **Enhanced Security in Vulnerable Situations**: Whether walking alone at night, traveling, or attending public events, the jacket ensures that help is always within reach. The system acts as an added layer of security, providing women with confidence knowing that they are protected and can get immediate assistance if necessary.

- **Reduced Response Time in Emergencies**: The integration of sensors and automated notifications reduces the need for users to manually communicate their distress. The system sends alerts with minimal delay, ensuring that emergency services are informed of the situation quickly. This can be vital in life-threatening scenarios, where every second counts.

- **Peace of Mind for Caregivers**: The system not only benefits the user but also provides peace of mind to their family members or caregivers, knowing that they can be immediately notified in case of any distress signal or health emergency.

4.2 DISADVANTAGES

- **Dependence on Battery Life:** The system relies on the continuous operation of various sensors, the ESP8266 microcontroller, and the GPS module, all of which are powered by batteries. If the battery runs out, the system will stop functioning, leaving the user unprotected. The user must regularly monitor and recharge or replace the battery to ensure continuous safety monitoring.

- **Connectivity Issues:** The system depends on Wi-Fi connectivity for sending alerts and monitoring the data remotely. In areas with poor or no Wi-Fi coverage, the system may not be able to send emergency alerts in real time. This could lead to delayed responses in critical situations, potentially jeopardizing the user's safety.

- **Sensor Limitations and False Alerts:** While the sensors are designed to detect falls, abnormal heart rates, and proximity to threats, there is always the risk of false positives (e.g., a fall detection triggered by a sudden movement not related to an actual fall). Similarly, proximity sensors may falsely detect harmless objects or people, leading to unnecessary alerts. This could result in user fatigue and desensitization to the system's alerts over time.

- **Limited Range of Proximity Sensor:** The proximity sensor has a limited detection range, meaning it may not be able to identify threats beyond a certain distance. In certain scenarios, such as an approaching danger that exceeds the sensor's range, the system may fail to warn the user in advance.

- **GPS Accuracy and Availability:** While the GPS module provides real-time location tracking, its accuracy can be affected by environmental factors such as poor satellite signals, tall buildings, or dense urban areas. In these situations, the GPS coordinates might not be accurate, potentially affecting the efficiency of emergency response teams in locating the user.
- **Initial Cost and Maintenance:** While the system can provide significant

benefits, the initial cost of the jacket, sensors, microcontroller, and other components may be high for some users. Additionally, regular maintenance, sensor calibration, and software updates may be required to ensure optimal performance, adding to the overall cost and effort.

- **Limited Customization:** While the system offers customizable settings for alert thresholds, it may not fully accommodate all user needs or preferences. Some users may find the default settings inadequate for their specific requirements, and the complexity of configuring the system might be challenging for non-technical individuals.

- **Dependency on Technology:** The effectiveness of the jacket is heavily reliant on technology, which may not be suitable for everyone, especially those not familiar with IoT devices or technology. In the event of a technical malfunction or failure, the system may be rendered useless, leaving the user vulnerable.

- **Battery Charging and Maintenance:** The system requires regular charging or battery replacements to remain functional. For users who forget or neglect this aspect, the safety features could be compromised. Additionally, the jacket and its components will require periodic maintenance to ensure the sensors and microcontroller are working properly.

CHAPTER 5

5.1 APPLICATIONS:

Based on the report provided, here are some practical and relevant applications:

- **Personal Safety in Public Spaces**: The jacket can be worn in public spaces such as streets, parks, or public transportation systems. In cases of potential threats like harassment or physical assault, the proximity sensor and SOS button can trigger immediate alerts, ensuring that emergency services or pre-selected contacts are notified. This feature enhances personal security, especially when traveling alone.

- **Emergency Response during Health Emergencies**: The system's health monitoring capabilities, including heart rate and body temperature sensors, are particularly beneficial for elderly individuals or those with medical conditions. If the system detects abnormal health parameters or a fall (via the IMU sensor), an immediate email alert can be sent to medical professionals, family members, or caregivers. This can save critical time in emergencies, enabling quicker medical intervention.

- **Travel and Commuting Safety**: The jacket's GPS functionality is highly useful for ensuring the safety of women while commuting or traveling. If a safety concern arises, the location data is sent with the alert, providing emergency responders with the precise location of the user. This feature ensures that even in unfamiliar or isolated locations, help can be summoned quickly.

