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Ballooned Network Disaster Managment

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Abstract: Once disaster happened, communication network and information system are seriously damaged and communication means for residents cannot be used in the disaster area. It is very critical to rescue survivals as soon as possible and guarantee the safety of rescuers .It is necessary to build up a provisional emergency system to monitor the rescuing progress and situation. In this paper, a micro controller- based E-Emergency system with a ballooned wireless adhoc network is proposed. This system includes E-Nurse card, positioning reader and wireless module .The radar and adhoc network techniques are integrated for position and communication. In the real test ,the position and life information of rescuers can be shown in PC or laptop in the monitor centre .Moreover, the information also can be presented in smart phones anywhere .Finally the performance of rescue would be improved and loss would be reduced. The System is specifically developed to provide a stable communication channel between victims and rescuers. Additionally, we propose an optimization to WiFi direct network to enable the inter-group communication between different WiFi direct groups using WiFi legacy. Using this hybrid solution of the two technologies (WiFi legacy and WiFi Direct), we developed an android disaster management system that is more robust and resilient to damage. Experimental results demonstrate that the system achieves improvement in terms of energy consumption, delay and reliability comparing to existing works.

Keywords: E-Nurse Card, Omni Directional Camera, GSM Module, Balloon Nodes, VoIP

I. INTRODUCTION

Recently natural disasters such as earthquake, seismic sea wave, typhoon, hurricane in addition to annual disaster have frequently happened at many places around the world. When disaster occurs, information networks in-frastructure performs very important role as the residents communication means. However, once a disaster occurred, failures of network equipment, cutoff of communication lines and traffic congestion cannot be avoided. More reliable and robust network environment is required even though the serious damaged by disaster occurred. So far, we have developed effective Wide Area Disaster Information Net-Work (WDN) using Internet over the combination of both wired and wire-less network .In this information network, two important functions including resident safety information system and bidirectional video communication system between evacuation places and disaster information center are provided .However, in this WDN, system failure of network and computing facilities by disaster were not considered. In this paper, a ballooned wireless network is proposed to promptly insure communication means to grasp the information with disaster area, residents safety and relief goods on the occurrence of disaster. By combining multiple ballooned wireless network nodes, a large adhoc network is au-tomatically organized in the sky on the disaster area and can cover shelters or interrupted communication area as urgent communication means. The system configuration and its function are described. A prototype system is constructed to evaluate its function and performance through several dis-aster applications such as Wide Area Disaster Information and Sharing System (WIDIS) .Voice over IP telephone (VoIP), and Omni-directional image surveillance system. Throughout the performance and functional evaluation, we could verify usefulness of the suggested system.

II. THEORY

A. E-Nurse card

It is a microcontroller chip embedded on the rescuer. In this system, the location of each reader has to be well defined and saved in the Monitor Centre for calculating the relation position. The Readers install adhoc Wi-Fi module and continue wave receiver. The Readers would receive the continue wave broadcasted by the rescuer. According to the technology of angulation positioning, the position of the rescuer would be estimated. Finally, the position information of the position would also be transmitted to the Monitor Centre through the adhoc network.

B. Omni directional camera

The wireless omni-directional video surveillance systemwhich is a combination of omnidirectional camera and Pan/Tilt/Zoom control camera is attacked to a ballooned to be used to take video with states in the disaster area or around the evacuated area from the sky and transfers the state to the disaster headquarter in local government While the Omni-directional camera takes wide vision of the disaster area, Pan/Tilt/Zoom control camera takes the more precise image specified on the omni-directional camera image by controlling pan, tilt and zoom operations by users

C. GSM module

Global System for Mobile Communications, is a standard developed by the European Telecommunications Standards Institute (ETSI).It was created to describe the protocols for second-generation (2G) digital cellular networks used by mobile phones and is now the default global standard for mobile communications – with over 90% market share, operating in over 219 countries and territories.

D. Balloon nodes

A commercially available balloon made by vinyl chloride is used by considering its simple structure, low cost and easy utilization even though the disaster happened. The volume size of a balloon varies depends on how much of a total weight of wireless LANs is loaded. In our case, the volume of balloon is 3.5 m3 and filled up by helium gas which provides 28 Kg as buoyancy. On the other hand, the total weight includes the balloon (8.5Kg) and wireless access node (8Kg) and the supporting ropes (1.5Kg). Thus, the residual buoyancy is 10Kg which is enough to keep the balloon 40-100 m high in the sky.

