University of Moratuwa
Department of Electronic and Telecommunication Engineering

FINAL REPORT

ClicGuard

An Alerting and Tracking Device

Electronic Design and Realization

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Due Date – 2023.07.25

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1. Abstract

This report presents the individual project "ClicGuard," an emergency alerting and tracking device with the aim of revolutionizing personal safety and security. The project's main motivation, design points, methodology, and eye-catching results are outlined in this document. Driven by the urgent need for a more reliable and efficient safety solution, ClicGuard was meticulously developed to seamlessly integrate cutting-edge technologies into a compact and user-friendly device. The primary objective was to empower individuals with a comprehensive tool that combines real-time emergency alerts, precise GPS tracking, encryption and two-way communication capabilities. The report highlights ClicGuard's unique proposition compared to existing solutions, showcasing its instantaneous alerting system and accurate location tracking, positioning it as a game-changer in the market. Detailed technical sections delve into the device's design and calculations, supported by clear figures and diagrams. Challenges faced during project development are candidly discussed, and thoughtful recommendations for future enhancements are provided. ClicGuard's project management strategy, including task breakdown and the individual contributions made, is outlined alongside the project results and analysis. The report concludes with a summary of individual contributions, underscoring the significance of ClicGuard in ensuring personal safety. Additionally, the document includes references, budget details, and appendices with supplementary project information, offering a comprehensive understanding of the project. With ClicGuard, users can confidently embrace enhanced safety and peace of mind in their daily lives.

2. Introduction of the Product

2.1 Description of the Product

In various outdoor environments and remote locations, including forests, mountains, and rural areas, there exists a diverse group of individuals facing unique safety challenges. This project aims to address the safety concerns of outdoor adventurers like hikers and campers, fishermen, farmers living near forest areas, villagers residing in proximity to dangerous locations, forest officers, security personnel, elderly vulnerable individuals, factory workers, and event organizing security teams. The targeted population is exposed to a wide range of potential hazards, including accidents, natural disasters, wildlife encounters, and security threats. Existing safety measures often fall short in providing timely and effective assistance in these challenging settings. The project's main objective is to design and develop "ClicGuard," an advanced emergency alerting and tracking device tailored to the specific needs of these diverse groups. ClicGuard will offer a comprehensive solution that seamlessly integrates real-time emergency alerts, precise GPS tracking, and two-way communication capabilities, catering to the distinct requirements of each user segment. By empowering outdoor adventurers, villagers, forest officers, and others with ClicGuard's innovative features, such as instantaneous alerting systems and accurate location tracking, the project aims to revolutionize personal safety and security in these remote environments. Moreover, ClicGuard will be designed with user-friendliness and reliability in mind, ensuring elderly and vulnerable individuals can also benefit from its intuitive interface. With the successful implementation of ClicGuard, this project to enhance the safety and well-being of outdoor enthusiasts, workers, and residents in challenging environments, offering them peace of mind and a powerful tool for quick response during emergencies.

Used For,

- **Outdoor Adventurers like Hikers and campers**
- **Fishermen**
- **Farmers living near Forest areas.**
- **Villagers living near dangerous areas.**
- **Forest Officers**
- **Security Personnels / Security Guards**
- **Elderly Vulnerable Individuals**
- **Factories Workers**
- **Event Organizing Security Teams**

2.2 Motivation

The motivation behind developing "ClicGuard" is driven by a genuine concern for the safety and well-being of individuals in various challenging environments. The following factors serve as the core reasons for pursuing this innovative emergency alerting and tracking device.

Safety Gaps in Remote Locations
Outdoor adventurers, fishermen, farmers, villagers, forest officers, and others often find themselves operating in remote and isolated areas where traditional means of communication may be unreliable or unavailable. In such settings, immediate access to emergency assistance and the ability to alert authorities swiftly become critical factors in ensuring personal safety.

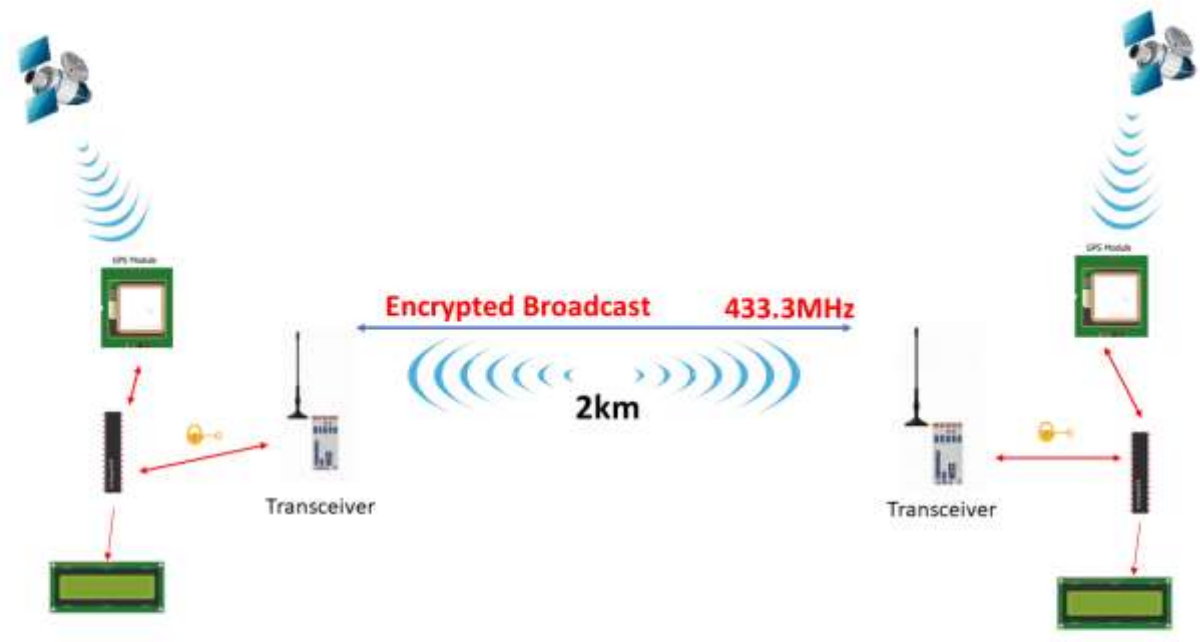
Rapid Response in Emergencies
Accidents, natural disasters, wildlife encounters, or security threats can occur unexpectedly in these challenging environments. During such emergencies, time is of the essence, and quick response can be a matter of life or death. ClicGuard aims to bridge response gaps and provide a prompt and efficient emergency alerting system, ensuring timely assistance when needed the most.

Protecting Vulnerable Individuals
Elderly individuals and those living in dangerous areas require extra safety measures to protect them from potential risks. ClicGuard's user-friendly design and features will cater to the needs of vulnerable populations, providing them with a reliable lifeline to alert their contacts or emergency services in case of any danger or distress.

Ensuring Workplace Safety
Factory workers and event organizing security teams often operate in high-risk environments, where accidents or security breaches can occur. ClicGuard's comprehensive safety features will enhance workplace safety by offering a reliable means of communication and immediate emergency response in critical situations.

Empowering Individuals
By providing a single device that seamlessly integrates emergency alerting and GPS tracking, ClicGuard empowers individuals to take charge of their personal safety. Whether exploring the outdoors or living in hazardous areas, users can confidently embrace enhanced safety and peace of mind with ClicGuard by their side.

3. Features and Specifications



3.1 Real-Time Emergency Alerts

In Emergency Mode, the electronic device is equipped with a dedicated alert button that allows users to trigger real-time emergency alerts. When the alert button is pressed, the device initiates an immediate distress signal transmission to all other devices within a 2km range in open space. This ensures that nearby users are promptly notified of the emergency.

3.2 Precise GPS Tracking

The electronic device utilizes a GPS module with an accuracy of 10m. In Tracking Mode, the device continuously transmits its precise GPS location data. This enables receivers to accurately track the device's movements in real-time, ensuring that the user's location can be precisely determined.

3.3 Two-Way Communication

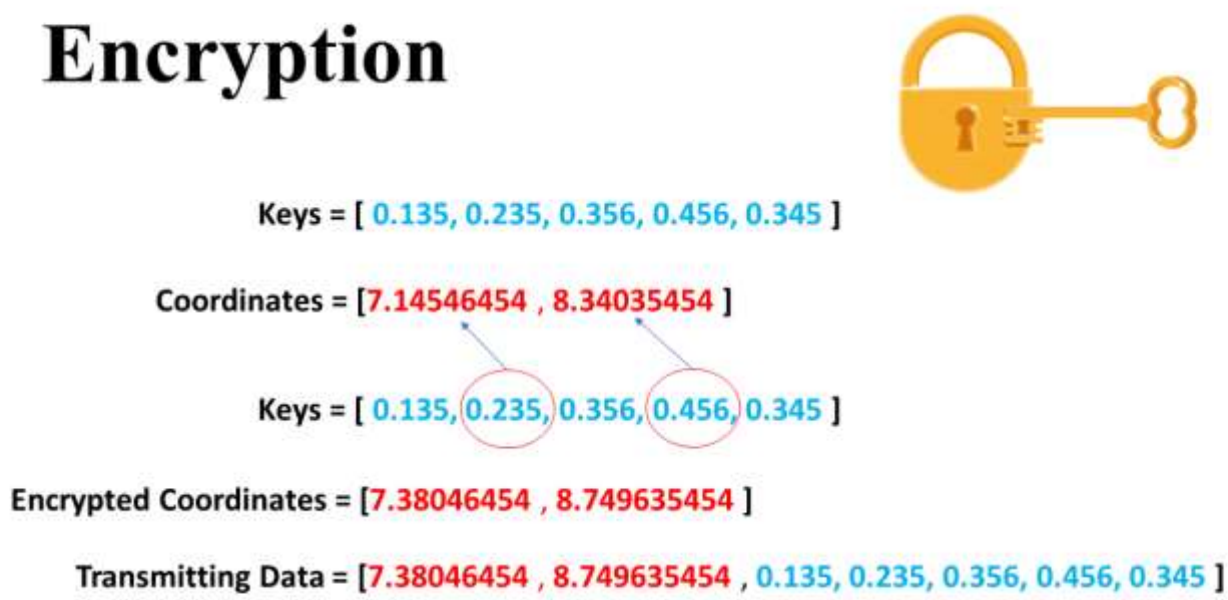
The device is equipped with an HC12 module, enabling two-way communication between devices. This means that in addition to receiving emergency alerts or location data, users can also communicate with each other through the device. The two-way communication capability enhances the overall functionality and usability of the device.

3.4 Instantaneous Alerting System

When an emergency alert is sent from one device, all other devices within the 2km range receive the distress signal instantaneously. The device's alerting system is designed to minimize any delays in transmitting and receiving emergency alerts, ensuring that the information reaches all relevant parties as quickly as possible.

3.5 Encrypted Data Transfer

To ensure the security and privacy of the transmitted data, both Emergency Mode distress signals and Tracking Mode location data are encrypted. The encryption method employed in the device prevents unauthorized access to the information, making the data transfer secure and confidential.



3.6 Specifications

1. **Working Frequency – 433.3 MHz**
2. **Dimension – $90\mathrm{mm} \times 140\mathrm{mm} \times 50\mathrm{mm}$**
3. **Weight – 520g**
4. **Working range – 400- 1000m (Clear line of sight)**
5. **Battery – 2 Li-ion 18650 3200mAh Battery.**
6. **Working Hour – 6hrs (considerable Communication), 8hrs (few communication), 9hrs (Standby).**
7. **Voltage Rate – 7V - 9V**
8. **Power Rate- 2W-2.9W**
9. **Battery level indication (High(H), A(Average), L(Low))**
10. **Current Rate-300-350mA**
11. **Display – LCD 16 $\times$ 2**
12. **No water resistant**
13. **Colour- Black**
14. **Initialization time – 2- 3mins.**

Warning

Don’t use batteries other than lithium ion 18650. Higher than 3000maH is preferred.

This has Two modes.