- **Protection Against Physical Threats**: The proximity sensor detects nearby people or objects, alerting the wearer of any unwanted attention or potential danger. This feature is particularly useful in crowded environments like malls, public events, or when walking through poorly lit areas at night, ensuring that women are aware of their surroundings and can take action to avoid a threat.

- **Domestic and Workplace Safety**: The jacket can also be used by women in their workplaces or homes, providing protection during instances where help is needed. Whether it's a sudden health problem, a fall, or an act of violence, the system can automatically or manually send alerts to appropriate contacts, providing peace of mind in both personal and professional settings.
- **Continuous Health Monitoring for Vulnerable Individuals**: For women with pre-existing health conditions or those who are pregnant, the jacket offers continuous health monitoring of vital signs such as heart rate and body temperature. The real-time monitoring of these parameters can alert caregivers or family members to any significant changes in health, ensuring that medical assistance can be provided promptly when necessary.

- **Preventative Measure Against Workplace Harassment**: The jacket's system can be a useful tool for women in industries or environments where workplace harassment is a concern. The SOS button and proximity sensor can be activated discretely in the event of harassment or unsafe behavior, notifying supervisors or emergency contacts and prompting immediate intervention.

- **Enhanced Outdoor Activity Safety**: Women participating in outdoor activities like hiking, jogging, or cycling can benefit from this safety jacket. If a fall or health emergency occurs during these activities, the system can immediately notify emergency services with the user's GPS coordinates, ensuring a rapid response, especially in remote areas where help may not be immediately available.

- **Peace of Mind for Family and Caregivers**: The jacket can also be beneficial for family members or caregivers, especially for women who live alone or have health concerns. The continuous monitoring and the ability to receive real-time alerts in case of emergencies provide added reassurance for loved ones who may be concerned about their safety and well-being.

- **Wearable Tech in Smart Cities**: As smart city infrastructure becomes more prevalent, wearable technologies like the Women Safety Jacket can be integrated into the broader network of safety and emergency response systems. This can make it easier to track the safety of women in urban environments and provide faster responses from authorities in case of emergencies.

- **Educational and Training Tool**: The jacket can be used in training programs for personal safety or healthcare. It can demonstrate how IoT technology can be used to improve the safety and well-being of individuals in high-risk environments. Schools, universities, or corporate entities could use this as part of safety education programs.

CHAPTER 6

CONCLUSION & FUTURE SCOPE

6.1 CONCLUSION:

In conclusion, the **Women Safety Jacket** project represents a significant advancement in personal safety and health monitoring through the integration of IoT technology. By incorporating sensors like heart rate monitors, temperature sensors, IMU sensors, proximity detectors, and an SOS button, the jacket offers a comprehensive solution to the growing concerns surrounding women's safety, particularly in public spaces, during travel, and in vulnerable situations. The ability to monitor vital health parameters in real time, detect falls, and send immediate alerts to emergency contacts or authorities has the potential to save lives, reduce risks, and provide much-needed peace of mind for both users and their loved ones. While the system offers numerous advantages, such as increased personal security, continuous health monitoring, and automated emergency alerts, it is important to acknowledge potential challenges like battery dependency, connectivity issues, and sensor limitations. Addressing these concerns through further refinement of the technology, ensuring long battery life, and improving system reliability will be essential for maximizing the jacket's effectiveness in real-world applications.

As wearable technologies continue to evolve, the **Women Safety Jacket** stands at the forefront of providing practical, innovative solutions for personal safety. It has the potential to empower women to navigate their environments with confidence, knowing that they have a reliable, smart system in place to protect them. With continued development, testing, and wider adoption, this project can contribute significantly to the growing movement towards safer, smarter cities, and ultimately, a safer world for women.

6.2 FUTURE SCOPE:

- **Integration with Smart City Infrastructure**: As smart cities develop, the jacket can be integrated with existing smart city technologies such as surveillance cameras, emergency response systems, and public alert systems. This integration would allow for more seamless communication between the user and local authorities, enhancing real-time response times and ensuring broader coverage in emergencies.

