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Exploring disaster environment using drone based wireless mesh network

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ABSTRACT

This paper is based on the Mesh network. Meshcomm helps to create a mesh network in the desired area to establish on-demand communication and to avoid casualties. Here we are using a chip called NodeMcu to provide a temporary network. The basic ideology is to connect the NodeMcu's with each other and create a mesh network. These nodes will be deployed in a way that they will provide emergency network covering the area these are deployed in. People in need will connect to this network using Wi-Fi on their mobiles. Once they are connected to the network they will receive a pop-up message, using that they can communicate to the rescue team or with each other.

Keywords— *Drone, Arduino esp8266, Mesh network*

1. INTRODUCTION

Recently, a natural disaster like an earthquake has occurred in the local, and there is a risk of a collapse of buildings due to earthquake or other disputes around the world. In addition, there are several places where networks are not available due to these circumstances. The absence of these networks for even short term can make a lot of destruction for human lives as well in such conditions. However, in order to provide continuous Internet and internet in such places, we need to use the unmanned aerial vehicle technology. In particular, disaster environment we need to utilize existing communication infrastructure and maintain short-term communication.

There comes the drone, which is an unmanned aerial vehicle with lots of capacity and functionalities like surveillance purposes for military, and crop monitoring for forest fire surveillance can be the solution for disaster and disputed areas. There are various methods to connect to people such as Bluetooth, cellular, Wi-Fi hotspot and mesh network for establishing a communication infrastructure. In the case of cellular, it can provide communication service over a wide range of area based on base-station. Upon that, we can expand the network services and communication range using the wireless mesh topology. A wireless mesh network is a technology used by connecting wireless LAN's which provides a low cost and a more efficient network. Wireless mesh nodes are connected to each other, and each node can act as a host as well as the router. It will be deployed into disaster areas in order to spread information. Nowadays drone will be of quad-copter, which is capable of stable and easy flight control. In addition, it can be compatible with existing communication equipment with mesh node and can be controlled using drone-related software such as DJI go and APM Planner 2.0.

2. LITERATURE SURVEY

Drones are of interest from quite many years from now. Many countries and companies came up with various types of UAVs besides the latest ones that we see on the internet like DJI.

The authors proposed radio based drone technology, and they showed the idea to be used in crop monitoring, and a few other areas. Another author used image processing techniques to identify the 2014–2015 Ebola Virus Disease (EVD) epidemic are in West Africa for quicker response and save human life [3].

3. PROPOSED SYSTEM

3.1 System model

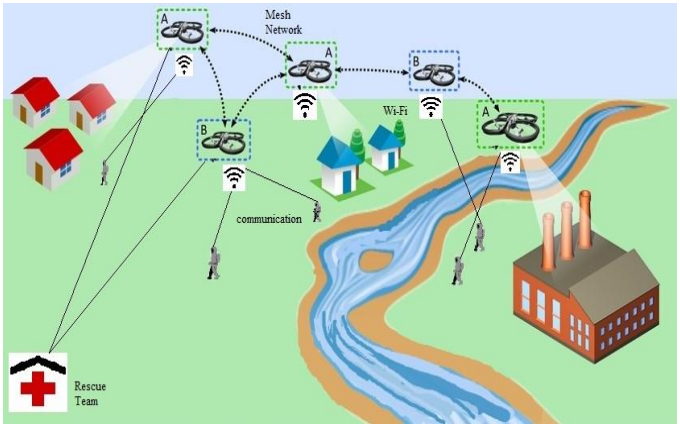

Fig. 1: Proposed system architecture

Here as shown in figure 1, we propose a system that can create a wireless mesh network to support the areas where disasters or floods destroy network infrastructure. This proposed system provides the wireless network with hopping devices like drones. In this scenario, the rescue team dispatches a number of proposed drones to the area and drones are distributed at the destinations. The intra network will be created in the area where the nodes are deployed.

People have to connect to this Wi-Fi network through smartphone, tablet or laptop. Once they connect, they will be able to communicate with other people those who connected to this network. Moreover, they can communicate with the rescue team. By searching nearby drones to establish wireless mesh network automatically, it provides Wi-Fi network to the area [2].

3.2 Wireless mesh network

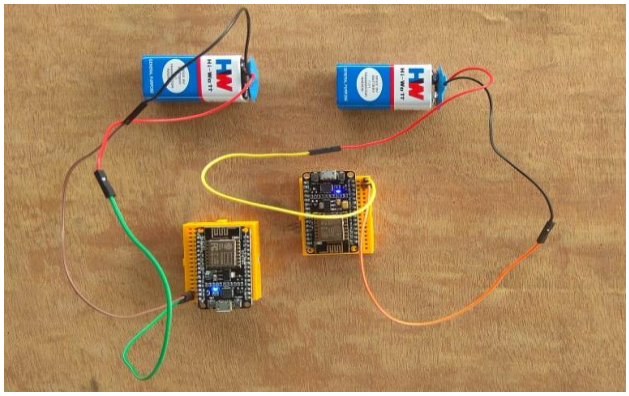

Fig. 2: Node MCU (esp8266 Wi-Fi mod)

To create a wireless mesh network we use ESP8266. As shown in figure 2 the ESP8266 is a low-cost Wi-Fi microchip with full TCP/IP stack. It is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. It has a 64 KiB boot ROM, 32 KiB instruction RAM, and 80 KiB user data RAM.

