CHAPTER 3. RESEARCH METHODOLOGY

This chapter reports the research techniques used in this study. It is categorized as explaining and designing of algorithm & software, followed by the hardware designing and fabrication. The firmware and hardware is integrated to perform the validation.

3. 1 Algorithm Design

Prior to research carried down for disaster area, localization algorithms have been studied. Many techniques have been examined for localization. Some of those include the latest algorithms like PSO, ANN, ABC, Fuzzy logic etc. There are few which are known to be classical localization algorithm like trilateration algorithm, location fingerprinting etc. In this study, trilateration and location fingerprinting methods have been approached and found to be best suited for tracking the trapped people. The network planned for tracking the trapped people in disaster prone area is designed using location fingerprinting method. To get the RF signatures of people moving around the disaster prone area, location printing method is best suited. After getting the RF signature, rescue operation team gets to know the last location of the person in post disaster situation. The last location can be tracked of the trapped person. If the trapped person is dislocated from the last known location of node, then to localize the trapped people another algorithm has to be applied. For the localization of the node trilateration algorithm has been adopted and designed state of the art unique method for localization (coined as unilateration algorithm). In trilateration four nodes of known location is needed to find the unknown location of the node. But in case

of unilateration only one node is needed thus reducing the node density in wireless sensor network. The unilateration algorithm is working on VPM (Vector Parameter based Mapping). To optimize it in terms of location error the optimization algorithm has been studied. Algorithm like PSO, ABC, GA, TLBO etc. has been studied. TLBO (teacher learner based optimization) has been chosen for our research. TLBO is easy to implement and flexible to choose. And moreover the algorithm does not require any specific tuning parameters to implement. Teacher learner concept is more flexible when combining with VPM protocol thus makes our algorithm more useful.

Now to get the RSSI values and estimated distance a proper device has to be selected. Many techniques are there e.g. Range free methods and range based methods. Range based method has been chosen and for getting the values we have chosen ZigBee protocol based modules. Rigorous studies have been done on ZigBee and Xbee –S2 modules have been chosen. After algorithm design and simulation, hardware design is crucial.

3. 2 Hardware Design

For designing the hardware it is important to have a device that will best suited for this experiment. For proving the proof of concept 8 bit microcontroller i.e. At mega 328P as the controller has been chosen which is having the special features like PCI (pin change interrupt). This feature makes the controller more flexible in terms of making any pin Rx/Tx. Test bed is approx. 150 × 100 m and the node density is six, so network with 8 bit microcontroller is sufficient to prove the proof of concept and more over the algorithm is flexible enough to run in 32 bit processors also. In subsequent chapters, cost analysis has been done for bigger area also including the cost of processors. And the use of microcontrollers in network makes it more flexible and easy to use.

The hardware is designed with all mode of communication available for easy troubleshooting. To gather RSSI data Xbee module is integrated and to store the RSSI values from Xbee, SD card module is used along with Real time clock. With these features the node can be tracked with signal strengths and time/date. To boot load the controller, a separate pin out has been given and for power supply USB B type port is given to attach it with any power source that will support USB A type to B type facility.

3. 3 Validation

After the designing of hardware and firmware both are integrated and validated on the test bed. University campus is selected as a test bed as it lies in seismic zone. Without using existing cellular infrastructure, designed nodes are placed and exhaustive experiments near ground being conducted around 1^{st} block, 6^{th} block, 7^{th} block, 3^{rd} block, cafeteria and food court.

A comparative study has been done with existing localization based networks as a finishing task.