Team YETi

Soldier Strap

Team Members:

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Task chosen: Soldier Strap by DRDO

Problem Statement by DRDO

The soldier strap will be given to soldiers and it will have the following functionality:

1. GPS location of the soldier
2. Will monitor and record maximum number of vital body parameters
3. SoS facility
4. Sufficient Battery Life
5. Should support location timeline. Security becomes very important in such straps.
6. Such a strap should transfer information by using a MANET-type communication system. It should access public network only when no node is available in immediate vicinity and only in case of emergency.

Motivation

- Indigenous product.
- Helps in tracking of personnel in adverse conditions. In 2015 alone, more than 850 soldiers lost their lives due to inaccessibility of the region.
- Ease of message transmission.
- An opportunity to give back:)

Breakdown of the problem

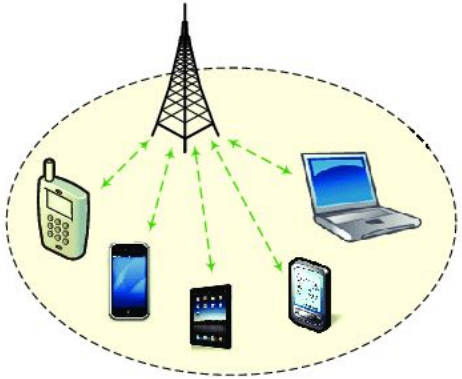
- *Communication system* ; Includes MANET implementation, network pattern planning, data transmission, data collection and organisation, motion timeline using GPS, SOS system.
- *Body vitals and Peripherals* ; Includes data collection modules like temperature sensor, pulse detector, GPS implementation, considerations of strap design, battery characteristics, LED monitor for active comrades.

Our approach

Understanding MANET(Mobile AdHoc Network)

In an infrastructure based wireless network every node is connected to a AP.

In Mobile Ad-hoc network (MANET or WANET) every node is directly connected to each other.

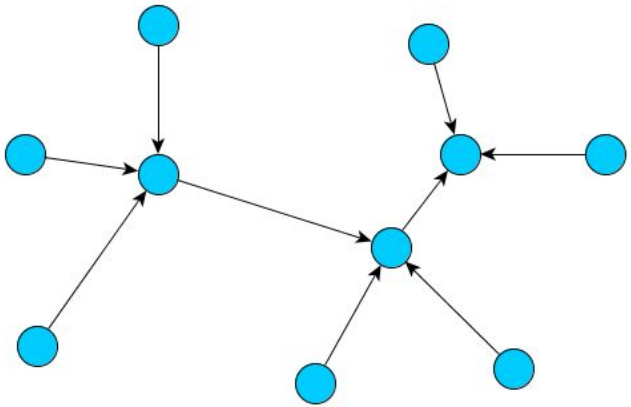


Infrastructure-based wireless networks

Wireless ad hoc networks

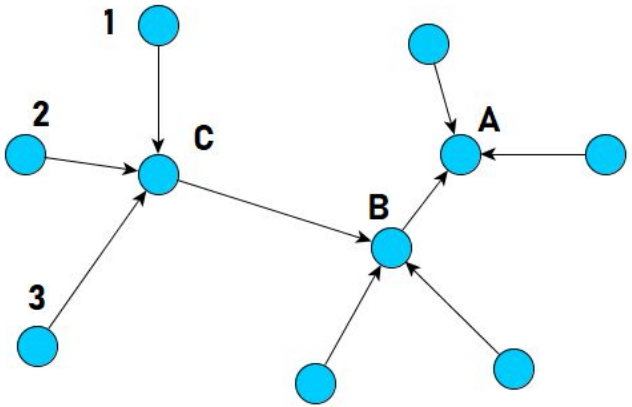
Connecting and Communicating

1. Self organizing and repairing mesh network.
2. Network loops are actively avoided.
3. JSON based messages and their types.
4. Time sync. with accuracy better than 10ms.



Organizing and repairing Mesh

1. Connection based on signal strength.
2. Connection table and users message are sent simultaneously.
3. Connections in Circles are not possible
4. Time synchronization using connection table.
5. Repairing of mesh within 2-3 messages.



