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Disaster Management using Wi-Fi and Zigbee

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Abstract: This paper is about the use of people's smart phones to send messages in a situation where help is needed and the infrastructure used to communicate cannot be used. The paper focuses on Wi-Fi and Zigbee wireless technologies. Smart phones in the affected areas may turn themselves into nodes and help in forming a temporary network. The Wi-Fi technology is used here because of its high range when compared to other wireless technologies. Zigbee has the lowest power consumption among all the wireless technologies. So when these two are used in unison they provide a perfect platform for the disaster management. The message sent to the rescuer is the information collected through the GPS module in the victim's phone.

Keywords: Smartphone, natural disaster, Wi-Fi, Zigbee, GPS.

I. INTRODUCTION

Natural disaster incidents, like earthquakes and hurricanes, often cause the breakdown of the cellular base stations. This leads to a complete and sudden collapse of the whole wireless network infrastructure.

One of the problems after a natural disaster is finding the people who need help. Nowadays if someone needs help from the emergency services they will call them. After a natural disaster the communication infrastructure can be damaged.

This will hinder the communication between the victim and the emergency services. One of the alternate ways to reach the emergency services without the use of communication infrastructure is discussed here.

The network here uses multiple nodes to relay messages to other users of the network. This is useful in case of a natural disaster and when there are enough nodes (people with smart phones) around to relay messages to the emergency services.

The benefit of using mobile phones is that a lot of people use smart phones.

These smart phones have a couple of wireless communication technologies like Wi-Fi and bluetooth. Here we have included zigbee as it uses less power. Firstly a literary study is done to find the advantages and disadvantages of Wi-fi and zigbee.

Secondly a way to switch the network in between these two depending some conditions is explained and last tests of this are done to determine if these advantages are useful.

The Fig1block diagram shows wireless network having two nodes. Each node has GSM/GPS, Wi-Fi and Xbee module.

These networks are continuously monitored and controlled by the microcontroller.

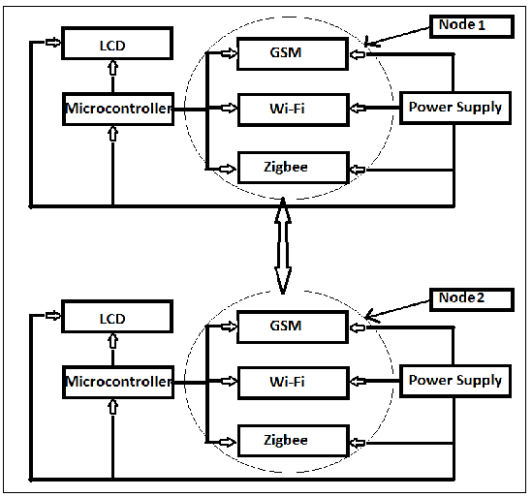

Figure 1 Block diagram Disaster management system

Initially the microcontroller switches ON the GSM/GPS module (representing the mobile phone), the GSM signal strength and the battery voltage is monitored by the microcontroller and also displayed on the LCD display. Whenever the signal strength of the GSM is low or nil then the microcontroller switches OFF the GSM power supply and Switch ON the Wi-Fi module. If this condition is happens at the disaster time then the person having problem during disaster can send the message to the other node. The application has to communicate with other devices via Wi-Fi..When the devices are connected a simple client / server construction is used to send messages over the network.

II. PROBLEM STATEMENT

There are different technologies used to create wireless networks. Wi-Fi is one of them; this research will be about Wi-Fi because it has the longest range of the wireless technologies. Range is essential because not only the highest density of victims (the ones that are within a close range of each other) but also the less high density of victims (those who are further away from each other) must

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be able to communicate with the emergency services. Adding Zigbee technology seems very helpful as its low power consumption gives rescuers more time to locate and save the victims. This is essential when the power level of the smart phone battery is low.

It is interesting to know if and how a smart phone can create an wireless network, what the advantages and disadvantages are to the alternatives and how smart phone Wi-Fi and Zigbee network can be improved.