E. VoIP Telephones

Just after an occurrence of disaster, since the traffic of conventional mobile telephone increases several ten times of ordinal case and leads to traffic congestion for a long time. In order to resolve this traffic congestion, by using wireless IP telephone network over and introducing VLAN or VPN functions, VoIP telephone service can be reserved in the evacuated areas

III. RELATED WORK

Here we introduce each papers based on the technologies used in the ballooned network and these are arranged in technologies bases

In [1], The introducing of a robust and large scale resident oriented safety information system is done. The safety information about the evacuated residents is registered to the local safety information server. All the local information servers are connected together by wireless networks and the safety information are send to an upper layer database in that district area, and all together, they are integrated into district safety information of that region. If any damaged local servers exist, they can be detected and recovered by upper layer database servers. These upper layer database servers are backed up by mirror servers which are located at mutually different locations which are at long distance to isolate the same disaster influence when some of them are destroyed. Thus two levels of backup functions and redundancy are introduced. These evacuated places over each city are connected by wired and wireless LANs. These connections lead to a central disaster centre. The safety information database servers and disaster information web servers including disaster information as well as ordinal life information are stored in each evacuation places and central disaster centres. Some of the benefits of using wireless LANs are high speed, cost effective network with 54Mbps and the robust and reliable physical network connection is realized even if the disaster has happened, the recovery of the network function from damage can be relatively quick and these can be done by simply compensating the damaged line by temporal wireless LAN which is installed on relied vehicle, more flexibility and effective safety information system by combining wireless LANs and mobile terminals such as mobile PCs, PDAs or wireless VoIPs

In[2] , balloon is used for weather information such as atmospheric pressure, temperature, humidity and wind speed. These information are reported to the ground by a radio equipment at a radio frequency of 403 or 1630 MHz. here , three applications a 2 wireless mesh network technologies are explained. The vertical network is for communications between the wireless network node attached to the balloon and mobile PCs or devices. It uses the access method, IEEE 802.11b,g with the maximum distance around 600 m (2000 ft). That is a standard Wireless Local area network (WLAN) protocol also known as Wi-Fi. It uses a hexahedral antenna because it can cover a ground area of around 100 m (328 ft) diameters from 40 m (131 ft) above the area. The mesh network is for between balloons. It works over Wi-Fi IEEE 802.11j with 4.9 GHz transmission frequency, 250 mW power density, and 54 Mbps network bandwidth, which is now incorporated into the IEEE 802.11-2007 standard.

In[3] this paper we introduce a system based on peer to peer network . Here a prototype disaster system is developed and a middleware for both disaster recovery and node sharing protocol is developed by using JAXTA. According to this

concept disaster information network is built in each capital in a bottom-up way. The key components of the system are client ,local safety information servers, integration servers and high speed network. It is a residence oriented disaster information system. Middleware of the system invented system is placed in between application layer and transport layer. An important goal in P2P networks is that all clients provide resources, including bandwidth, storage space, and computing power. Thus, as nodes arrive and demand on the system increases, the total capacity of the system also increases. This is not true of client-server architecture with a fixed set of servers, in which adding more clients could mean slower data transfer for all users.

In [4] this paper we propose a disaster communication method based on wireless LAN system . Each residence may produce a leaked waves to the outdoor. It is used as urgent information infrastructure. Proposed system is a community based disaster information sharing system. For verifying validity, the proposed system carried out the performance evaluation of RTT and throughput. RTT is measured by using default command. In order to obtain showing of disaster information common channel wave is leaked to out doors, so that the community residents can use this channel and access to the disaster information server to inform and share the disaster information. Also this channel can be used for the outdoor residents to inform to the local government office, police and fire department. The residents in the community can also communicate each other using wireless VoIP terminal or videophone such as skype from/to indoor and outdoor in both directions.

In [5] this paper we propose a disaster communication method based on wireless LAN system . Each residence may produce a leaked waves to the outdoor. It is used as urgent information infrastructure. Proposed system is a community based disaster information sharing system. For verifying validity, the proposed system carried out the performance evaluation of RTT and throughput. RTT is measured by using default command. In order to obtain showing of disaster information common channel wave is leaked to out doors, so that the community residents can use this channel and access to the disaster information server to inform and share the disaster information. Also this channel can be used for the outdoor residents to inform to the local government office, police and fire department. The residents in the community can also communicate each other using wireless VoIP terminal or videophone such as skype from/to indoor and outdoor in both directions.