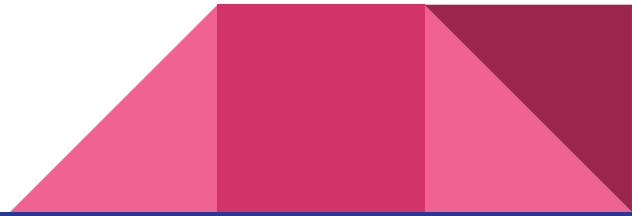
JSON based messaging

```
{
  "dest": 887034362,
  "from": 37418,
  "type":6
 }
```

dest is the id of the destination node

from is the id of the source node

type defines the nature of message



Classification of User Messages

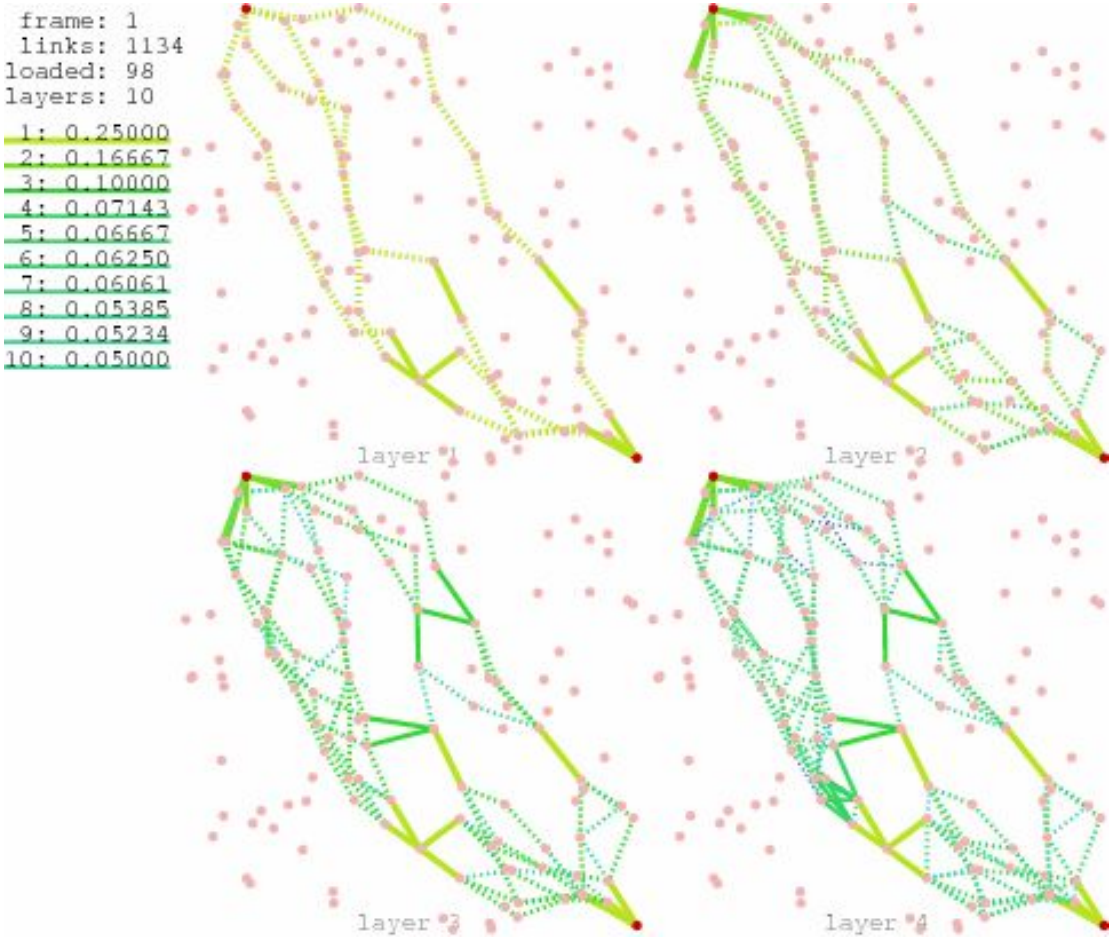
Single address message OR broadcast Message

```
{
   "dest": 887034362,
   "from": 37418,
   "type":9,
   "msg": "The message I want to send"
}
```