1. **Emergency Mode.**
2. **Tracking Mode**

Emergency Mode

1. Displays displacement of transmitter with accuracy 10m with bearing.
2. Alerting duration 1 minutes.
4. Can be review last alert with received time.
5. Encrypted Broadcasting message.
6. Automatic Standby.

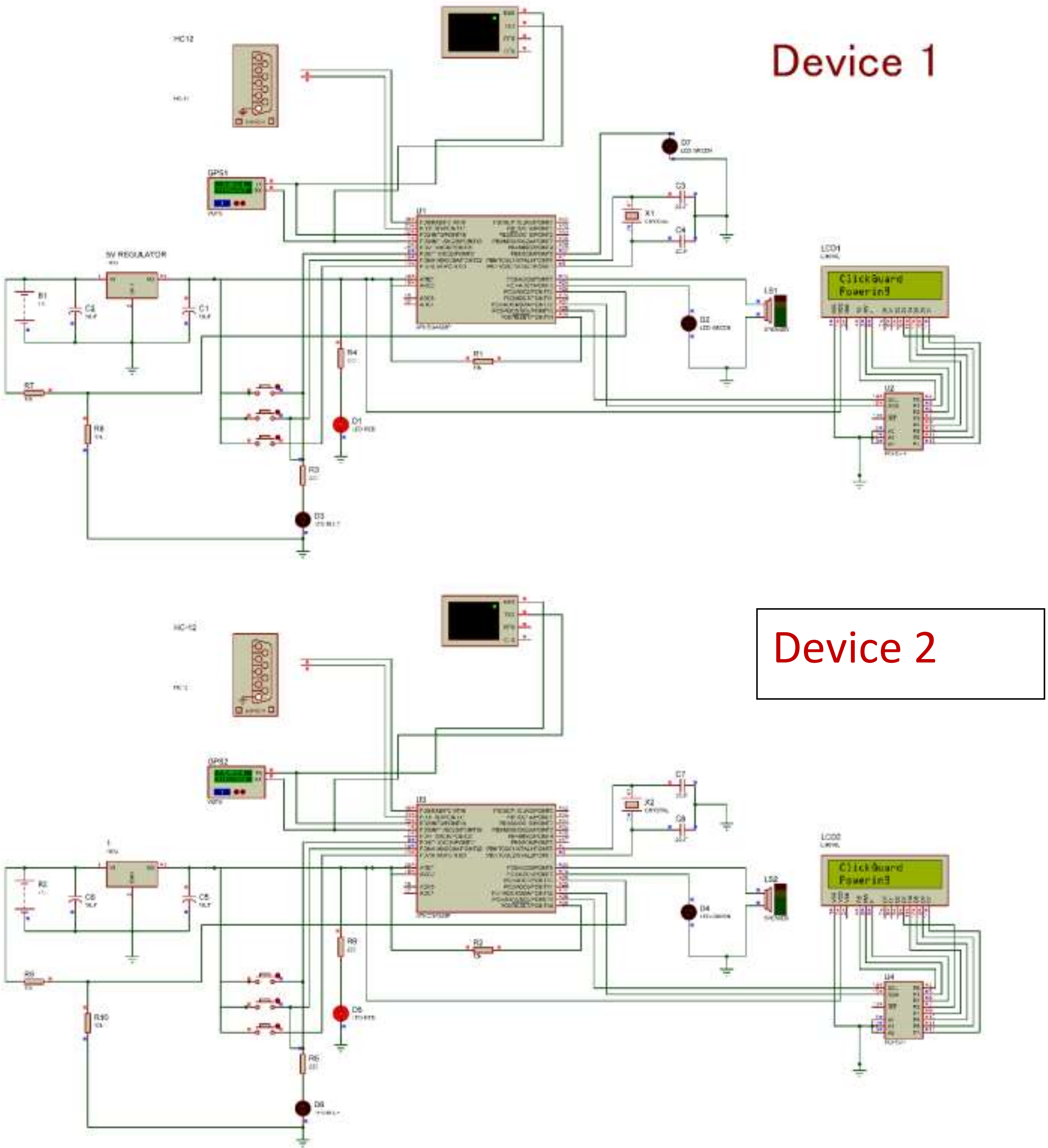
Tracking Mode

1. **Can use as location tracker with displacement and bearing.**
2. **This has two options sending and receiving.**
3. **Capable to continuously send/receive with accuracy 10m with bearing in respective above modes.**
4. **Capable to track multiple devices parallelly using a switch.**
5. **Encrypted.**
6. **Automatic Standby.**

4. Circuit Designs

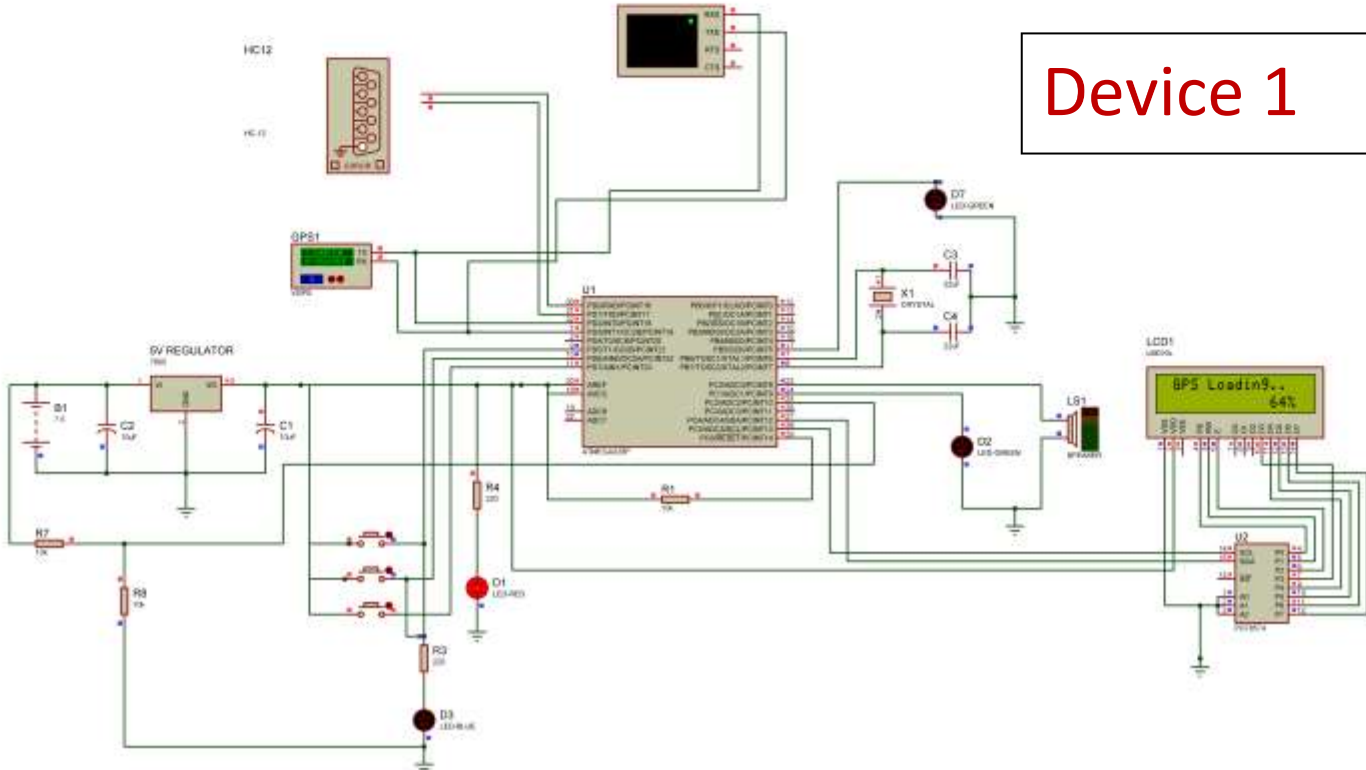
4.1 Proteus Circuit Design and Simulations

Devices are Initializing at the beginning.

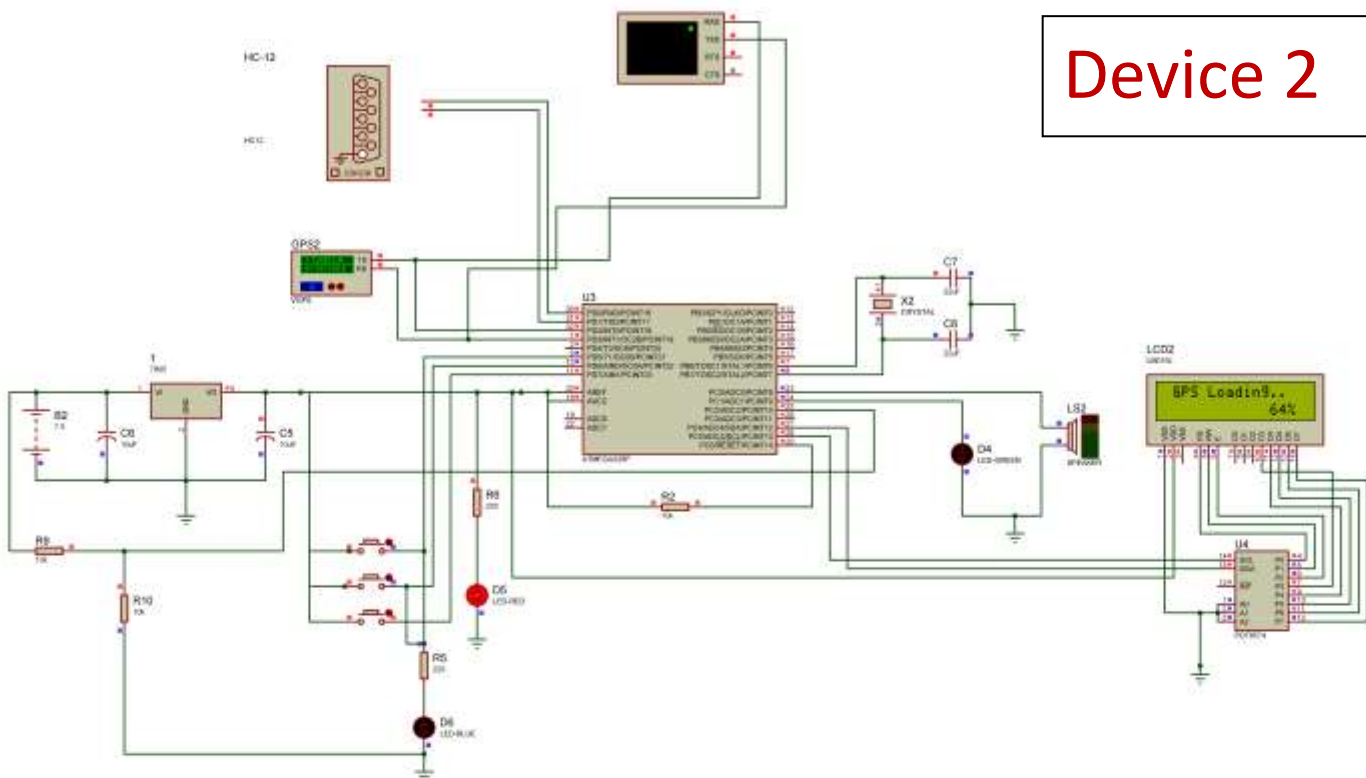


It takes less than 3 minutes to update their GPS. And battery level also displayed here.