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In[7] WDN is been explained. Recently risk management for disasters such as earth quick , mountain explosion , seismic sea wave , in addition to ordinal disasters , such as typhoon, rain flooding and snow-slide has been seriously concerned to keep the safety for the residents in many countries. More reliable and robust information system than the conventional business or research oriented information network must be constructed to normally and correctly perform their functions for residents even though serious disaster happened. In this paper , we propose a unified Wide Area Disaster Information Network(WDN) using internet through a temporarily created network. The prototype system of the disaster information system based on our suggested WDN was built to demonstrate and evaluate its functionality. Though the practical training in the local city for preparation of mountain explosion , we could confirm the usefulness of the suggested system. It is a unified wide area disaster information network using internet based on the both wired and wireless network

In [8] a wireless Adhoc network is introduced, disasters cause a huge destruction which results in the failure of conventional communication systems, where the communication infrastructure might be collapsed partially or completely. In such situations, the rescue teams are deployed immediately in order to save human lives. In such scenarios, communication plays a vital role for better disaster response information gathering. To meet such needs we present peer to peer communicating Ad-hoc networks, which doesn't have infrastructure and is very helpful during catastrophic or tumultuous activities. In general, Ad-hoc networks have nodes, long transmission link which again require towers for antennas in order to establish long distance communication. But by using peer to peer communication mechanism, number of nodes is used between the source and destination for long distance communication. This in turn decreases the cost and increases the availability. When there is a situation where internet or wired networks are completely unavailable, it is necessary to move for completely wireless technologies Mobile Ad-hoc Network" i.e. MANET which is having wireless communication technology such as Wi-Fi, is proposed. It is an

infrastructure less, self-relying network which is composed of individual devices and they communicate among themselves directly. Usage of MANET can provide the communication and it is helpful during the disaster management.

In[9] This paper describes an ad hoc networking scheme and routing protocol for emergency communications. The objective of the network is to collect damage assessment information quickly and stably in a disaster. The network is configured with a hybrid wireless network, combining ad hoc networks and a cellular network to maintain connectivity between a base station (BS) and nodes even in a disaster. In the event that a direct link between the BS and a node is disconnected due to damage or obstacles, the node switches to the ad hoc mode, and accesses the BS via neighboring nodes by multi hopping. The routing protocol proposed in this paper discovers and builds a route by way of monitoring neighbors_ communications instead of broadcasting a route request packet. The network employs a dedicated medium access control protocol based on TDM (Time Division Multiplexing) for multi hopping in ad hoc networks to maintain accessibility and to perform a short delay. Experiments showed that approximately 90% of nodes are capable of reaching the BS within a few hops, even in conditions where only 20% of nodes maintain direct connections to the BS. In addition, the results showed that it is feasible for the network to operate in a short delay for delivering a packet to the BS. However, throughput is not retrieved sufficiently due to the restriction of the access protocol, whereas reachability does improve sufficiently. Therefore, the network is suitable for collecting damage assessment information and transmitting urgent traffic quickly and stably, while the data is restricted to a small amount.

In [10]We propose to construct an ad hoc network of wireless smart badges in order to acquire information from trapped survivors. We investigate the energy efficient routing problem that arises in such a network and show that since smart badges have very limited power sources and very low data rates, which may be inadequate in an emergency situation, the solution of the routing problem requires new protocols. The problem is formulated as an any cast routing problem in which the objective is to maximize the time until the first battery drains-out. in an emergency network constructed after a collapse, which may connect thousands of nodes and may route critical information, the required data rates and the consumed energy may be much higher than in daily use. Thus, the low data rates and the limited power sources are a major constraint on the performance of an emergency network. This paper focuses on energy efficient routing protocols for emergency networks of badges. We note that since wireless devices usually have a finite power supply, there is an increasing interest in research regarding energy conserving protocols .Thus, our network model is based on the model for energy conserving routing in a wireless sensor network. However, unlike a wireless sensor network in which the available bandwidth is usually sufficient, in the emergency network there is a strict bandwidth restriction along with a strict energy restriction. Hence, the solution of the problem calls for the development of new protocols.

In [11]We propose to construct an ad hoc network of wireless smart badges in order to acquire information from trapped survivors. We investigate the energy efficient routing problem that arises in such a network and show that since smart badges have very limited power sources and very low data rates, which may be inadequate in an emergency situation, the solution of the routing problem requires new protocols. The problem is formulated as an any cast routing problem in which the objective is to maximize the time until the first battery drains-out. in an emergency network constructed after a collapse, which may connect thousands of nodes and may route critical information, the required data rates and the consumed energy may be much higher than in daily use. Thus, the low data rates and the limited power sources are a major constraint on the performance of an emergency network. This paper focuses on energy efficient routing protocols for emergency networks of badges. We note that since wireless devices usually have a finite power supply, there is an increasing interest in research regarding energy conserving protocols .Thus, our network model is based on the model for energy conserving routing in a wireless sensor network. However, unlike a wireless sensor network in which the available bandwidth is usually sufficient, in the emergency network there is a strict bandwidth restriction along with a strict energy restriction. Hence, the solution of the problem calls for the development of new protocols.