- **Advanced Health Monitoring**: The health monitoring features can be expanded to include additional sensors, such as blood oxygen levels, ECG (electrocardiogram), or even glucose levels for users with specific health needs. By adding more medical sensors, the jacket could become a comprehensive health monitoring device, providing constant updates on various vital parameters.

- **Machine Learning and AI Integration**: With the addition of machine learning algorithms, the system could become smarter over time, learning to detect patterns in the user's health and behavior. This could help predict potential health emergencies, such as a heart attack or stroke, based on prior data trends, and send preemptive alerts to the user or caregivers.

- **AI-Driven Threat Detection**: Advanced AI could be incorporated to analyze data from the proximity sensor and other environmental sensors to more accurately detect threats and unsafe situations. For example, it could use facial recognition or other pattern recognition technologies to identify potential threats based on unusual behavior, like someone following the user too closely.

- **Wearable Power Management**: As the system becomes more sophisticated, power management will be a key challenge. Future versions of the jacket could incorporate energy-harvesting technologies, such as solar panels or kinetic energy converters, to extend battery life and make the jacket more sustainable.

- **Seamless Integration with Other Wearable Devices**: In the future, the Women Safety Jacket could be designed to work in tandem with other wearable devices, such as smartwatches, fitness trackers, or even health-monitoring implants. This would provide a more comprehensive picture of the user's health and safety in real time.

- **Customizable User Experience**: Future versions could allow users to customize their safety settings in more detail, such as defining specific parameters for when alerts should be sent or even providing options for automatic emergency contact selection. The jacket could have personalized responses for different user profiles, based on health history, location, or preferences.

- **Global Tracking and Multinational Communication**: The jacket's GPS functionality could be expanded to include global tracking, allowing users to send alerts internationally in case of emergencies. This could be particularly useful for women traveling abroad or in situations where they might not be familiar with their surroundings or language.

- **Smart Fabric and Comfort Enhancements**: Future iterations could improve the physical design of the jacket to make it more comfortable and stylish while still integrating sensors and technology. The fabric could be designed with advanced materials that are lightweight, breathable, and waterproof while housing embedded sensors seamlessly.

- **Real-time Audio and Video Communication**: Future versions of the jacket could incorporate real-time audio or video communication features, allowing users to directly communicate with emergency services or loved ones through a built-in microphone or camera. This would enable more precise communication in emergencies.

- **Social and Community Integration**: The jacket could be expanded to allow social and community integration, where users can form safety networks with other women or people in their area. For example, users could send out safety signals to a trusted group or share real-time updates of their location when they feel threatened.

- **Legal and Social Awareness**: The project could have a larger role in promoting awareness about women's safety issues. It could be integrated with legal systems for faster reporting of crimes or harassment, and also collaborate with social platforms to raise awareness on safety-related concerns.

6.3 REFERENCES:

[1]. IMU sensor: https://en.wikipedia.org/wiki/Inertial_measurement_unit

[2]. Blynk: https://blynk.io/

[3]. Study of women safety: https://timesofindia.indiatimes.com/india/india-records-51-cases-of-crime-against-women-every-hour-over-4-4-lakh-cases-in-2022-ncrb-report/articleshow/105731269.cms

[4]. sending messages through email: https://support.google.com/websearch/answer/4815696?hl=en

