**(ADDED TO PAPER)**

**Hub Software/Network Overview**

For our Smart Fire Alarm system, the hub will be the most important processing unit. All of the fire alarms installed in the system will be using the same network sending data between Xbee modules to the hub system. Therefor the hub will be the coordinator for the network allowing all the fire alarms to connect to it. The most important aspect of the hub is that it will be doing all of the calculations needed to orchestrate the system.

The first important aspect of the software is that it will hold all important data regarding the number of alarms installed in the system as well as their locations. It will also hold the location of the suitable exits for the building that the system will be installed in. For each alarm installed in the system the hub will store information regarding the adjacent alarms or exits to each alarm. For example, the hub might store that alarm 2 has an exit directly to the north, alarm 3 directly to its right and alarm 1 directly to its left. It would then make sure that for alarm 1, alarm 2 is registered as being directly to its right. All of this information would have to be stored during installation of the system into a building. Once all of this information in stored, the hub will have a data blueprint of all alarms and exits inside the entire building and will have the knowledge necessary to direct people to the correct locations in the event of an emergency.

The next important aspect of the software is that it will be receiving signals from each of the fire alarms over the XBee wireless network. This means that when a sensor for an alarm reads that there is a hazard the fire alarm will send a signal to the hub that it needs to go off. The hub will save which XBee signal is correlated to which alarm so that it is aware of the specific alarm that goes off when it reads a signal. The hub will then use this information to know which specific alarm is going off and will join this with the above information to calculate the correct directions that people will need to travel through the building to reach the best exit.

A quick explanation of how the hub calculated the directions to send out to the alarms will now be provided. In the event that the hub receives a signal from an alarm that it is going off, the hub will start at that alarm and calculate the today distance to an exit in each of the possible directions that a person can go from this alarm that is going off. For example, if the alarm has two possible directions that you can go from this alarm it will add the distance to the next adjacent alarm to the distance that it calculates it takes to get to the next closest exit from that adjacent alarm. The system will than continue to do this calculation all the way down until it reaches an exit. The returned value would be the total distance to an exit if you go that direction. It would then do this for the other direction and decide which direction has the smallest distance. The beauty of this type of algorithm is that, as long as there is one continuous path from one alarm to all of the others, the system would have calculated the best direction to go to from each alarm throughout the entire system. This type of algorithm is what is known as a recursive algorithm. The hub would then have all the information it needs to send the correct signals out to all the alarms in order to send everyone to the proper exits no matter where you are located throughout the building.

The last important aspect of the system is the sending of signals to each individual alarm. The system will send two important signals to each alarm in the event of an emergency. After the system decides the proper directions to send out to each alarm the hub will send out the signal to each alarm of which LED arrow to light up. This will be the visual que for users to know which direction to go. The LED signals sent out by the hub will follow the decisions that were made earlier of which is the best direction to travel to reach an exit. Secondly, the hub will calculate the order of buzzer sounds to send out in order to send audio ques to users of which direction to head. The hub will do this by saving the “level” of each alarm from the fire. What this means is that while calculating the directions, the hub will also calculate the order of the alarms. It will keep track of the first alarm that is traveled to from the fire, then the second, then third and so on. It will use this information to send the buzzers off for each alarm in order with a delay in between. This delayed audio signal will be what a user can follow to expedite the process of figuring out the best way for them to exit a building. Lastly, the hub will also have a reset signal that can be sent out to all of the alarms in order to reset the alarms. This means turning off the LEDs for each alarm as well as turning off the buzzer sounds. This reset can either be set to go off after a certain amount of time or directly on the hub via a user sent signal.