type 9 : for single address

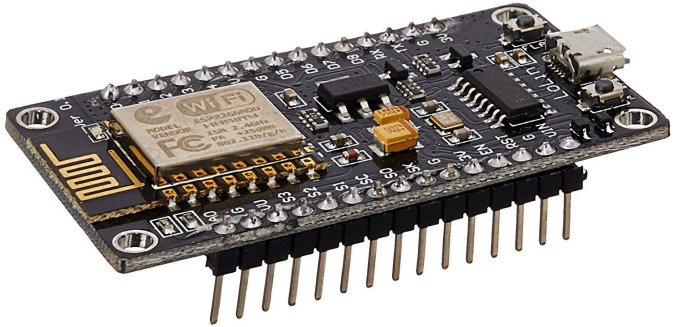
type 8 : for Broadcast

Mobile Ad-Hoc network Animation



Wireless Communication Setup

NodeMcu - esp8266



1. Can be programed in 'C' language using Arduino IDE directly
2. NodeMCU comes with 128KB RAM and 4 MBytes of ROM
3. Compact size : 5cm x 2.5 cm

GSM module - Sim800L/900A

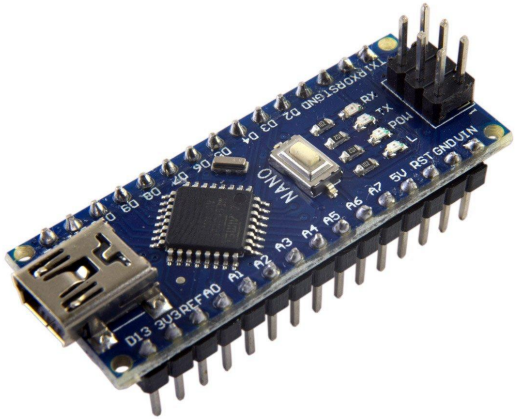
1. Programmed using a microcontroller.
2. Has Email and Sms sending capabilities.
3. Low power standby mode.

In absence of any node in immediate vicinity

For sending a Email through Google or DRDO own portal

Arduino Nano Microcontroller

1. It has 8 ADCs
2. 32KB flash memory
3. 16Hz clock speed



Sensors

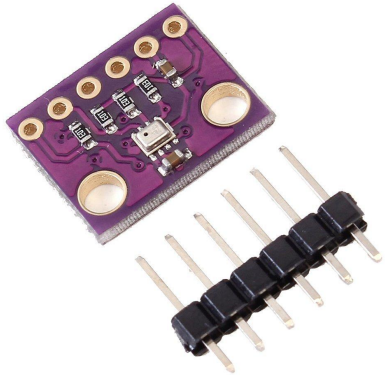
- **Barometric sensor**

  Range : 300 to 1100 hPa with ±0.12 hPa

  OR

  +9000m to -500m with ±1 m

  Refresh rate : 157 times/sec



BMP280

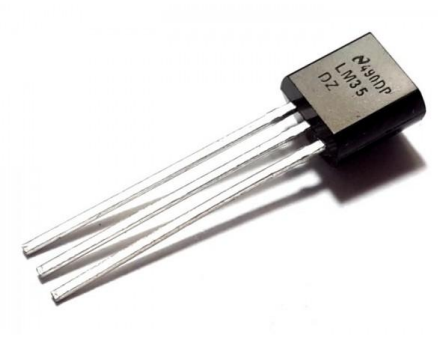
- **Temperature sensor**

  0.5°C Accuracy at +25°C

  Less than 60-µA Current Drain

  Low Self-Heating, 0.08°C in Still Air

  The scale factor is 10 mV/°C.