CODE

```
#include <Arduino.h>
#if defined(ESP32)
  #include <WiFi.h>
#elif defined(ESP8266)
  #include <ESP8266WiFi.h>
#endif
#include <ESP_Mail_Client.h>

#include "secrets.h"
#define BLYNK_TEMPLATE_ID "TMPL3x-rZ3JLj"
#define BLYNK_TEMPLATE_NAME "Women Safety Device"
#define BLYNK_AUTH_TOKEN "cCGezmrQm9V04DSSrrF-vFxC73wauOLD"

/* Comment this out to disable prints and save space */
#define BLYNK_PRINT Serial

#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>
BlynkTimer timer;

#include "gps.h"
#include <Wire.h>
#include <Adafruit_BMP085.h>
#include "MAX30105.h"
#include "heartRate.h"

/* Declare the global used SMTPSession object for SMTP transport */
SMTPSession smtp;

Adafruit_BMP085 bmp;
MAX30105 particleSensor;
```

```
const byte RATE_SIZE = 4; //Increase this for more averaging. 4 is good.
byte rates[RATE_SIZE]; //Array of heart rates
byte rateSpot = 0;
long lastBeat = 0; //Time at which the last beat occurred

float beatsPerMinute;
int beatAvg;

const int BUTTON = 16;
const int SENSOR = 2;

int isreadyTosend = 1;

void setup()
{
 Serial.begin(9600);
 Serial.println("Initializing...");

 pinMode(BUTTON, INPUT);
 pinMode(SENSOR, INPUT);

 if (!bmp.begin()) {
  Serial.println("No BMP180 / BMP085");// we dont wait for this
  while (1) {}
 }

 // Initialize sensor
 if (!particleSensor.begin(Wire, I2C_SPEED_FAST)) //Use default I2C port, 400kHz
speed
 {
  Serial.println("MAX30102 was not found. Please check wiring/power. ");
  while (1);
 }
 Serial.println("Place your index finger on the sensor with steady pressure.");
```

```
  particleSensor.setup(); //Configure sensor with default settings
  particleSensor.setPulseAmplitudeRed(0x0A); //Turn Red LED to low to indicate
sensor is running
  particleSensor.setPulseAmplitudeGreen(0); //Turn off Green LED

  WiFi.begin(WIFI_SSID, WIFI_PASSWORD);
  Serial.print("Connecting to Wi-Fi");
  while (WiFi.status() != WL_CONNECTED){
    Serial.print(".");
    delay(300);
  }
  Serial.println();
  Serial.print("Connected with IP: ");
  Serial.println(WiFi.localIP());
  Serial.println();

  // Connect to Blynk server
  Blynk.begin(BLYNK_AUTH_TOKEN, WIFI_SSID, WIFI_PASSWORD);
  timer.setInterval(5000L, uploadData);

  delay(3000);
}


void uploadData()
{
  float temp = bmp.readTemperature();
  Serial.print(" Temp=");
  Serial.print(temp);
  Blynk.virtualWrite(V0, temp);

  Serial.print("BPM=");
  Serial.print(beatsPerMinute);
```

```
  Blynk.virtualWrite(V1, beatsPerMinute);

  // Read GPS
  gps_read();
  Serial.println(latitude);
  Serial.println(longitude);
  String loc_link = "\nLocation:\nhttps://www.google.co.in/maps/search/" +
String(latitude, 6) + ',' + String(longitude, 6);
  Serial.println(loc_link);

  Blynk.virtualWrite(V2, latitude);
  Blynk.virtualWrite(V3, longitude);

}

/* Callback function to get the Email sending status */
void smtpCallback(SMTP_Status status){
  /* Print the current status */
  Serial.println(status.info());

  /* Print the sending result */
  if (status.success()){
    // ESP_MAIL_PRINTF used in the examples is for format printing via debug Serial
port
    // that works for all supported Arduino platform SDKs e.g. AVR, SAMD, ESP32
and ESP8266.
    // In ESP8266 and ESP32, you can use Serial.printf directly.

    Serial.println("----------------");
    ESP_MAIL_PRINTF("Message sent success: %d\n", status.completedCount());
    ESP_MAIL_PRINTF("Message sent failed: %d\n", status.failedCount());
    Serial.println("----------------\n");

    for (size_t i = 0; i < smtp.sendingResult.size(); i++)
```

```
    {
      /* Get the result item */
      SMTP_Result result = smtp.sendingResult.getItem(i);

      // In case, ESP32, ESP8266 and SAMD device, the timestamp get from
result.timestamp should be valid if
      // your device time was synched with NTP server.
      // Other devices may show invalid timestamp as the device time was not set i.e. it
will show Jan 1, 1970.
      // You can call smtp.setSystemTime(xxx) to set device time manually. Where xxx
is timestamp (seconds since Jan 1, 1970)