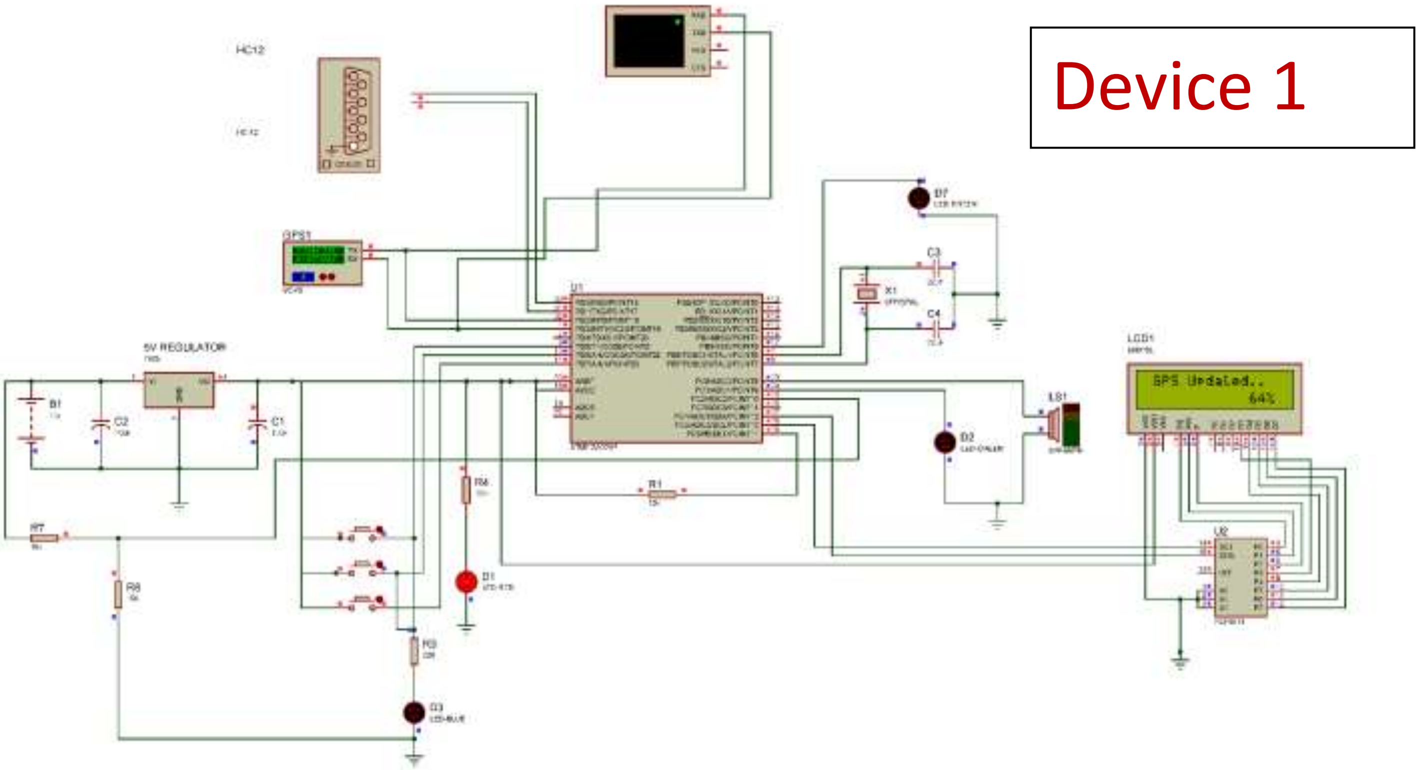
Device 1

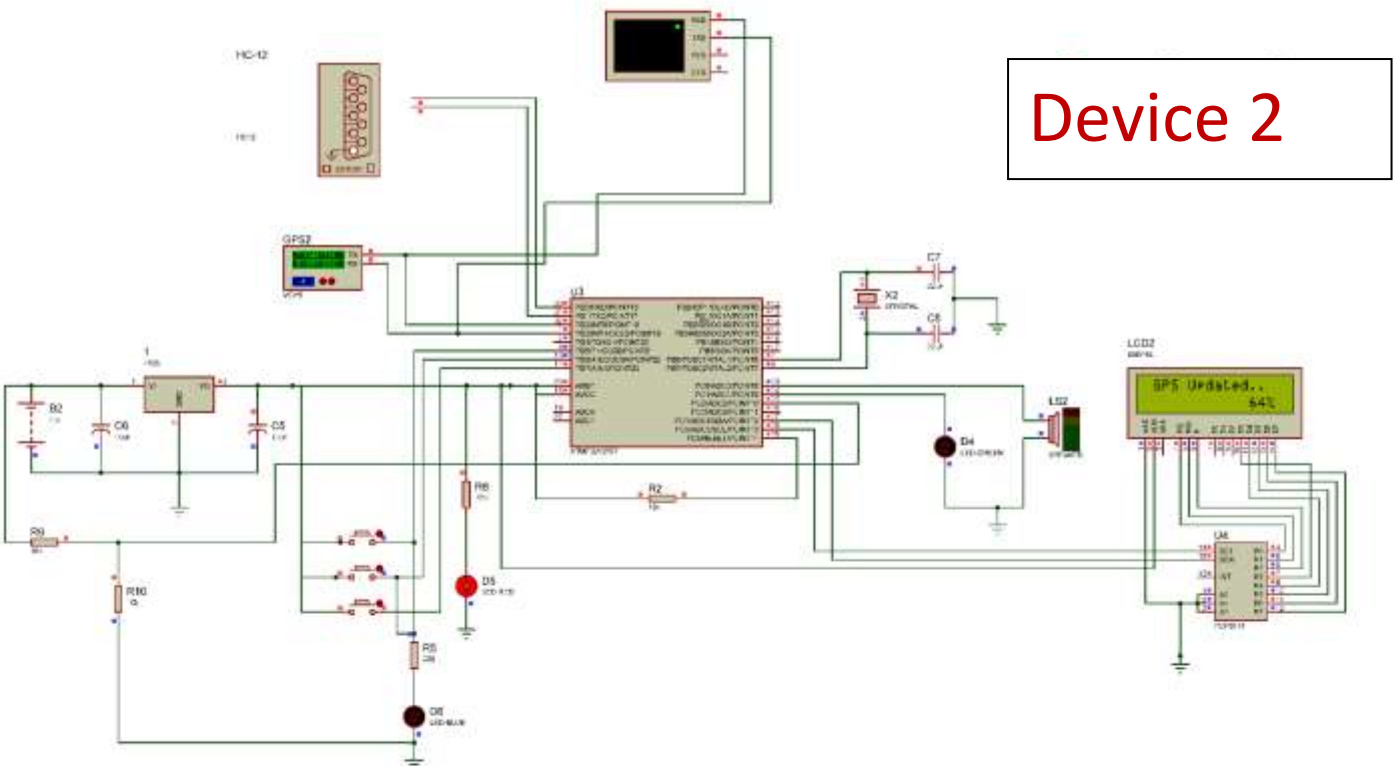


Device 2

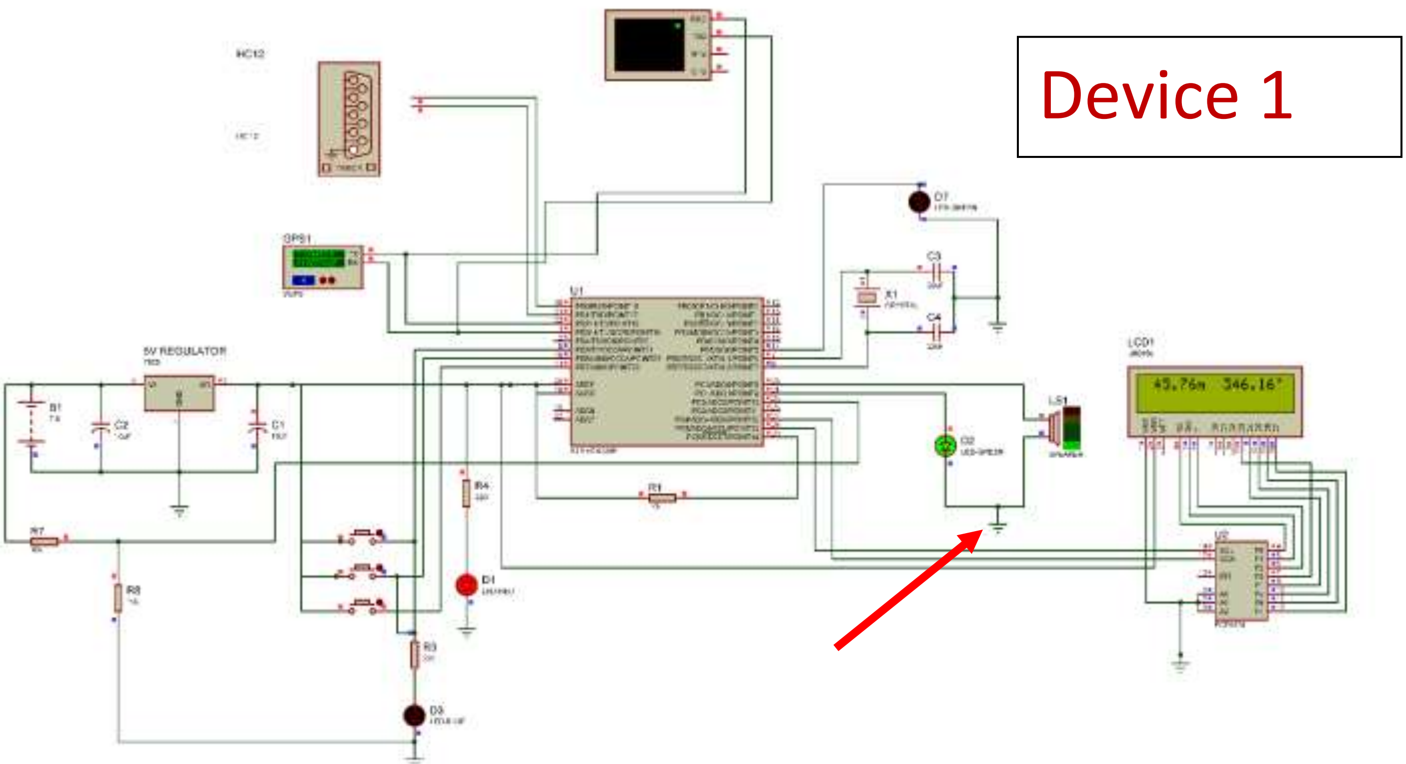


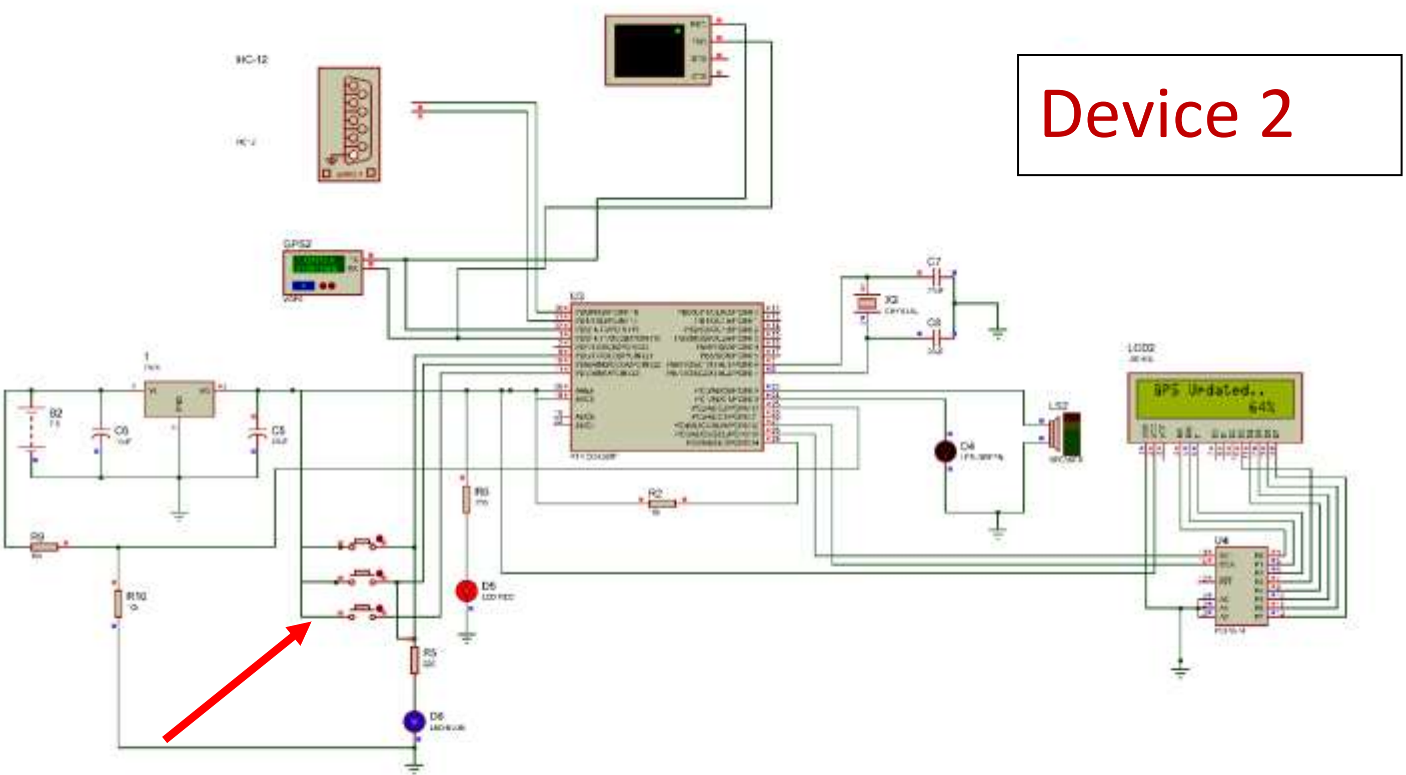
GPS coordinates are updated with battery level. Now the devices are ready to receive alerts from similar device.