III. DISASTER MANAGEMENT AND ITS WORKING

When the disaster strikes, the wireless communication networks are damaged and the victims in the disaster areas are left without any contact with the outside world. So it is necessary to establish some type of communication with the outside world through other means. The Wi-fi and Zigbee are two such wireless communication technologies that are best suited for this purpose. During the disaster the victim's mobile(fig 2) first checks the absence of the network. If it finds that the network is absent it switches to one of these wireless technologies. This switching is based on the power level of the battery. Here we have used only two nodes for the Wi-fi and three nodes for the Zigbee. This is because the Wi-fi transreceiver needs to know in advance the address of the receiver node. Here the output is being measured using the Arduino Uno microcontroller. The analog output of the microcontroller can output a voltage of 5V. Using a resistance pot we can vary this. Suppose we keep the resistance to such a point where the voltage drop is less than 3V, the microcontroller switches to Wi-Fi using the relay. Conversely, if the voltage drop is more than 3V then the microcontroller switches to Zigbee technology using the relay. This is equivalent of connecting batteries with different power levels to the mobile.

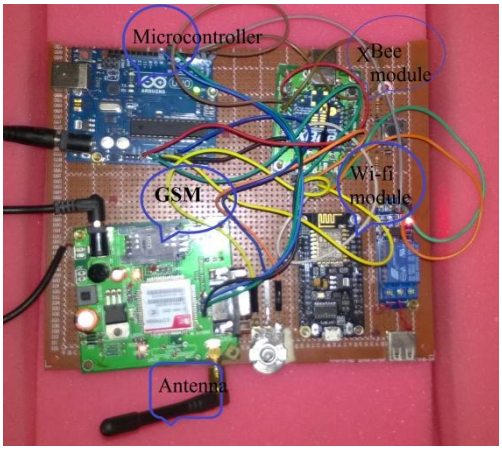

Figure 2 Transmission node consisting of GSM, Wi-fi, zigbee

When the microcontroller activates the Wi-fi transmitter of the victim's node, it starts to send the GPS coordinates of the victim's location to the Wi-fi receiver whose address it already knows. This is also the main disadvantage of using Wi-fi wireless technology as the sender smart phone has to know the address of the destination device beforehand. The message received in the second device through the Wi-fi is shown in fig4 as the Wi-Fi output port is connected to the computer which has zigbee compatible ESplorer software.

If the microcontroller decides to send the victim's location coordinates through zigbee technology, the primary zigbee transmitter scans the surrounding environment for nearby zigbee devices and sends the message to the nearest zigbee device by assigning coordinator destination SH and SL values. This message will be received in the second node through zigbee transreceiver and the microcontroller displays the message in LCD screen through serial driver as shown in figure3. A buzzer is included in the receiver node(fig 5) to intimate the rescuers of the disaster.