- **Pulse sensor**

  low-cost optical heart rate sensor

  Works with 3 Volts to 5 Volts

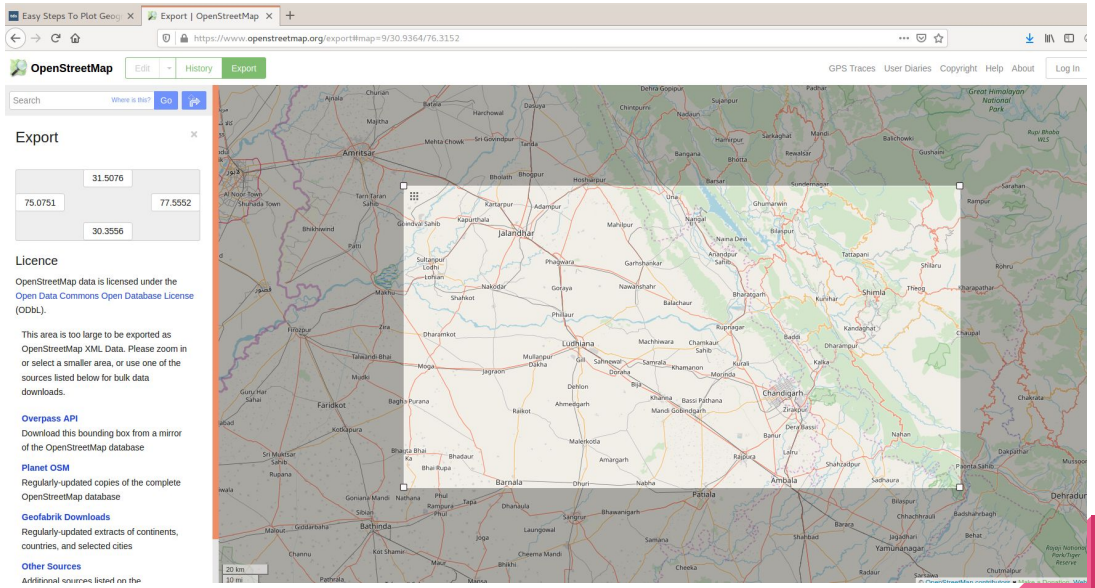
  Tiny Size 15.8mm diameter

Data reception and analysis

The data will come in a form of series of longitudes and latitudes of each soldier along with their vitals.

	longitude	latitude
0	46.659107	24.768269
1	46.702409	24.680454
2	46.650310	24.767690
3	46.748908	24.715848
4	46.758220	24.712114

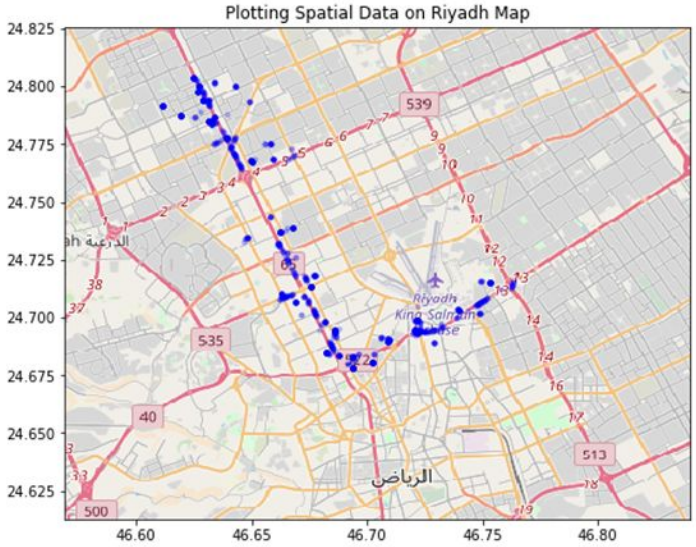
There are numerous ways to get the image of the map of the location of the soldier group, one such way is OneStreetMap



Code to plot the gps latiitude and longitude of each soldier on the googlemaps generated map of the gps location of the group of soldiers.

```
fig, ax = plt.subplots(figsize = (8,7))

ax.scatter(df.longitude, df.latitude, zorder=1, alpha= 0.2, c='b',
s=10)

ax.set_title('Plotting Spatial Data on Riyadh Map')
ax.set_xlim(BBox[0],BBox[1])
ax.set_ylim(BBox[2],BBox[3])
```