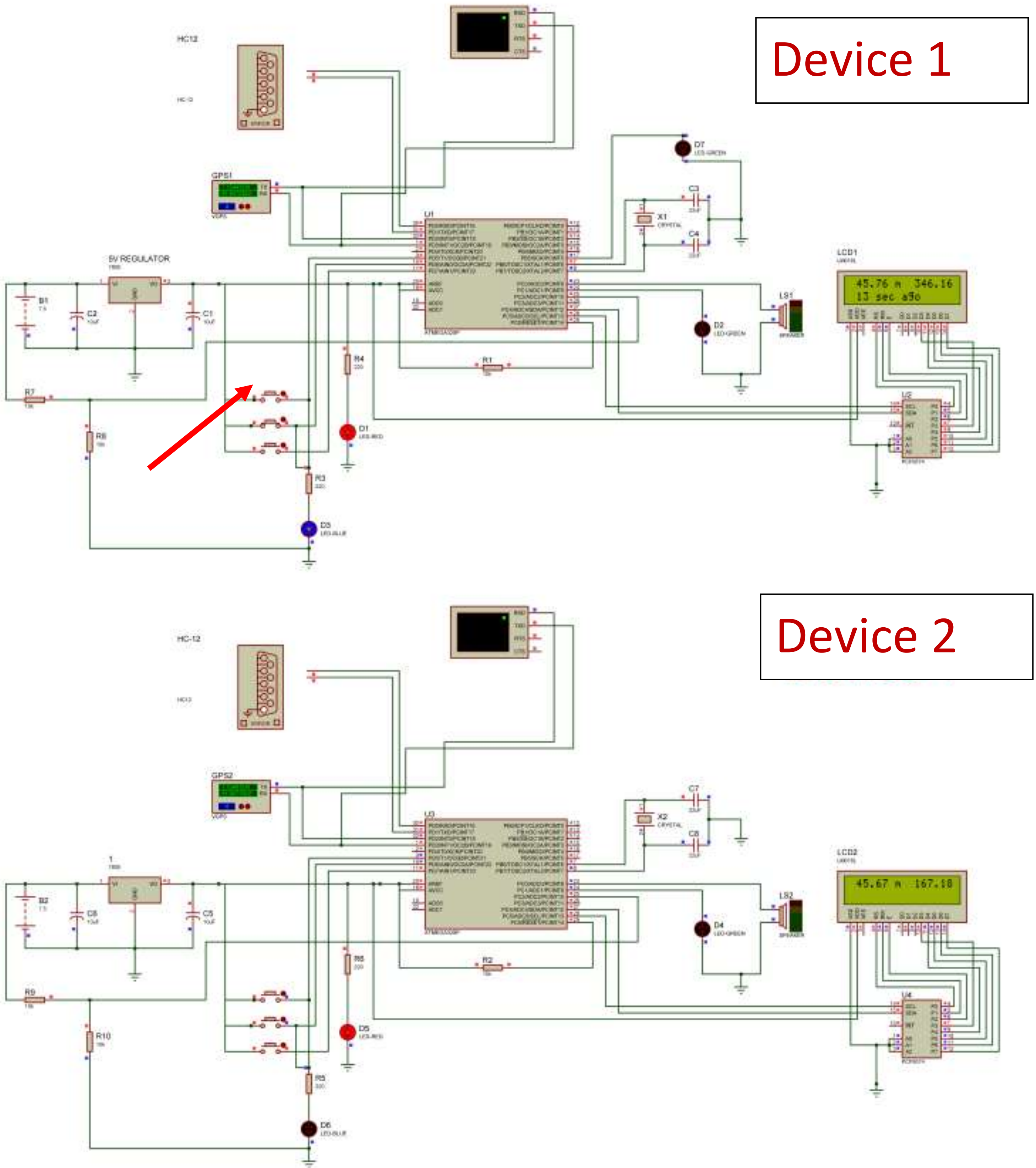


Here let device 2 is transmitter. When device 2 **Alert** button was pressed, it transmits its own encrypted GPS coordinates with key. The device 1 (Receiver) got the GPS when it is within maximum range 700-850m and calculate the distance, bearing and display it in display. In addition to that, during alerts buzzer and LED blinks for 1 minutes. Likewise multiple devices can receive this. The accuracy is 10m.

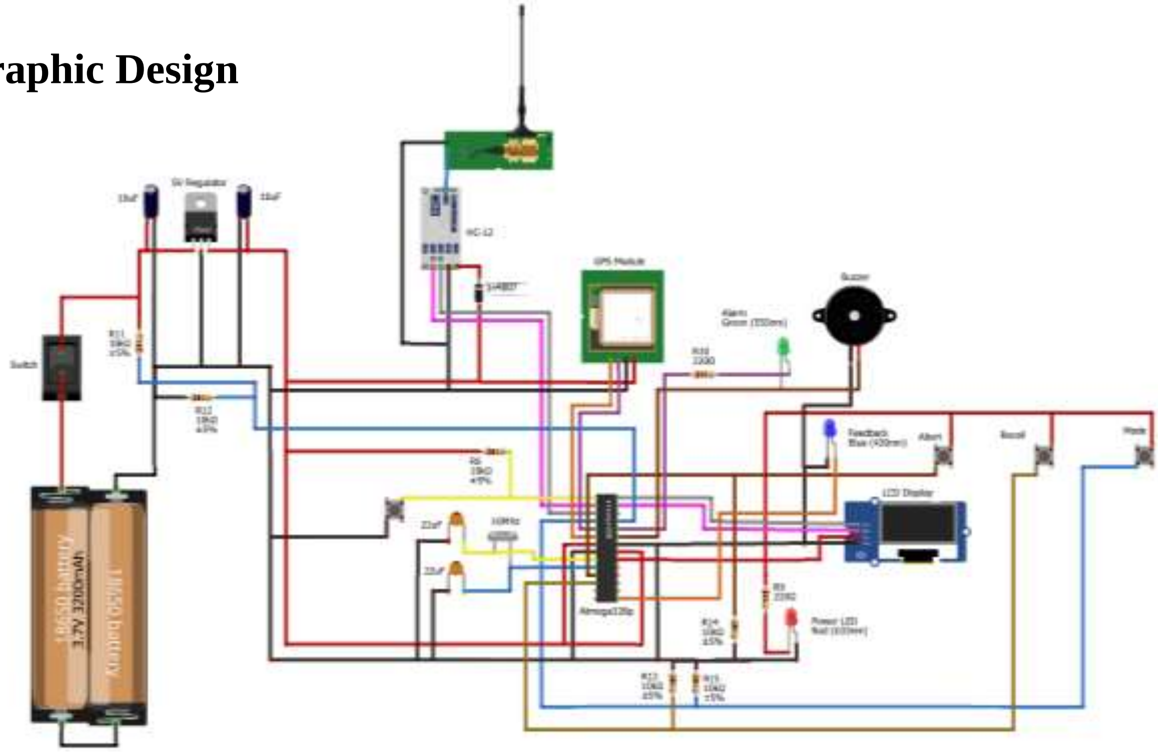




When a person misses any alerts while the device is not with him. He can use **Recall** button to check the last alerts with time deference.