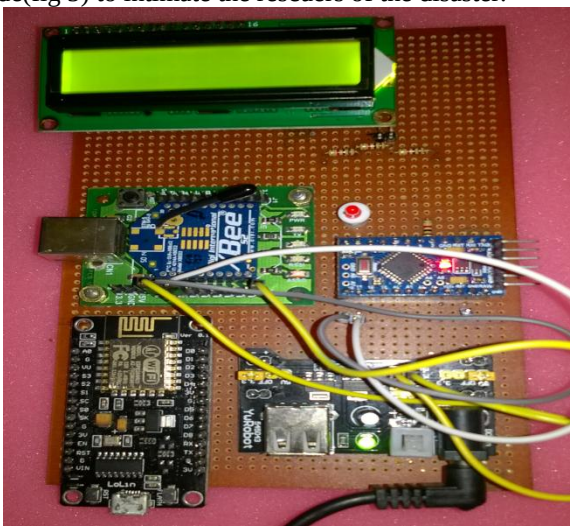

Figure3.Intermediate node consisting of Wi-fi, zigbee transreceiver

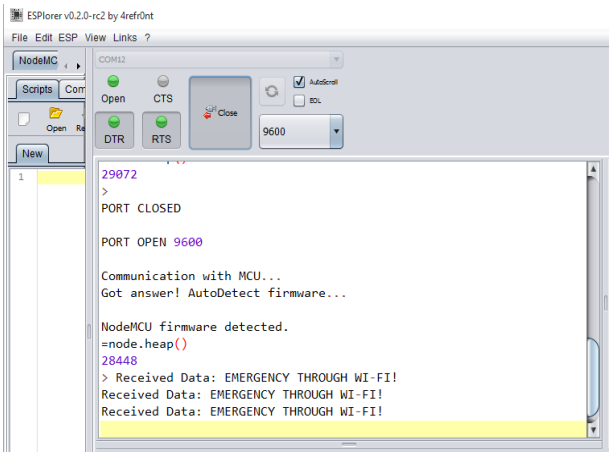

Figure 4.Reciever node Wi-Fi result

The message received from the victim's device in second device(fig 3) is retransmitted to other zigbee devices, it again scans all the surrounding zigbee devices nearby and it will decide which zigbee device to send by assigning the destination coordinate values. Since there is no Arduino Uno microcontroller in the intermediate and receiver nodes to give a constant supply of 3.3V to the Wi-fi and Zigbee transreceiver, we will have to use voltage regulator along with the pro mini microcontroller. So we have used pro mini microcontroller in both fig 3 and fig 5.

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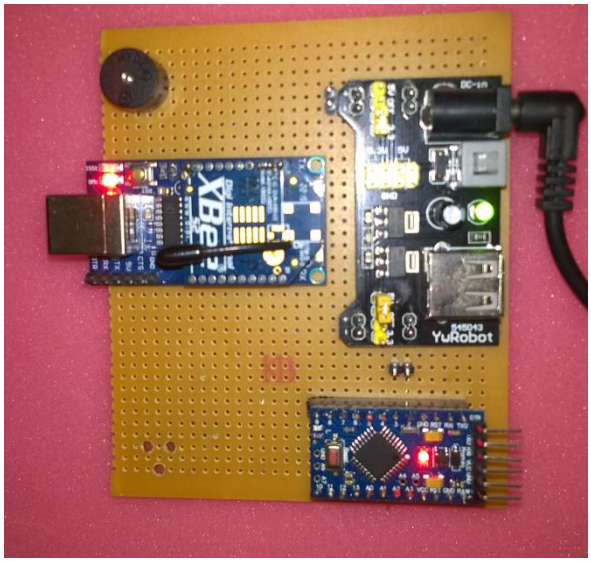

Figure 5. Receiver node consisting of zigbee transreceiver

IV. ADVANTAGES & DISADVANTAGES

Wi-Fi and zigbee are some of the main wireless technologies. These two wireless standards can be used to communicate between devices. These technologies are compared in the next part in terms of: range, throughput, power consumption, availability on smart phones and number of nodes (the maximum amount of nodes in one wireless network).

A.Range
Range is an important requirement because the larger the range the greater the amount of people you can reach in lesser populated areas.

One of the main advantages of Wi-Fi versus other technologies is range. Wi-Fi has a nominal range of about 100 meters where Bluetooth and UWB only have a range of 10 meters. Some implementations of Zigbee can also reach about 100 meters.

B. Number of Nodes
Number of nodes is important if you want to create a network that can cover a lot of ground and connect a lot of victim people. Combined with the range of a technology you can calculate how much ground you theoretical can cover and how much people can be reached.

C. Throughput
Throughput is also important but not as important as range of number of nodes. This element shows how much information each node can receive from the network. However it does not mean the node can also send this amount of information over the network. This is the theoretical maximum throughput of the protocol. Wi-Fi has a maximum of 54 Mb/s and Zigbee 250 Kb/s.

D. Power consumption
Power consumption is in this case an important aspect. You want the victims of the natural disaster to be saved as quickly as possible but also that the network stays online for the longest possible time, this to give the emergency services the longest time to find the people sending the messages. Power consumption is an indication of how long a network can exists while only using the smart phone's battery.

E. Availability on smart phones
The availability on smart phones of the technologies is the most essential. A technology can be the most efficient of them all but when it is not available on smart phones then it is useless in this type of situation. This requirement is a make or break condition: without it these two wireless technologies is not applicable to this situation.

The manufacture's sites of current smart phones show that the current line of smart phones only has Wi-Fi.

V. CONCLUSION

Only Wi-Fi is available on current smart phones. The Zigbee is not available and thus not useful for making a network on smart phones. From the available technology on smart phones Wi-Fi has the advantage of greater range, throughput, availability and the number of nodes, but at the cost of significant higher power consumption. If Zigbee was available on smart phones it would be a great candidate to create an wireless network because with a good implementation the range would be the same as Wi-Fi but at a far less power consumption. But the throughput could be a problem in big networks where a couple of smart phones are the bottleneck for the entire network.

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