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In [15]This paper gives Mobile Ad-Hoc Network (MANET) along with Dynamic Source Routing protocol (DSR). Simulation results for performance measurement of DSR algorithm for normal condition are given first. Same parameters are measured after applying disaster condition on nodes is presented in next section. In last section simulation results of disaster prevention condition are given. It is observed that performance of the network after application of prevention condition is nearly same as the normal performance. The performance is evaluated in terms of Network Throughput, Packet Delivery Ratio, and Average end to end delay. The role of information and communication technology in disaster management has been evolving. Large quantities of disaster-related data are being generated. Behavior of critical infrastructures is being explored through simulation, response plans are being created by government agencies and individual organizations, sensory systems are providing potentially relevant information, and social media have been flooded with disaster information. Current data storage systems are disparate and provide few or no integration capabilities. To make the most of available information, a reliable and scalable storage system supported by information sharing, reuse, integration, and analysis is needed

In[16] this paper, a self power supplied micro wireless ballooned network is introduced to provide communication between the disaster affected people and rescue team. Communication means is achieved by combining multiple ballooned wireless nodes with self supply.self supply of power is provided by using solar panel power supply.to provide the facilities to the affected people ,we use WDN a video communication system, ballooned wireless between is used. The system includes multiple ballooned network nodes, fixed access point, mobile node PCs, wireless IP telephones, solar power panel system. Ballooned node consist of two wireless LANs IEEE802.11.j and IEEE802.11.b,g.The balloon node is attached with camera to observe the affected area from the sky. The balloon nodes are launched about 40-100 meter height in the sky with attached LAN and each node connected to neighbouring nodes by LANs auto configuration function and the wireless network is connected to a fixed access point. PAN/TILT/ZOOM control camera is attached to the ballooned node and using this we can take video to observe the states of the disaster area from sky and transfer the information into the volunteers. Electric power from the solar panel is supplied to the network node by using very thin power cable. A web based sharing system is used to register and retrieve information from the disaster area .The disadvantage of the system is difficulty in the implementation of solar system and its maintenance. Maintenance and implementation of solar panel system is costly and it include difficulties.

In[17] this paper it discuss about the method which used to find and save the missing people and know the degree of the disaster happened. When disaster is occurred there will be lack of power supply and communication network failure. Introduced a wireless ballooned monitoring system which uses Omni directional camera in order to take the images from the upper layer of damaged area and send it to the head quarters of volunteers. The system includes multiple

ballooned wireless networked nodes with Omni directional camera, fixed access point, mobile node PCs,wireless telephone. The mobile node PC is used to register the residence safety, disaster information, relief goods at shelters to the disaster information servers through adhoc network. VoIP is performed voice communication between the residence or volunteers when the mobile telephone network is congested. Disaster monitoring system is consist of three layers-camera control layer, image process layer and change format layer. camera control layer is manages the network connection to the omni directional camera on the ballooned network unit. Image processing layer processes omni directional images and the change format layer will makes image format conversion to deal with from the original ringed images to various formats such as panorama images, the extended image on the specified location. The electric power required for omni directional camera and the LAN router is supplied by self supply and mobile energy supply system which is a combination of mobile battery and solar panel. The images captured by omni directional are transmitted through the wireless LAN on the ground and received at the relay station in the wide area.

In[18] this paper, a disaster surveillance video transmission system by wireless ballooned network is proposed to promptly observe and grasp the information around the disaster area form sky on the occurrence of disaster. A combination of both omnidirectional camera and pan-tile-zoomed control camera so called PTZ camera is used to widely capture images with 360 degree direction by omnidirectional camera while the specified point in the omni-directional camera image is panned, tilted and zoomed using PTZ camera. The system performs very important role as the resident's communication means. once a disaster occurred, failures of network equipment, cutoff of communication lines and traffic congestion cannot be avoided. More reliable and robust network environment is required even though the serious damaged by disaster occurred. The system is implemented by combining multiple ballooned wireless network nodes, a large mesh network is automatically organized in the sky on the disaster area and can cover shelters or interrupted communication area as urgent communication means. The urgent information network infrastructure in disaster area quickly is organized using the suggested ballooned wireless mesh network. The electric power for wireless network node is supplied from power battery for emergency or vehicles on the ground through the very thin power cable. The system configuration consisted of two type of camera units with camera server, omni-directional camera and a PTZ camera and client TGc1. The omni-directionaal camera with PAL lens is attached to DV, HDV or C-mounted USB camera and connected to the camera server through IEEE1394 or USB interfaces. On the other hand, the video output signal NTSC of the PTZ camera is converted by A/D converter to DV format and connected to the camera server through IEEE1394.On the camera server, moving object detection function by which the location and the size of the moving object can be detected from the image and automatic motion tracking function by which the PTZ camera automatically can track to the detected moving object can be performed. The video images captured from the PTZ are sent to the client as a live video stream.