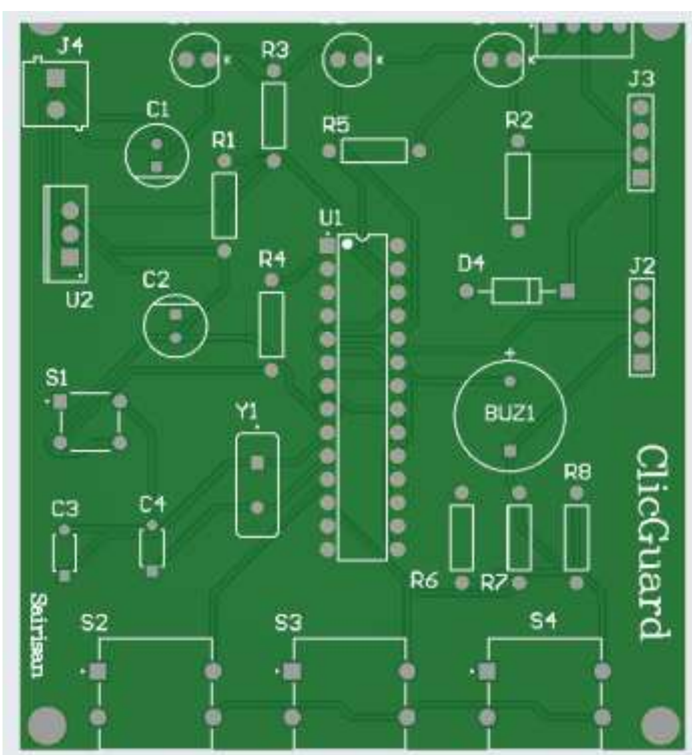


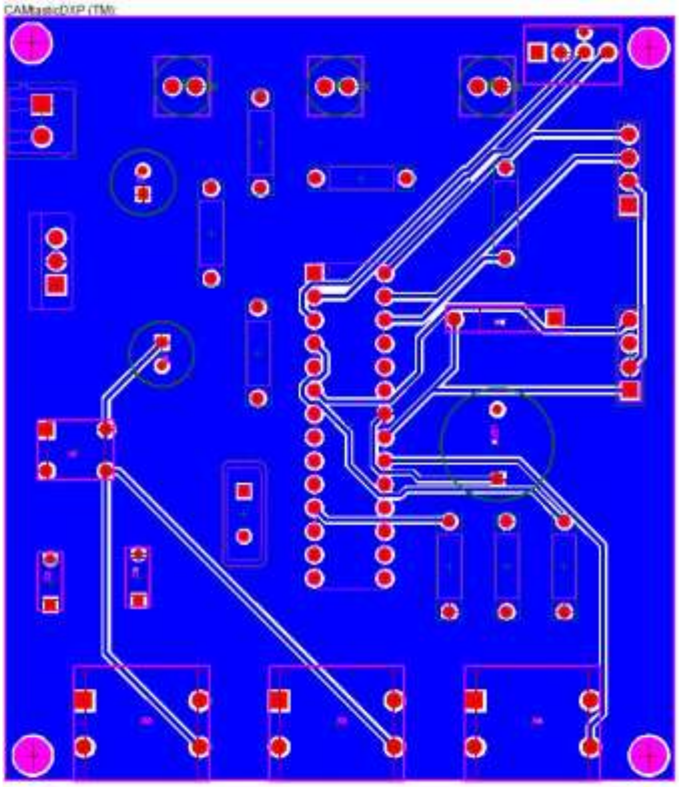
4.2 Graphic Design

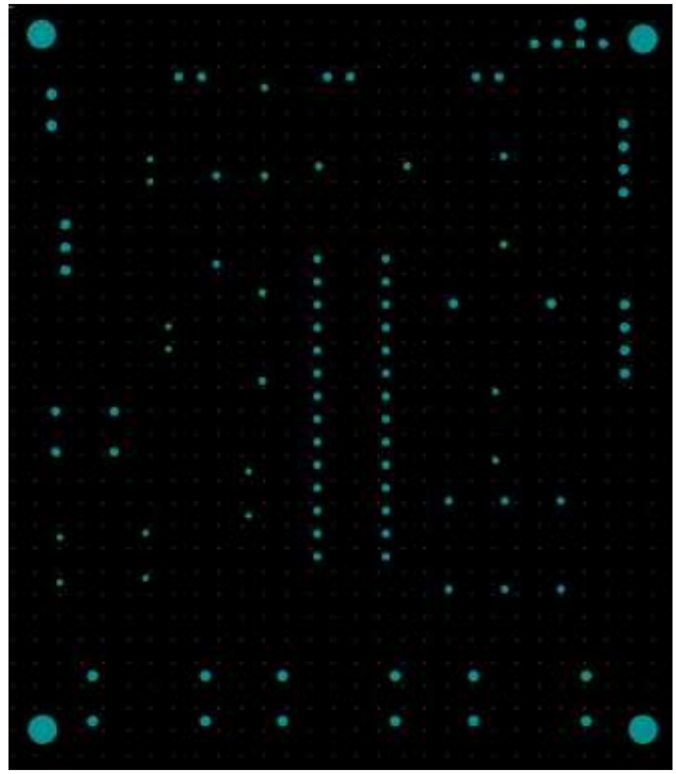


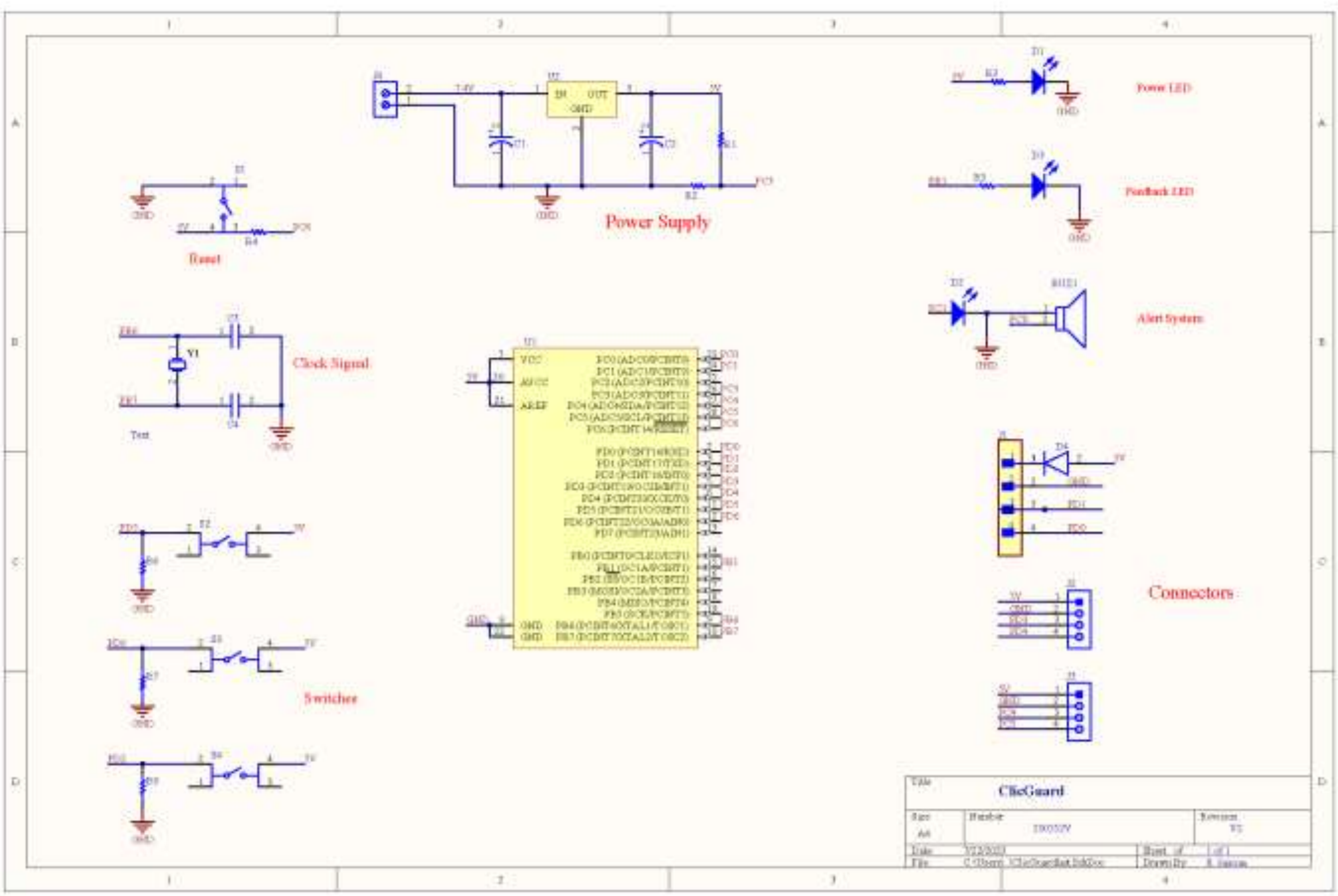
Designed by Software Fritizing

4.3 PCB Design and Gerber Files




CAMtasticDXP (TM)

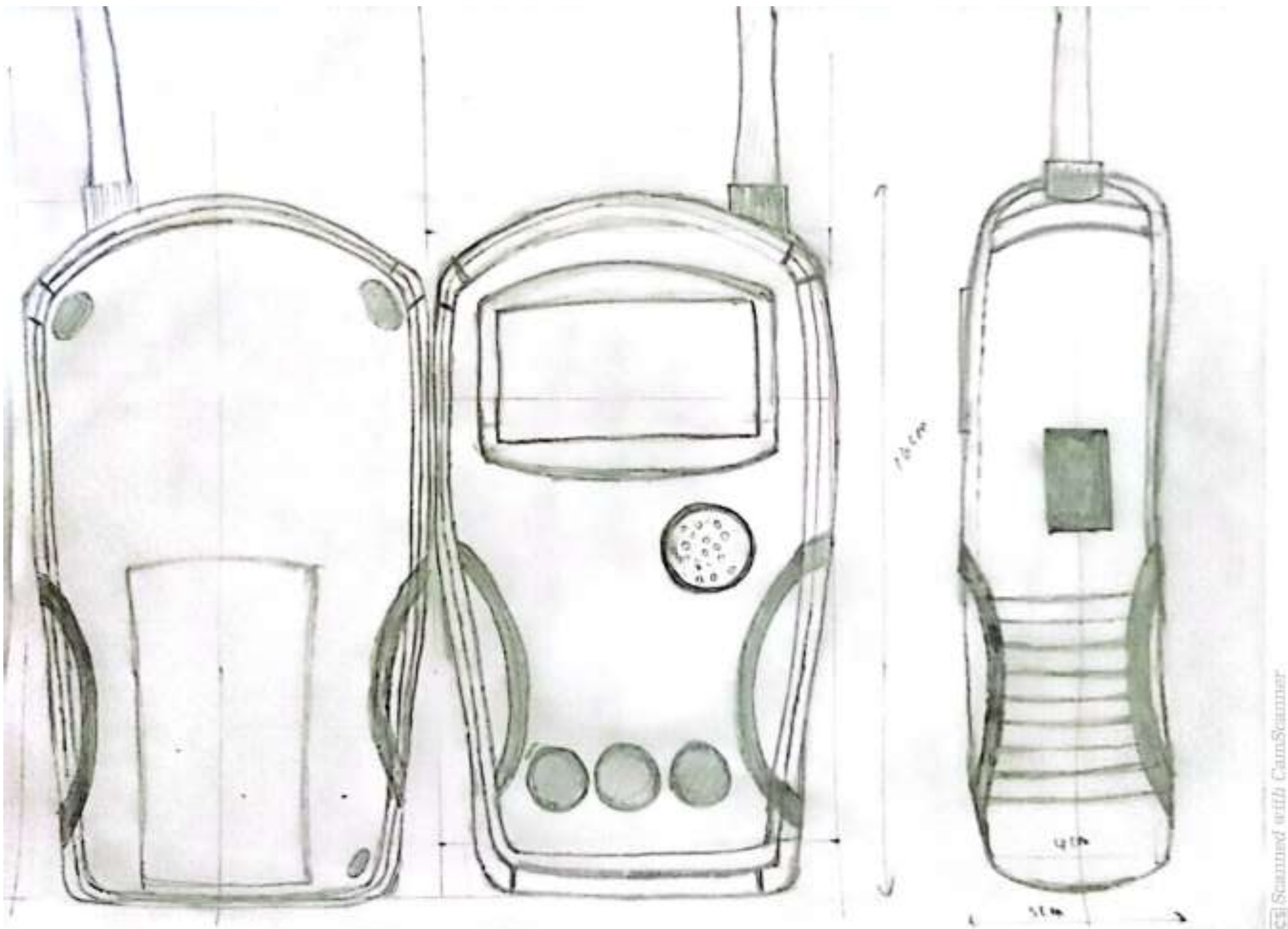


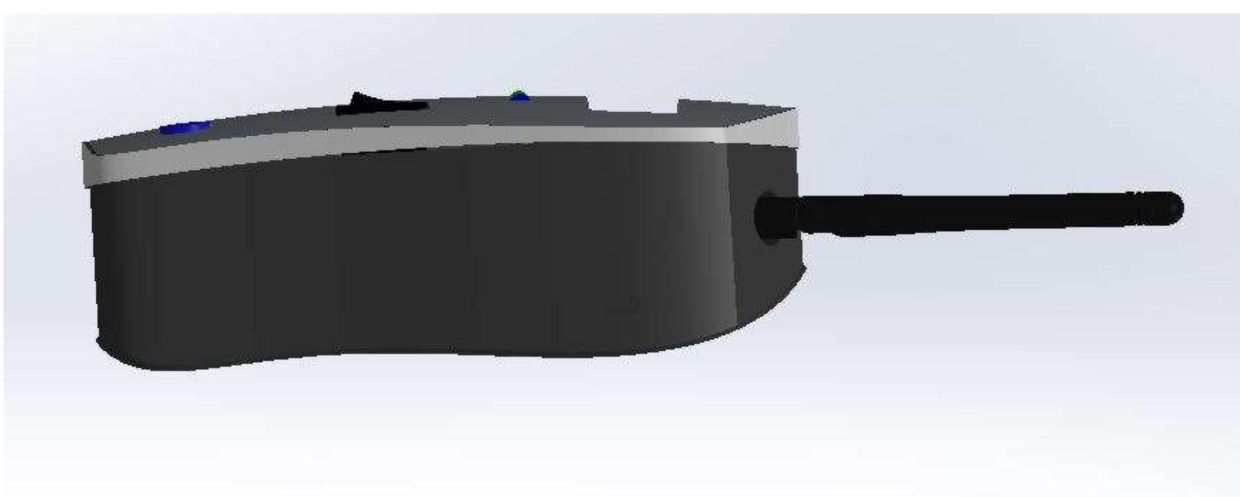

Power Supply
Reset
Clock Signal
Switches
Power LED
Feedback LED
Alert System
Connectors
ClicGuard