      ESP_MAIL_PRINTF("Message No: %d\n", i + 1);
      ESP_MAIL_PRINTF("Status: %s\n", result.completed ? "success" : "failed");
      ESP_MAIL_PRINTF("Date/Time: %s\n",
MailClient.Time.getDateTimeString(result.timestamp, "%B %d, %Y
%H:%M:%S").c_str());
      ESP_MAIL_PRINTF("Recipient: %s\n", result.recipients.c_str());
      ESP_MAIL_PRINTF("Subject: %s\n", result.subject.c_str());
    }
    Serial.println("----------------\n");

    // You need to clear sending result as the memory usage will grow up.
    smtp.sendingResult.clear();
  }
}

void sendEmail()
{
/*  Set the network reconnection option */
  MailClient.networkReconnect(true);

  /** Enable the debug via Serial port
   * 0 for no debugging
```

```
  * 1 for basic level debugging
  *
  * Debug port can be changed via ESP_MAIL_DEFAULT_DEBUG_PORT in
ESP_Mail_FS.h
  */
 smtp.debug(1);

 /* Set the callback function to get the sending results */
 smtp.callback(smtpCallback);

 /* Declare the Session_Config for user defined session credentials */
 Session_Config config;

 /* Set the session config */
 config.server.host_name = SMTP_HOST;
 config.server.port = SMTP_PORT;
 config.login.email = AUTHOR_EMAIL;
 config.login.password = AUTHOR_PASSWORD;
 config.login.user_domain = "";

 /*
 Set the NTP config time
 For times east of the Prime Meridian use 0-12
 For times west of the Prime Meridian add 12 to the offset.
 Ex. American/Denver GMT would be -6. 6 + 12 = 18
 See https://en.wikipedia.org/wiki/Time_zone for a list of the GMT/UTC timezone
offsets
 */
 config.time.ntp_server = F("pool.ntp.org,time.nist.gov");
 config.time.gmt_offset = 3;
 config.time.day_light_offset = 0;

 /* Declare the message class */
 SMTP_Message message;
```

```
  /* Set the message headers */
  message.sender.name = F("ESP");
  message.sender.email = AUTHOR_EMAIL;
  message.subject = F("Women Safety Email - Danger!");
  message.addRecipient(F("POC"), RECIPIENT_EMAIL);

  //Send raw text message
  String textMsg = "\nLocation:\nhttps://www.google.co.in/maps/search/" +
String(latitude, 6) + ',' + String(longitude, 6);
  message.text.content = textMsg.c_str();
  message.text.charSet = "us-ascii";
  message.text.transfer_encoding = Content_Transfer_Encoding::enc_7bit;

  message.priority = esp_mail_smtp_priority::esp_mail_smtp_priority_low;
  message.response.notify = esp_mail_smtp_notify_success |
esp_mail_smtp_notify_failure | esp_mail_smtp_notify_delay;


  /* Connect to the server */
  if (!smtp.connect(&config)){
    ESP_MAIL_PRINTF("Connection error, Status Code: %d, Error Code: %d, Reason:
%s", smtp.statusCode(), smtp.errorCode(), smtp.errorReason().c_str());
    return;
  }

  if (!smtp.isLoggedIn()){
    Serial.println("\nNot yet logged in.");
  }
  else{
    if (smtp.isAuthenticated())
      Serial.println("\nSuccessfully logged in.");
    else
      Serial.println("\nConnected with no Auth.");
```

```
 }

 /* Start sending Email and close the session */
 if (!MailClient.sendMail(&smtp, &message))
   ESP_MAIL_PRINTF("Error, Status Code: %d, Error Code: %d, Reason: %s",
smtp.statusCode(), smtp.errorCode(), smtp.errorReason().c_str());

}


void loop()
{
 //Run the Blynk library
 Blynk.run();
   timer.run();

   long irValue = particleSensor.getIR();

   if (checkForBeat(irValue) == true)
   {
   //We sensed a beat!
   long delta = millis() - lastBeat;
   lastBeat = millis();

   beatsPerMinute = 60 / (delta / 1000.0);

   if (beatsPerMinute < 255 && beatsPerMinute > 20)
   {
     rates[rateSpot++] = (byte)beatsPerMinute; //Store this reading in the array
     rateSpot %= RATE_SIZE; //Wrap variable

     //Take average of readings
     beatAvg = 0;
     for (byte x = 0 ; x < RATE_SIZE ; x++)
```

```
    beatAvg += rates[x];
   beatAvg /= RATE_SIZE;
  }
  }

  if (irValue < 50000)
   Serial.println(" No finger? ");


  if ((digitalRead(BUTTON) == LOW) || (digitalRead(SENSOR) == LOW))
  {
   if (isreadyTosend)
   {
    Serial.println(" ### Sending Email ###");
    sendEmail();
    isreadyTosend = 0;
   }
  }
}
```