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A Survey on Emergency Navigation using Wireless sensor Networks

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Abstract;- **Wireless sensor networks (WSNs) provide emergency navigation services, given their easy deployment and the ability of intelligent sensing and communication. They help people in escaping from a hazardous region safely and quickly when an emergency occurs. However guiding more and more people to the same exit, causes congestion which does not help in timely evacuation. Many a times, trapped people move back and forth during navigation, known as oscillation. Frequent oscillations lead to the people remaining in danger for a longer period of time, and decreases their chances of survival. The evacuation systems must provide shortest and safest navigation path with reduced congestion. In this paper, we give a survey of various emergency navigation schemes. The existing systems are evaluated in terms of parameters such as scalability, congestion avoidance, evacuation time, survival rate, communication cost, reaction to emergency dynamics and navigation efficiency with guaranteed safety.**

Keywords;- **Congestion, Emergency, Navigation, Wireless Sensor Network (WSN).**

I. INTRODUCTION

WSNs raise many exciting opportunities to minimize the impacts caused by emergencies [1]-[4].In a mobile sensor network, the sensors are able to relocate and self-organize into a network. One interesting application of WSN is that they are used as indoor guiding service for emergency evacuation whose goal is to assist moving objects in escaping a hazardous region safely and quickly when an emergency occurs. WSNs are an attractive option for indoor environments today, due to the recognition of the importance of energy conservation [5] and emergency/rescue operations [3], [10]. The sensor nodes are deployed in an area of interest in advance. The users are equipped with communicating devices like 802.15.4 compatible PDAs that communicate with sensors in the network [7], [8]. When an emergency occurs in this area, the service can determine the emergency location from the data collected by sensor nodes. It then plans safer paths that detour around the hazardous regions and arranges proper paths that can evacuate all people in short time. According to guiding directions of sensor nodes, a person can follow the planned paths to escape to safe area.

In centralized load-balancing guiding system, an analytical model is used to estimate the total evacuation time [9]. The base station uses this model to construct a guiding tree whose evacuation time is the shortest. It relies on wired infrastructure or multi-hop wireless sensor network for gathering sensing data. The central server thus has the comprehensive knowledge of all sensor nodes. Optimal navigation paths are then constructed by the central server and sent via the sensor network to inform and guide the moving objects. However, an emergency (e.g., fire, earthquake) may damage the central server or the sensor network. Each sensor node exchanges sensing data with neighboring nodes and determines its guiding direction based on collected data [7]- [10]. The concept of potential is used to attract or repulse the moving objects. A danger area has a repulsive potential to push away moving objects, and a safe area has an attractive potential to pull them towards it. Based on potential of various locations, navigation paths with guiding directions are constructed for objects to move away from the danger area. The concept of potential is also utilized in [11], which additionally considers scenarios with multiple emergency events and multiple exits in their proposed protocol.

The navigation of human beings seeks for a safe-critical path, other than packet loss or energy efficiency which is the first priority as in packet routing. Here the safety of a path not only means to be far away from a hazardous area, but also refers to mild congestion, less detours as well as fast reaction to emergency. Secondly, human navigation consumes much more time than traditional packet routing process, due to the limited movement speed of people. While during one packet delivery process the network is often considered static, human navigation in contrast deals with emergency dynamics almost all along the guiding process.

II. LITERATURE SURVEY

Chen wang ; Hongzhi Lin; Hongbo Jiang, "Cans: Towards Congestion-adaptive And Small Stretch Emergency Navigation With Wireless Sensor Networks. The algorithm proposed in this paper achieves both mild congestion and small stretch, where all operations are in-situ carried out by cyber-physical interactions among people and sensor nodes. It not require location information, nor the reliance on any particular communication model. It is also distributed and scalable to the size of the network with limited storage on each node. It develops a potential map which indicates the hazard level of an exit, and develops a hazard level map which tells the location of hazardous areas so that users are guided to different paths and heavy congestion is avoided. People near the hazardous area achieve a mild congestion at the cost of a slight detour, while people distant from the danger avoid unnecessary detours. It has faster reacting speed to emergency dynamics and highest navigation path planning efficiency.[12]

Ziliang Wang; Zhenjiang Li; Mo Li; Yunhao Liu; Zheng Yang, "Sensor Network Navigation Without Locations". The navigation system presented in this paper embeds a road map in the sensor network without location information so as to provide users navigating routes with guaranteed safety. The road map is rebuilt in the event of changes in dangerous areas. Users issue only local queries to obtain navigation route. It incurs the least overhead as only local communication is needed to update the road backbone when dangerous areas change.[13]