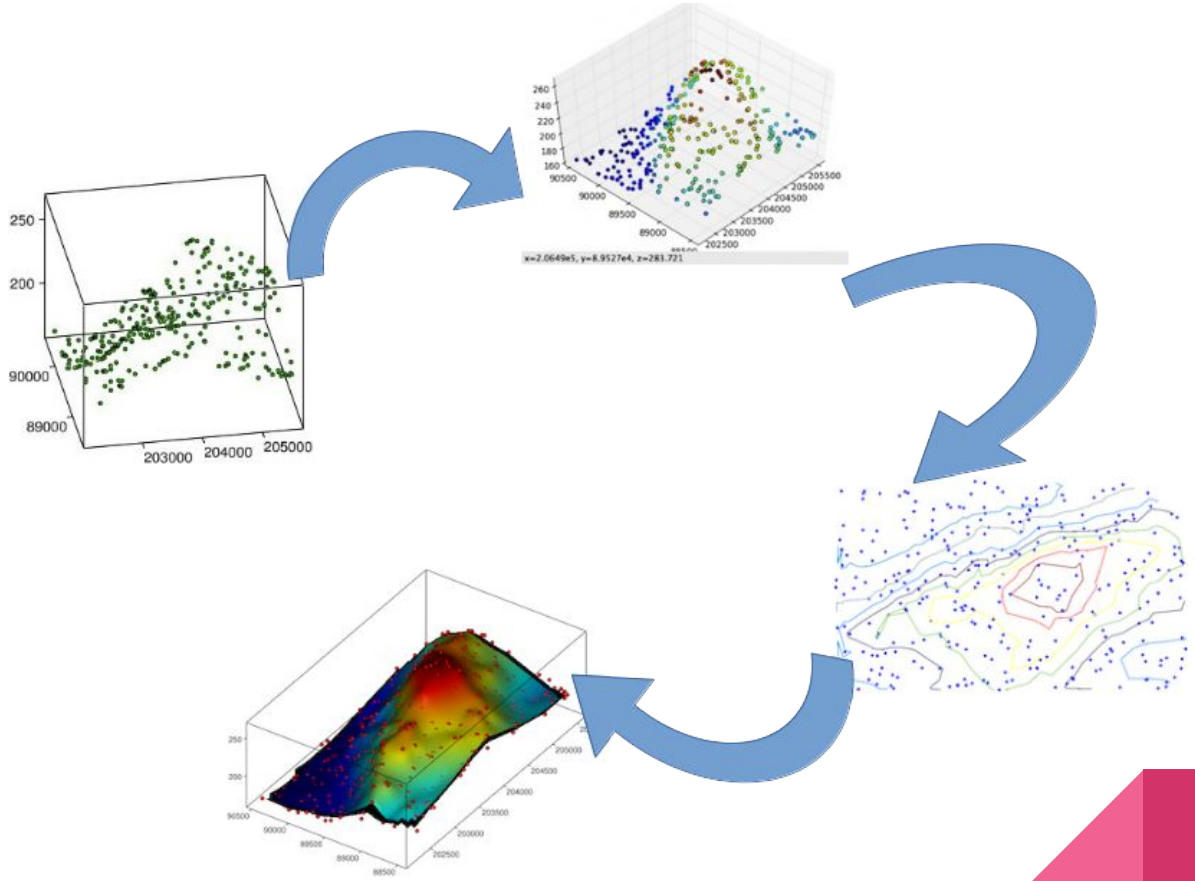
The scattered gps coords of the soldiers looks like this, on the map image. Which will be continuously in sinc and updated.



Code for vital data display inside the image.

```
import matplotlib.pyplot as plt

plt.subplots(figsize = (18,17))
im = plt.imread('map.png')
implot = plt.imshow(im)

# put a blue dot at (10, 20)
plt.scatter([10], [20])

x = [800, 400]
y = [500, 600]

# put a red dot, size 40, at 2 locations:
plt.scatter(x, y, c='r', s=40)
s = 'vitals'
plt.text(x[0]+10, y[0]+10, s, bbox=dict(fill=False, edgecolor='red', linewidth=2))
plt.text(x[1]+10, y[1]+10, s, bbox=dict(fill=False, edgecolor='red', linewidth=2))

plt.show()
```