In[19] The paper discuss about how a disaster information system can be formed by automatic antenna control method. The system is introduced to use it when a dangerous situation is formed by any natural disasters. More reliable and robust network environment is required even though the serious damaged by disaster occurred. In this information network, two important functions including resident safety information system and bidirectional video communication system between evacuation places and disaster information center are provided. In this method, combining multiple ballooned wireless network nodes, a large mesh network is automatically organized in the sky on the disaster area and can cover shelters or interrupted communication area as urgent communication means. A commercially available balloon made by vinyl chloride is used by considering its simple structure, low cost and easy utilization even though the disaster happened. The volume size of a balloon varies depends on how much of a total weight of wireless LANs is loaded. The multiple wireless network nodes are mutually and automatically connected by auto configuration function by which the links from one wireless node to the neighbor node whose electro-magnetic field power density is the strongest among them and repeating this procedure to organize minimum spanning tree network. Thus, an adhoc network is organized in the sky .When a wireless network node moves or is failure, then the network node also automatically selects the best neighbor node as the same procedure. When disaster occurred traffic congestion is occurred, In order to resolve this traffic congestion, by using wireless IP telephone network over and introducing VLAN or VPN functions, VoIP telephone service can be reserved in the evacuated areas. In this system, three middleware functions are developed as function libraries. First, Midfield is developed to transmit the omni-directional and PTZ vide images on IP network, record into files and control remotely the video stream. Second, omnidirectional middleware is developed to convert the omni-directional images to the equivalent panorama images. Third, PTZ middleware is developed to control the PTZ camera images. Those system functions is known as Telegnosis system

In[20] this paper, a renewable energy based wireless ballooned network is designed to insure communication means to grasp information in disaster areas. By combining multiple ballooned wireless network nodes, a large adhoc network is automatically organized in the sky on the disaster area and can cover shelters or interrupted communication area as urgent communication means. SKYMESH is an emergency communication system for large scale disaster. As emergency communication systems for the large scale disaster of wireless network using balloons, a network construction method for SKYMESH is proposed. The proposed network construction method is implemented, and its

performance is evaluated. A ballooned wireless network is proposed to promptly insure communication means to grasp the information with disaster area, resident's safety and relief goods on the occurrence of disaster. By combining multiple ballooned wireless network nodes, a large adhoc network is automatically organized in the sky on the disaster area and can cover shelters or interrupted communication area as urgent communication means. The Structure consists of balloon nodes, terrestrial nodes and user terminals are termed as SKYMESH. SKYMESH is an emergency communication system for large scale disaster. Then not only specialists but also people who are out of touch with network technology can construct it. SKYMESH has a peculiar characteristic, which derives from network components such as balloon nodes and terrestrial nodes.

IV. CONCLUSION

The microcontroller-based E-Emergency System with wireless adhoc networks includes E-Nurse card, Positioning reader and Wireless module. The Radar and adhoc network techniques are integrated for position and communication. The system can be established easily anytime and any-where without any infrastructure. In the real test, not only the Monitor Center but also the smart phones in anywhere can monitor the real-time safety information of the rescue team workers, i.e., heartbeat, breath and position. Finally, the performance of rescue would be improved, and the loss would be reduced. By combining multiple ballooned wireless net-works, an adhoc network is organized in the sky on the disaster area, shelters or interrupted communication area as urgent communication means. A Prototype system was constructed to evaluate its function and performance through three disaster application such as WIDIS, VoIP, and Omni-directional video surveillance system. Through this evaluation of the prototype system, the usefulness of our suggested ballooned wireless adhoc network system could be verified. three applications to which balloon networking are applied: Shibata et al. proposal for disasters, the Sky Site platform from Space Data Inc, and Google Project Loon. Moreover, it presented that technologies in typical wireless mesh networks are able to be applied to balloon networking. While it has been shown that using balloons to provide wireless networks has several advantages, unfortunately balloon networking is not being actively researched. This is because only few papers have been published and other works are not unveiled. However, seeing the progress of the project, it does give us a lot of reasons to stay optimistic and find solutions to deal with the drawbacks thus making the Internet affordable for everyone innovating the connectivity worldwide

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