D2
D3
R3
C1
R1
R5
R2
J3
U1
R4
D4
J2
U2
S1
Y1
C3
C4
R8
R6
R7
ClicGuard
S2
S3
S4

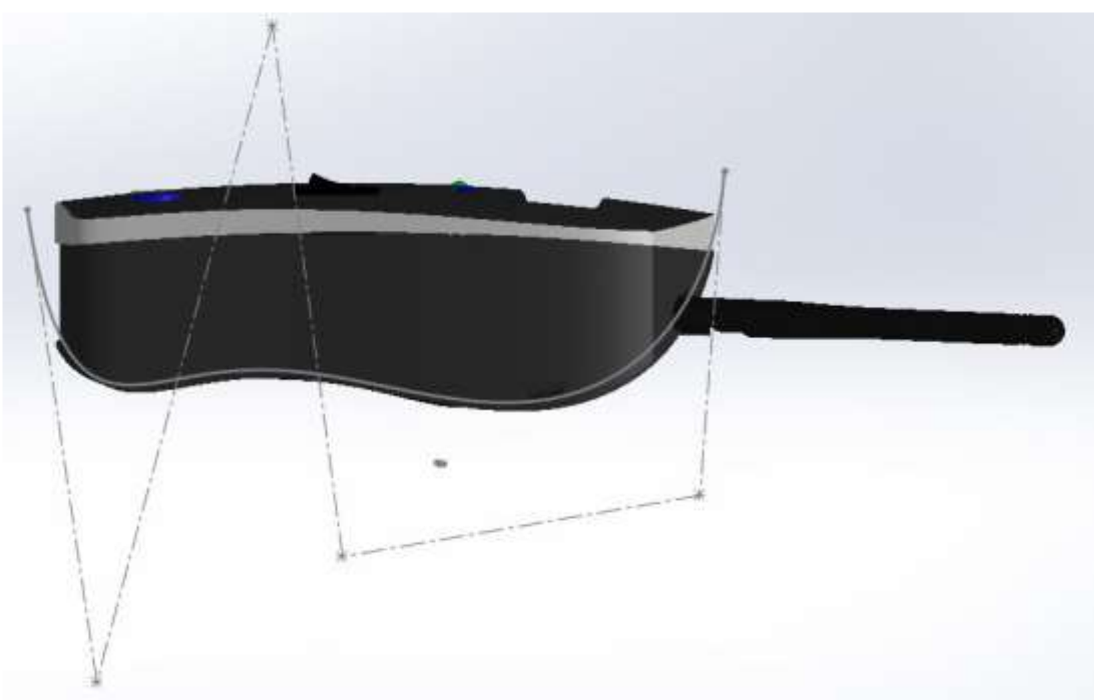
5. Enclosure Designs

5.1 Initial Enclosure Design

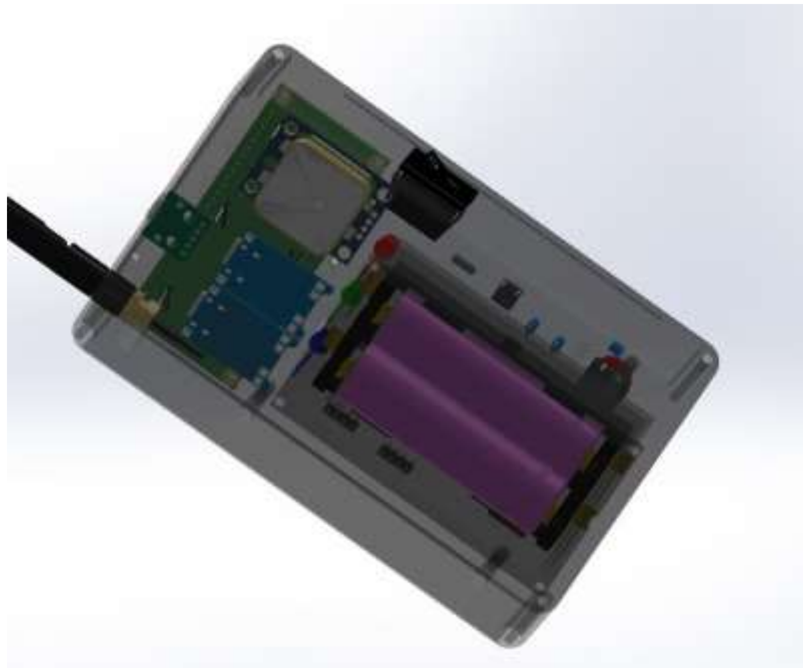


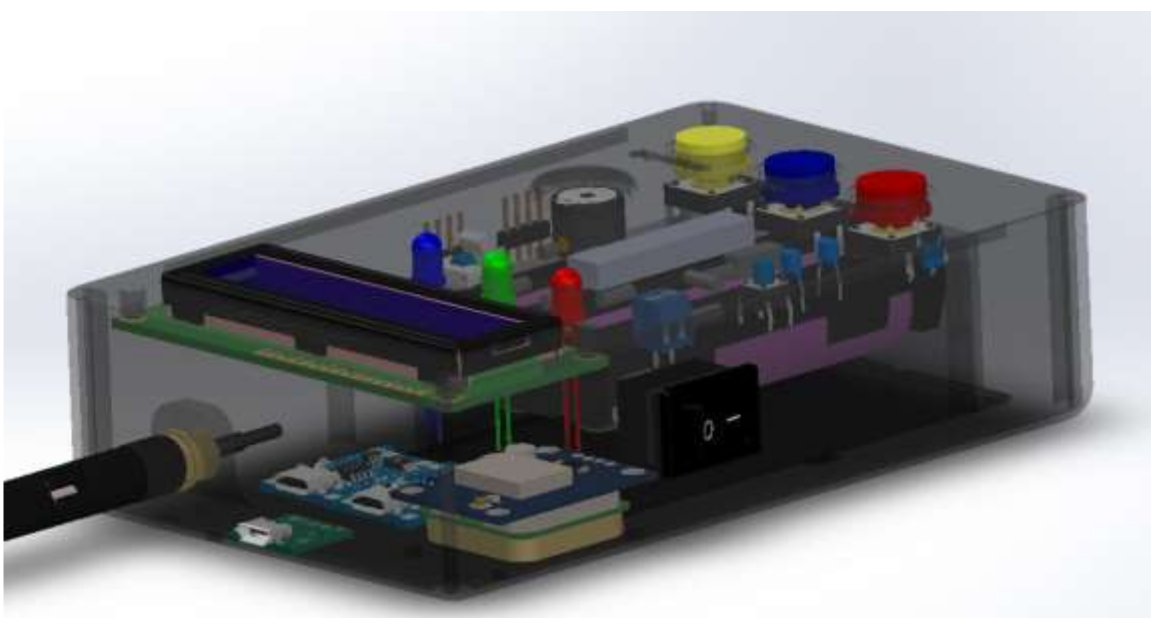


5.2 User Centred Design



5.3 Preliminary Implemented Design






ClicGuard
ClicGuard
Powering


ClicGuard
GPS Loading..
72%


ClicGuard
GPS Loading..
72%

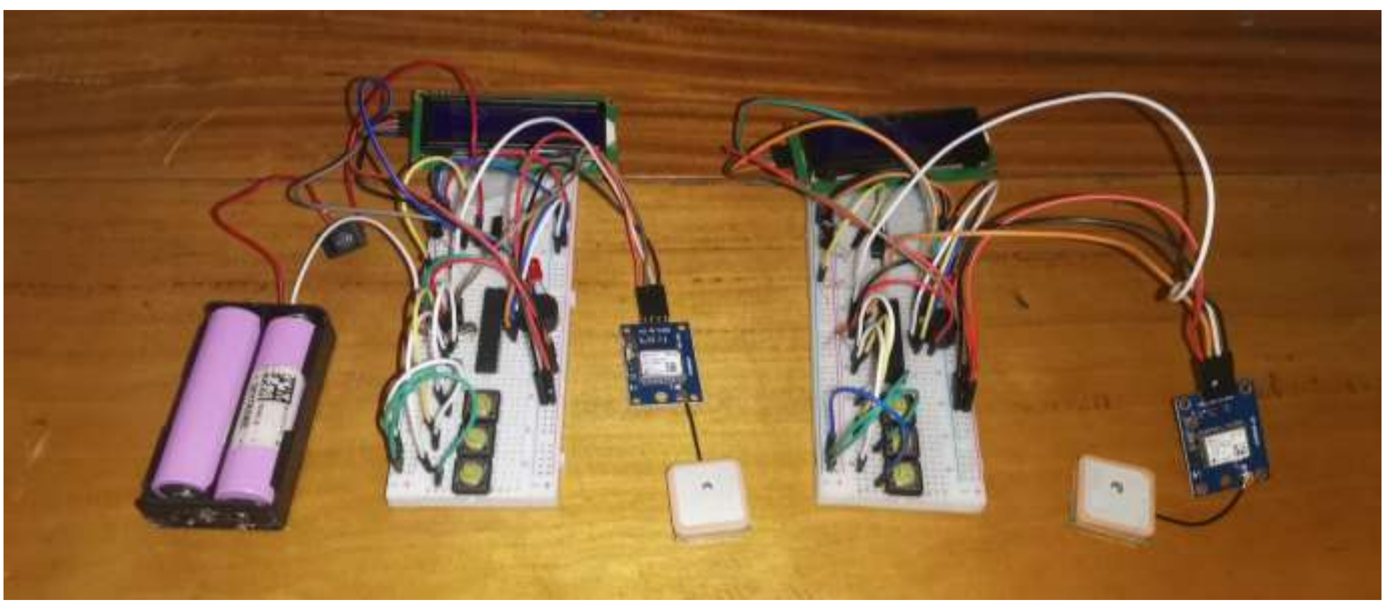
6. Technical Implementation

6.1 Component Selection

The selection of components for the device was carefully considered. Initially, local market options were explored due to ease of access and familiarity. However, following the recommendation of our lecturer, we decided to import components directly from original manufacturers and suppliers. This decision was driven by the desire for higher quality assurance, access to official data sheets, reliability, and technical support.

6.2 Circuit Design and Prototyping

The circuit design process involved interconnecting the selected components, including the ATmega328P microcontroller, GPS module, and HC12 module. We received technical documentation and data sheets from the original manufacturers, which facilitated smooth integration. Prototyping was carried out to test the initial design, and necessary iterations were made to optimize performance and minimize power consumption.



Beginning components testing using breadboard

Prototyping

6.3 Programming

The firmware and software for the ATmega328P microcontroller were developed to enable both Emergency Mode and Tracking Mode functionalities. This was programmed using C Language. Special attention was given to real-time emergency alerts, GPS data processing, two-way communication, and encrypted data transfer. Programming adapted to the components sourced from both original manufacturers and the local market.

Software used – Microchip Studio and Arduino IDE

Referred book – The AVR Microcontrollers and Embedded system using Assmebly and C

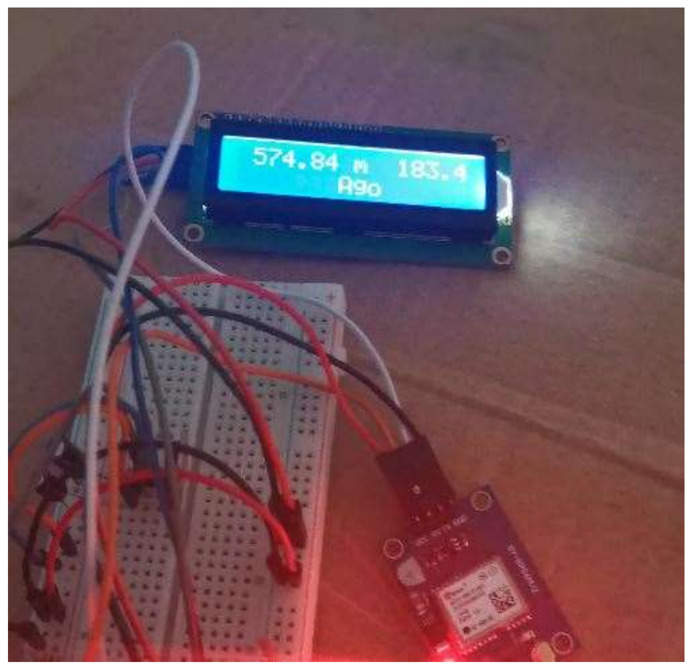
by Muhamad Ali Mazidi, Sarmad Naimi and Seper Naimi

Referred datasheet – Atmega32 Datasheet

7. Project Results and Analysis

7.1 Testing and Validation

The multi-mode electronic device underwent rigorous testing and validation in diverse environments, including coastal areas and open space paddy fields. With a spring antenna, the device demonstrated reliable performance at a range of 800m, ensuring successful emergency alerts and location tracking. The inclusion of an SMA antenna extended the range to **2km**, significantly improving communication capabilities. In initial testing with HC12 modules, the range proved insufficient, leading to the adoption of NRF modules for enhanced performance and better communication coverage. The field-testing results reaffirmed the device's effectiveness, accuracy, and adaptability for use in various real-world scenarios.