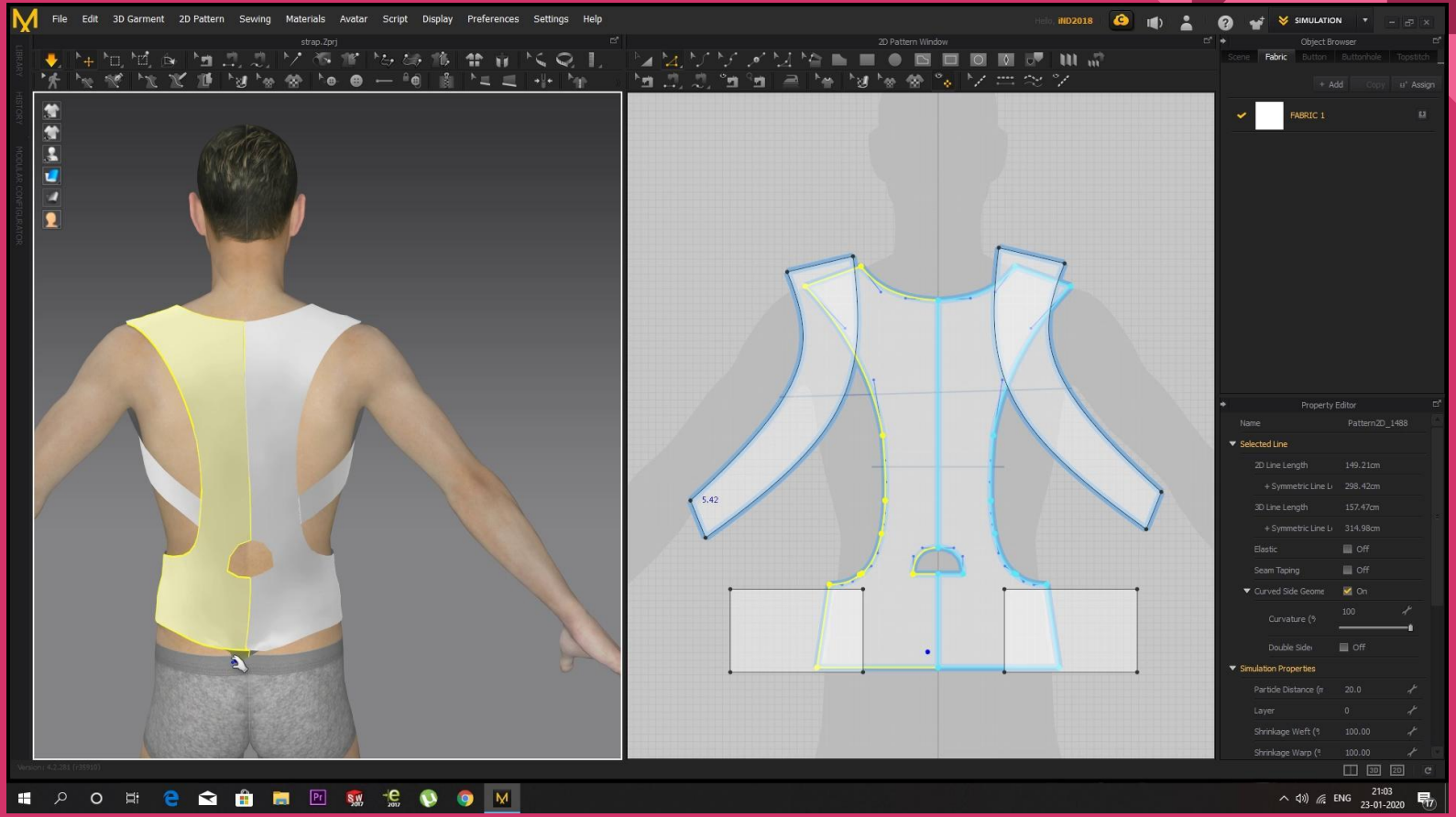
The vital of each soldier will be depicted along side their gps pointers


250
200
90000
89000
203000
204000
205000
260
240
220
200
180
160
90500
90000
89500
89000
205500
205000
204500
204000
203500
203000
202500
x=2.0649e5, y=8.9527e4, z=283.721

Data flow schematic

Plotting diagram

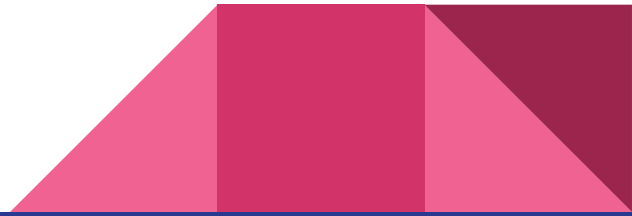
Our solution looks like



Work done till now

Wifi network simulation

Gps simulation



Further Research/Future Prospects

1. Better wifi to increase range.
2. Fracture warning system using frequency separation.
3. Fabrication of custom PCB.
4. To implement and use Indian GPS modules to enhance security.
5. Continuous blood pressure measuring.
6. Decrease size of battery and make it comfortable.
7. Extra strap design.

Cost Estimation

S.NO	DESCRIPTION	APPROX. COST(Rs.)
1	NodeMcu esp8266	200
2	Sim	1000
3	GPS	500
4	Barometer sensor	100
5	Pulse sensor	200
6	Temperature sensor	50
7	Fabrication cost	2000
8	Arduino Nano	250
9	Miscellaneous (battery, antenna, wiring etc.)	1500