Fig. 3: Node MCU connected to the power supply

As shown in figure 3, the 9v battery is connected to provide power supply to the chip via breadboard, which can provide up to 5 hours of continuous use. The positive terminal is connected to the Vin port and the ground terminal is connected to the GND port in the chip. One node with Node 1 named and another with Node 2 named hot spot will be created and interconnected through the mesh network. As the user sends a message from Node 1 the messages will be visible at the other end devices connected to the Node 2 hot spot.

Below flowchart represents the working of an internal system where first the configuration of nodes takes place and the searching for the neighbouring nodes occurs and then it tries to connect to the nearest node. After the mesh network is created when the users can connect to that network.

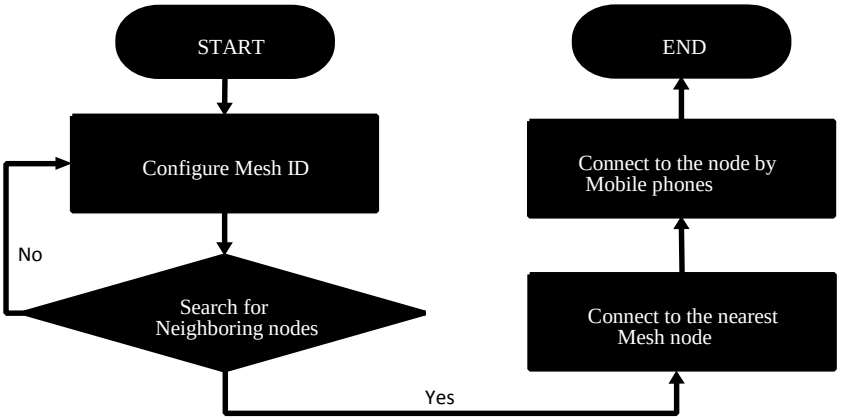

Fig. 4: Flowchart of mesh network

3.3 Drone with wireless mesh node

The drone is used for military purposes and used in various fields such as law enforcement, agriculture-surveillance, entertainment, disaster recovery, mining, etc. Previously, the drone is used only as a surveillance role for the delivery of goods for specific purposes but it is possible to utilize the drone as a search tool activating the automatic flight with exact coordinates. Usually, drone flies low it can be helpful to supply the Internet using wireless mesh node and it can be used in the dangerous areas where people cannot reach [1].

As shown in the below figure 5, we use a quad-copter drone that is stable and easy to control flight. The total weight of the parts is calculated to be 65 grams. It can fly about 30 minutes with 6000 mAh battery. If we use a higher capacity battery, flight time can be increased. It is equipped with Flight Controller (FC), Electronic Speed Control (ESC), motors, and propellers. A mesh node is installed under the proposed drone.

Fig. 5: Implemented drone with a wireless mesh network

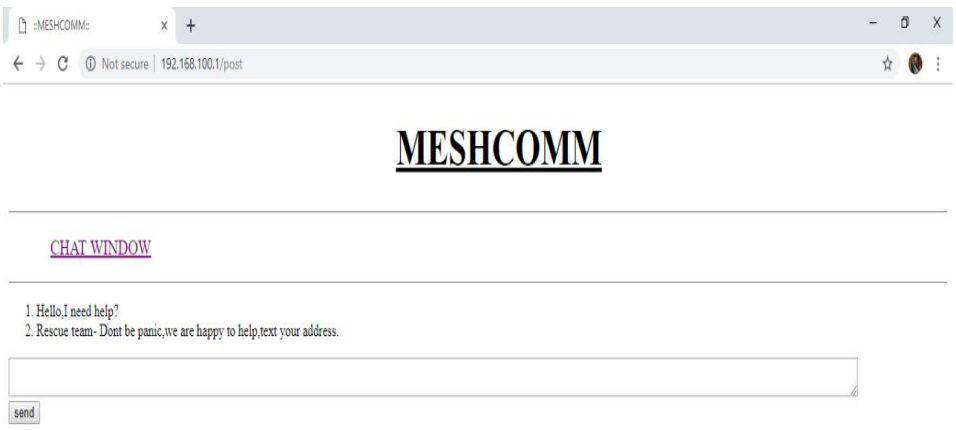

Fig. 6: Chat window after connecting to the network

Users can chat using this webpage and can share their current location name and details to the rescue teams.

4. APPLICATION

- This system can be used in Education such as many colleges, universities and high schools are converting their entire campuses to wireless mesh networks.
- This system reduces the need to bury cables in old buildings and across campuses. With multiple properly places indoor and outdoor nodes, everyone will be connected.
- This system can be used in entertainment fests. Instead of collecting everyone's contact number, we can directly pass the information through the network.
- This system can be used in Future Applications such as The U.S. military, which helped develop wireless mesh technology, where thousands of microchip-sized mesh nodes can be dropped onto a battlefield to set up instant surveillance networks. Information to both ground troops and headquarter personnel can be transmitted.

5. CONCLUSION AND FUTURE ENHANCEMENT

In this paper, we propose a system, which uses low-cost wireless mesh network nodes, fixed to the drone as a way to communicate to the trapped people with reduced cost and can save precious lives. It is possible to provide instant wireless communication infrastructure with Wi-Fi. The drone has a flight time of about 25 minutes, can provide up to 80 m bps transmission speed at a distance of 100m.

In the future, it will be developed using a flexible solar panel as a method for extending flight time and network operating time. Along with video calling to the rescue team as well as the internet can be provided with better speed and with the more stable network.

6. REFERENCES

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