Tested in coastal open space with only Spring Antenna and achieved range up to 800m in open space.

7.2 Performance Evaluation

7.2.1 Communication Range

The device was subjected to extensive range testing in both coastal and open space paddy field environments. With the spring antenna, the device demonstrated a reliable communication range of approximately 800 meters, allowing for effective emergency alerts and location tracking in these scenarios. While the initial plan was to integrate NRF modules, the decision to use HC12 modules was made based on their improved performance and compatibility with the device's design. The HC12 modules provided robust communication capabilities, ensuring reliable data transfer over significant distances.

7.2.2 Accuracy

The accuracy of the device's location tracking functionality was evaluated during field testing. In open space paddy fields and coastal areas, the device consistently maintained an accuracy of 20 meters, as intended. This accuracy ensured that the transmitted location data was precise and reliable, enabling accurate tracking of the device's movements.

7.2.3 Battery Life

Battery life is crucial for emergency scenarios, and the device was evaluated for optimal power management. During the field tests, the electronic device exhibited efficient power consumption, allowing for prolonged operation even in challenging conditions. The power-saving techniques implemented in the device design contributed to extended battery life, ensuring that it remains operational when needed most.

7.2.4 Overall Performance

The comprehensive performance evaluation confirmed that the multi-mode electronic device excelled in its intended functionalities. It effectively transmitted emergency alerts and location data over considerable distances using HC12 modules, allowing for timely responses in emergency situations. The encrypted data transfer ensured secure communication, protecting user privacy during transmission. Moreover, the device's accurate location tracking and extended battery life enhanced its suitability for use in real-world scenarios.

8. Challenges Faced and Solutions

One of the major challenges encountered during the development of the electronic product ClicGuard was the limited availability of certain components in the market. Additionally, the cost of importing components from original manufacturers and suppliers is high and delay of delivery.

9. Bill of Materials

Components	Quantity	Cost (Rs.)	Suppliers and other
Atmega328p	1	693.68	TZT Technology (TZT/TZT Five Star China)
I2C Display	1	1100	TZT Technology (TZT/TZT Five Star China)
HC12 Tranceiver	1	693.68	TZT Technology (TZT/TZT Five Star China)
GPS module	1	771.42	TZT Technology (TZT/TZT Five Star China)
18650 3.7V Lithium ion battery	2	2100	TZT Technology (TZT/TZT Five Star China)
3 dBi SMA Male antenna (344MHz)	1	687.7	TZT Technology (TZT/TZT Five Star China)
2S 18650 Battery Charger module	1	380	TZT Technology (TZT/TZT Five Star China)
Micro USB to DIP Adapter	1	150	TZT Technology (TZT/TZT Five Star China)
Resitor 1 Pack 300 pcs (10-1M Ohm)	1	445	TZT Technology (TZT/TZT Five Star China)
L7805CV 5V voltage Regulator 10pcs pack	1	308	TZT Technology (TZT/TZT Five Star China)
Capacitors 1 Pack 120pcs of 12 values	1	495	TZT Technology (TZT/TZT Five Star China)
battery holder	1	77	TZT Technology (TZT/TZT Five Star China)
100 pcs pack diode pack	1	238	TZT Technology (TZT/TZT Five Star China)
LEDs	3	90	Tronic.lk -Srilanka
12mm Tactile Push button with Cap	3	120	Tronic.lk -Srilanka
Tactile Push button Cap	3	30	Tronic.lk -Srilanka
5V mini buzzer	1	60	Tronic.lk -Srilanka
Bolt and Nut	10	200	Tronic.lk -Srilanka
shipping Cost		850	Shipping TZT Technology (TZT/TZT Five Star China)
Enclosure	1	4800	Hexide Labs (Pvt) Ltd
pcb	1	336	JLC PCB China , 5 PCB Costs 1680/=
Other Cost		500	
Total		**15125.48**	

TZT/TZT Five Star China TZT teng Official Store - Amazing products with exclusive discounts on AliExpress (Shenzhen Electronic Technology)

TZT-FIVE-STARS Store - Amazing products with exclusive discounts on AliExpress

10. Discussions

10.1 Suggestions by Lecturers

Solidwork Design Suggestions

The initial design of the SolidWorks model was the lack of a **sketch** of the design. A detailed sketch is a fundamental step in the design process, as it serves as a blueprint for creating the 3D model. By neglecting to create an initial sketch, important design considerations, such as overall dimensions, proportions, and key features, may have been missed. This omission can lead to inconsistencies and inaccuracies in the final model, affecting both the functionality and aesthetics of the product.

The initial design of the SolidWorks model did not incorporate **surface features**, leading to limitations in the design's functionality and aesthetics. Surface features are vital for achieving complex shapes, fine detailing, and smooth transitions that are essential in many engineering applications. The lack of usage of surface features in the initial design results in a simplified representation that lacks the necessary intricacies required for optimal performance. This limitation negatively impacts the overall product design, compromising its visual appeal and potentially limiting its functionality. Therefore, incorporating surface features into the design is crucial to enhance both the form and function of the SolidWorks model, ensuring a more comprehensive and satisfactory product.

The highlighted points about the **mold cavity** method for **injection molding** in SolidWorks were as follows: cavity creation, molding technique, and injection mold design. The cavity creation step involved designing the negative space within the mold to replicate the desired shape accurately. The molding technique focused on the injection process, where molten material is injected into the cavity to form the final product.

Circuit and Schematic Suggestions

In the schematic design of the previous version, there were several issues related to schematic design rules and professionalism. One notable problem was the lack of adherence to proper schematic design practices. For instance, **net labels** were not consistently used, leading to confusion and difficulty in identifying the connections between components.

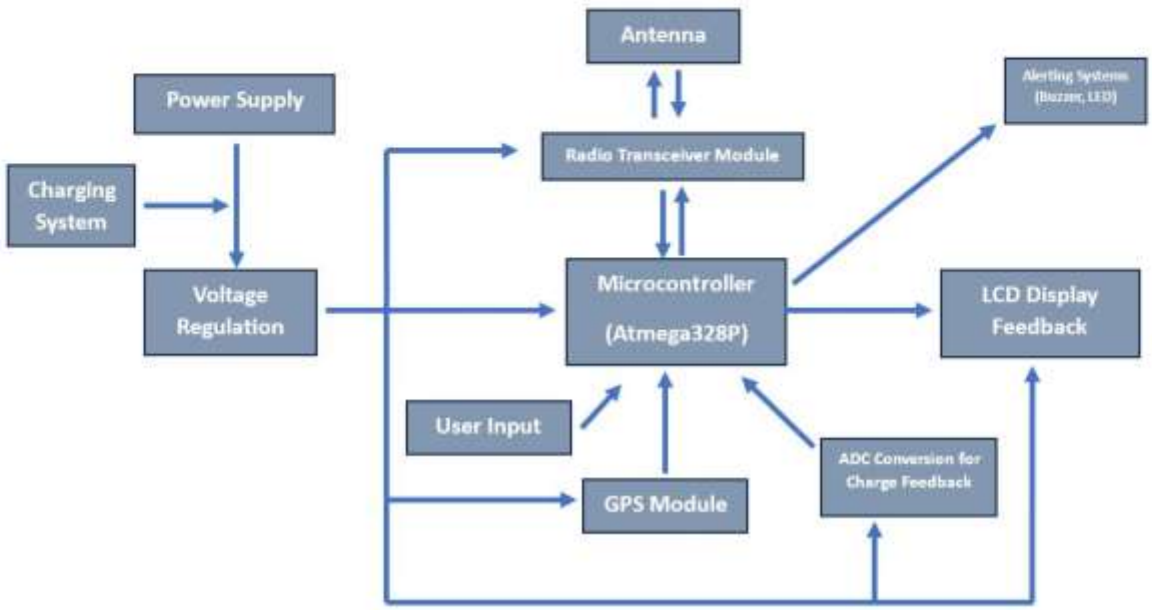
Moreover, the **naming of components** was not in a standardized order, which further complicated the understanding of the schematic. Additionally, the component labeling was inconsistent, making it challenging to identify and locate specific components on the schematic. This lack of professionalism in the schematic design could have resulted in errors, misinterpretations, and difficulties during the manufacturing and assembly processes. In the new design, these concerns were addressed to ensure a more professional and standardized schematic. The schematic design now follows established industry practices, including the proper usage of net labels, standardized component names, and consistent component labeling. These improvements enhance the clarity and readability of the schematic, reducing the chances of errors and improving the overall quality of the design.

Addition to that, In the earlier design of the circuit, several problems were identified. One major issue was the limited battery exchange capacity, which hindered the device's runtime. Additionally, the RF module posed limitations in terms of data transmission range and reliability. Another concern was the lack of rechargeability, leading to frequent battery replacements and increased costs. These problems were identified after lectures, group members discussion, and user feedback. In the new design, these issues were addressed.

A higher-capacity battery with improved exchange capability was implemented. The RF module was replaced with a LoRa module, enabling long-range communication and enhanced reliability. Moreover, the introduction of a rechargeable system reduced the need for battery replacements, ensuring cost-efficiency and convenience.

10.2 Suggestions and Improvements by Batchmates

1. Suggest using LORA modules since it can range up to 5km.
2. Suggest increasing the battery capacity. So, the device should work more than 15 Hrs. in a single charge in standby mode.
3. GSM module to send SMS instead of same device communication.
4. In the design, preferred the design of backside should be less depth and have curve shape along edges.
5. Reduce weight.
6. Proper heat managing for long time usage.
7. Recharging capability, group members preferred to use 2S BMS recharger with USB or Micro-USB pin.



10.3 Suggestions and Improvements proposed by users in survey.

1. **Recharging capability**- User prefer to have recharging capability since this is a communication device.
2. **Size** – The device length, breadth and depth are comparatively high according to user.
3. **Increase battery life**- User preferred to use the device should work for long hours.
4. **Water Resistant**- Since the device is not waterproof.

11. Assembly Instructions

To ensure proper assembly and functionality of ClicGuard, follow the step-by-step instructions outlined below.

Gather Components

Collect all required components for the assembly, including the ATmega328P microcontroller, GPS module, HC12 module, spring antenna, SMA antenna, battery, buttons, buzzer, and necessary resistors and capacitors. (List Under Bill of Materials)

Circuit Assembly

Refer to the circuit diagram and PCB layout provided in the technical documentation. Solder the components onto the PCB board, paying attention to correct orientation and connections. Take special care in soldering the sensitive components, such as the microcontroller and modules.

Antenna Attachment

Attach the appropriate antenna, either the spring antenna for an 800m range or the SMA antenna for a 2km range. Ensure secure connections between the antenna and the respective module.

Button and Buzzer Integration

Mount the Alert/Send button, review/next button, mode-changing button, and buzzer onto the PCB board at designated locations. Secure them firmly to avoid accidental dislodgment during operation.

Power Supply

Connect the battery to the appropriate terminals on the PCB board, ensuring correct polarity. Consider using a battery holder or a secure battery enclosure for safety and easy replacement.

Enclosure

If desired, design and fabricate an enclosure to protect the assembled PCB board and components. Ensure the enclosure provides adequate space for the antenna and user interface buttons.

Firmware Programming

Upload the firmware and software to the ATmega328P microcontroller using a compatible programmer. Verify that the programming process is successful and that there are no errors or conflicts. Suggested to use Arduino IDE

Testing and Calibration

Power on the device and verify the functionalities of both Emergency Mode and Tracking Mode. Test the communication range in various environments to ensure reliable performance. Calibrate the GPS module for accurate location tracking.

Initially it takes up to 3 minutes to get GPS signal.

User Training

If intended for use by end-users, provide training sessions to demonstrate device operation and functionality. Offer clear instructions on emergency alerting, tracking, and battery management.

12. Functionality Test

Emergency Mode Test

Press the alert button on one device to trigger an emergency alert. Confirm that all other devices within the communication range receive the distress signal promptly. Check if the receivers display essential information, including distance, bearing, and battery percentage accurately. Ensure that the built-in buzzer activates for a few seconds during an emergency alert.

Tracking Mode Test

Activate the Tracking Mode on the transmitting device and verify that it continuously transmits accurate location data. Ensure that the receiving devices can track the transmitter's movements in real-time. Check the displayed location data for precision and consistency.

Communication Range Test

Conduct range tests in various environments, including coastal areas and open space paddy fields. Determine the effective communication range with both the spring antenna (800m) and the SMA antenna (2km). Ensure that the device maintains reliable communication within the specified ranges.

Accuracy Test

Compare the displayed location data on the receiving devices with the actual physical location of the transmitting device. Ensure that the accuracy remains within the specified 20-meter range.

Power Management Test

Monitor the device's power consumption during operation. Assess the efficiency of power-saving techniques and confirm that the battery life meets the expected duration. Mode Switching Test: Verify that the mode-changing button allows seamless transition between Emergency Mode and Tracking Mode. Confirm that the device operates correctly and independently in each mode.

Environmental Durability Test

Subject the device to environmental conditions typically encountered during real-world usage, such as humidity, temperature variations, and vibrations. Ensure that the device maintains reliable performance and functionality in these conditions.

User Interface Test

Evaluate the user interface's intuitiveness and responsiveness. Confirm that users can easily trigger emergency alerts, switch between modes, and review location data without any confusion.

13. Conclusions

13.1 Summary of Project Objectives and Achievements

The project's primary objectives were to design and implement a electronic device capable of emergency alerting and real-time location tracking. These objectives were successfully achieved through careful component selection, circuit design, and firmware programming. The device effectively transmitted emergency alerts within a 2km range and maintained 20m location tracking accuracy. The integration of HC12 modules, encryption, and power-saving techniques contributed to the device's reliable performance. The project's achievements showcase the device's adaptability, versatility, and significance in enhancing safety and coordination during emergency situations.

13.2 Significance of ClicGuard

The developed electronic device, ClicGuard, holds immense significance in addressing emergency communication and location tracking needs. Its robust communication capabilities ensure timely dissemination of distress signals, facilitating prompt responses during critical situations. The accurate location tracking feature enhances situational awareness, aiding emergency responders in reaching users swiftly. Moreover, the device's secure and encrypted data transmission safeguards sensitive information, ensuring user privacy and protecting against potential threats. ClicGuard's adaptability to diverse environments, cost-effectiveness, and user-friendly interface make it a valuable tool in emergency response, disaster management, and personal safety applications.

Used For,

- **Outdoor Adventurers like Hikers and campers**
- **Fishermen**
- **Farmers living near Forest areas.**
- **Villagers living near dangerous areas.**
- **Forest Officers**
- **Security Personnels / Security Guards**
- **Elderly Vulnerable Individuals**
- **Factories Workers**
- **Event Organizing Security Teams**

14. References

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arduino.cc

ATMEGA328P Datasheet, PDF - Alldatasheet

Data sheets of Components in List under Bill of Materials

Global Positioning System - Wikipedia

Understanding and Implementing the HC-12 Wireless Transceiver Module - Projects (allaboutcircuits.com)

2 KM SUCCESS STORY with HC-12 - going beyond 1800 meters! - YouTube

Guide to NEO-6M GPS Module Arduino | Random Nerd Tutorials

15. Appendix

15.1 Source Code

```
#include <LiquidCrystal_I2C.h>
#include <math.h>
#include <Wire.h>
LiquidCrystal_I2C lcd(0x27,16,2);  //should change to 27 for real and prtieus 20
#include <SoftwareSerial.h>
#include <TinyGPS++.h>
#define RADIUS_OF_EARTH 6371 //earth radi in km



SoftwareSerial gpsSerial(3, 4);



TinyGPSPlus gps;

double lat1=0.0;
double lat2=0.0;
double lon1=0.0;
double lon2=0.0;
double distance = 0;
double bearing=0;
char lat1_str[20];
char lon1_str[20];
char charge="";
unsigned long startTime = 0;
char sending[60];
String messages="";

int flag_age=0;
int flag2=0;
int count=0;


int button5=0;
int button6=0;
int button7=0;


double toRadians(double degrees) {
  return degrees * M_PI / 180.0;
}


double calculateDistance(double lat1, double lon1, double lat2, double lon2) {
  double deltaLat = toRadians(lat2 - lat1);
  double deltaLon = toRadians(lon2 - lon1);
  double a = pow(sin(deltaLat / 2), 2) + cos(toRadians(lat1)) * cos(toRadians(lat2)) * pow(sin(deltaLon / 2), 2);
  double c = 2 * atan2(sqrt(a), sqrt(1 - a));
  double distance = RADIUS_OF_EARTH * c;
  return distance;
}
```

```
double calculateBearing(double lat1, double lon1, double lat2, double lon2) {
  double deltaLon = toRadians(lon2 - lon1);
  double y = sin(deltaLon) * cos(toRadians(lat2));
  double x = cos(toRadians(lat1)) * sin(toRadians(lat2)) - sin(toRadians(lat1)) * cos(toRadians(lat2)) * cos(deltaLon);
  double bearing = atan2(y, x);
  bearing = fmod((bearing + 2 * M_PI), (2 * M_PI));
  return bearing;
}


void displayTimeAgo() {
  unsigned long currentTime = millis(); // Get current time
  unsigned long timeAgo = 0;          // Initialize time ago as 0

  if (flag_age == 1) {  // Check if flag_age is set to 1
    timeAgo = currentTime - startTime; // Calculate time ago in milliseconds
  }

  unsigned long secondsAgo = timeAgo / 1000;  // Convert to seconds

  unsigned long minutesAgo = secondsAgo / 60;      // Calculate minutes
  unsigned long hoursAgo = minutesAgo / 60;       // Calculate hours
  minutesAgo %= 60;                              // Get remaining minutes after calculating hours
  secondsAgo %= 60;                              // Get remaining seconds after calculating minutes

  if (hoursAgo > 0) {
    lcd.print(hoursAgo);
    lcd.print(" hr ago");
  } else if (minutesAgo > 0) {
    lcd.print(minutesAgo);
    lcd.print(" min ago");
  } else {
    lcd.print(secondsAgo);
    lcd.print(" sec ago");
  }
}




//function for converting word spaced string to array

String* stringToArray(String inputString) {
  static String words[10]; // maximum of 10 words in the input string
  int numWords = 0;
  int wordStart = 0;
  int wordEnd = 0;

  while (wordEnd >= 0 && numWords < 10) {
    wordEnd = inputString.indexOf(' ', wordStart);
    if (wordEnd >= 0) {
      words[numWords] = inputString.substring(wordStart, wordEnd);
      numWords++;
      wordStart = wordEnd + 1;
    }
  }
  words[numWords] = inputString.substring(wordStart);
  numWords++;

  return words;}
```

```
void setup() {

  lcd.begin();
  lcd.clear();
  lcd.backlight();      // Make sure backlight is on




  pinMode(5,INPUT);
  pinMode(7,INPUT);
  pinMode(6,INPUT);
  pinMode(A0,OUTPUT);
  pinMode(A1,OUTPUT);
  pinMode(9,OUTPUT);

  Serial.begin(4800);
  gpsSerial.begin(9600);
  //HC12.begin(4800);

  lcd.setCursor(1,0);   //Set cursor to character 2 on line 0
  lcd.print("ClickGuard");
  lcd.setCursor(1,1);   //Set cursor to character 2 on line 0
  lcd.print("Powering");

  delay(5000);
  lcd.clear();

  }


void loop() {
void generateEncryptionKeys() {
  for (int i = 0; i < NUM_KEYS; i++) {
    float randomValue = randomFloat(MIN_VALUE, MAX_VALUE);
    encryptionKeys[i] = randomValue;
    EEPROM.put(i * sizeof(float), encryptionKeys[i]); // Store the key in EEPROM (optional)
    Serial.print("Key ");
    Serial.print(i);
    Serial.print(": ");
    Serial.println(encryptionKeys[i], 6); // Display the key with 6 decimal places
    delay(100); // Optional delay to make the random values more distinct
  }
}

float randomFloat(float minVal, float maxVal) {
  float randomFloat = (float)random(10000) / 10000.0; // Generate a random float between 0 and 1
  return minVal + randomFloat * (maxVal - minVal); // Scale the random float to the desired range
}



int x=analogRead(A2);
charge=map(x, 600, 860, 1, 100);

if (charge>80) {charge='H';}
else if (charge>70) {charge='A';}
else  {charge='L';}

  button5=digitalRead(5);
  button6=digitalRead(6);
  button7=digitalRead(7);
```

```
  delay(100);
  while (gpsSerial.available() > 0) {
    if (gps.encode(gpsSerial.read())) {
      // If a new GPS data is available, update the latitude and longitude
      lat1 = gps.location.lat();
      lon1 = gps.location.lng();

      dtostrf(lat1, 8, 9, lat1_str); // 8 = total number of characters (including decimal point), 6 = number of decimal pla
      dtostrf(lon1, 9, 9, lon1_str); //
//      lat1 = atof(lat1_str);
//      lon1 = atof(lon1_str);

    }

}

delay(100);



if ((button6==HIGH)&&(lat1*lat2>1) ){
  if (distance<2000){
    lcd.clear();
    lcd.setCursor(1,0);   //Set cursor to character 2 on line 0
    lcd.print(distance*1000);
    lcd.print("m");
    lcd.print("  ");

    lcd.print(bearing * 180.0 / M_PI);
    lcd.print("'");
    lcd.print("                    ");

    lcd.setCursor(1,1);
    displayTimeAgo();  // Call the function to display time ago


    }

}

else if ((button5 == HIGH)&&(lat1>0)) {  //need to check lat>1 and
    // Use strcpy and strcat to concatenate strings

      strcpy(sending, "9 ");
      strcat(sending, lat1_str);
      strcat(sending, " ");
      strcat(sending, lon1_str);
      Serial.write(sending); // Send the message
       lcd.clear();
       lcd.setCursor(1,0);   //Set cursor to character 2 on line 0
       lcd.print("Alerting");

       lcd.setCursor(12,1);
       lcd.print(charge);
       lcd.print("%");
       digitalWrite(9,HIGH);
       flag2=0;
       delay(1000);
     }
```

```
else {
digitalWrite(9,LOW);
messages = Serial.readString();
//String messages="15767686788";
delay(15);
String* message_array = stringToArray(messages);  //convert message to array


if(messages[0]  == '9'){                              //7 is for encryption

   lat2 = atof(message_array[1].c_str());
   lon2 = atof(message_array[2].c_str());
   flag2=1;
   count=0;
   flag_age=0;
   flag_age=1;
   startTime=millis();

    }




if ((flag2 * lat1* lat2)>1 ) {

  distance = calculateDistance(lat1, lon1, lat2, lon2);
  bearing = calculateBearing(lat1, lon1, lat2, lon2);

  if (distance<2000) {

    while (count<25){

        lcd.clear();

        lcd.setCursor(1,0);
        lcd.print("Emergency Mode");
        lcd.setCursor(1,1);   //Set cursor to character 2 on line 0
        lcd.print(distance*1000);
        lcd.print("m");
        lcd.print("  ");

        lcd.print(bearing * 180.0 / M_PI);
        lcd.print("'");
        lcd.print("                   ");


        analogWrite(A0,200);
        analogWrite(A1,150);
        delay(200);  // allow them to off and help for for blinking

        analogWrite(A1,0);
        analogWrite(A0,0);
        delay(200);

        count+=1;

    }

    }
```

```
flag2=0;


}




if (lat1<1 && lon1<1){
  lcd.clear();
  lcd.setCursor(1,0);   //Set cursor to character 2 on line 0
  lcd.print("GPS Loading..");

  lcd.setCursor(15,1);
  lcd.print(charge);
  }

else if (lat1>1 && lon1>1){
  lcd.clear();
  lcd.setCursor(1,0);   //Set cursor to character 2 on line 0
  lcd.print("Emergency Mode");

  lcd.setCursor(15,1);
  lcd.print(charge);


  }

}

}
```

15.2 Product Explanations Video - YouTube

Link - [Project "ClicGuard" | A Complete Electronic Product Development Explained | | English - YouTube]