Guang Tan; Stephen A. Jarvis; Anne – Marie Kermarrec, "Connectivity-guaranteed And Obstacle-adaptive Deployment Schemes For Mobile Sensor Networks". The navigation scheme stated in this paper maximizes sensing coverage, achieves connectivity for a network with arbitrary sensor communication/ sensing ranges or node densities. Floor- based scheme is used that divides the field into floors. It does not need any knowledge of the field layout, which can be irregular and have obstacles of arbitrary shape. A high network coverage and a small moving distance is obtained.[14]

Lin wang; Yuan He; Wenyuan Liu; Nan Jing; Jiliang Wang; Yunhao Liu, "On Oscillation-free Emergency Navigation Via Wireless Sensor Networks". The system uses the concept of moving speed to evaluate the congestion degree to accurately estimate the evacuating time. Oscillation is defined as a situation where the trapped users will move back and forth passively in local area due to crowd congestion or emergency dynamics. It reduces the direction oscillations due to the network communication delay and adapt to the variation of hazardous region. A metric called ENO(Expected Number of Oscillations) is used to measure the success rate of navigation. It greatly reduces the stay time of users in dangerous regions, enhancing the overall safety of the guided users. [15]

Yunhao Liu; Yuan He; Mo Li; Jiliang Wang; Kebin Liu; Luferng Mo; Wei Dong; Zheng Yang; Min Xi; Jizhong Zhao; Xiang – Yang Li, "Does Wireless Sensor Network Scale? A Measurement Study On Greenorbs" . GreenOrbs is a monitoring system deployed in forest area that performs all-year-round ecological surveillance in the forest, collecting various sensory data, such as temperature, humidity, illumination, and content of carbon dioxide. The collected information can be utilized to support various forestry applications. The main aim of this system is to check whether wireless sensor networks scales. Network yield, percentage of successfully acknowledged packets are measured. The system does not suffer from 'hot area' problem. It is the first method to conduct a long term and large-scale measurement study on an operating sensor network in the wild. [16]

Buragohain;D.Agrawal;S.Suri,"Distributed Navigation Algorithms For Sensor Networks". The system constructs a skeleton graph which is nothing but a reduced graph with fewer nodes from the full communication graph. It makes use of skeleton graph to find approximate safe paths with much lower communication cost. Shortest path is found which is of optimal quality and safe .The system also calculates minimum exposure path.[10]

Dilusha Weeraddana; Ashanie Gunathillake and Samiru Gayan, "Sensor Network Based Emergency Response And Navigation Support Architecture". The paper proposes a system that integrates the WSN based knowledge

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with the soft knowledge acquired from various data sources for the emergency navigation support. The main funcationalities of the system include gathering data from WSN deployed in multi-story building, processing it with information from knowledge base, share the decisions made with first responders and people in the building. Meets the navigation requirements of both the firefighters and victims and evacuates people much faster avoiding congestion.[17]

Shen Li , Andong Zhan, Xiaobing Wu, Panlong Yang and Guihai Chen, "Efficient Emergency Rescue Navigation With Wireless Sensor Networks". The Emergency Rescue Navigation strategy takes both pedestrian congestion and rescue force flexibility into account to save trapped people. The system uses a directed graph to model the entire environment. The movements of people are taken as network flows on graph. By calculating maximum cut on graph, the system gives commands to firemen to avoid hazardous areas so that trapped people are saved and congestion is avoided. It minimizes evacuation time by sending firemen to clean obstacles and keep those regions safe. [18]

Gaddafi Abdul-Salaam, Abdul Hanan Abdullah and Mohammad Hossein anisi, "Energy-efficient Data Reporting For Navigation In Position-free Hybrid Wireless Sensor Networks". Hybrid Wireless Sensor Networks consists of both static and mobile sensor nodes that work together for sensing and collecting data. Total power consumption is minimized because each node adjusts its radio frequency transmission power needed to reach neighbour nodes without using maximum radio frequency power. It reports event packets in an energy-efficient manner .It significantly reduces the energy consumption and maximize the HWSN lifetime. The elimination of packet redundancy is feasible. [19]

Chi-Han Lin ; Po-Yu Chen; Wen –Tsuen Chen, " An Adaptive Guiding Protocol For Crowd Evacuation Based On Wireless Sensor Networks". This protocol takes into account many factors like location of hazardous regions, distance to exits, congestion degree of each location and guides moving objects with load balancing among multiple navigation paths to multiple exits and avoids congestion to reduce the evacuation time. It achieves the highest survival rate. [20]

S.NO	TITLE	DESCRIPTION
1	**Cans: Towards Congestion adaptive And Small Stretch Emergency Navigation With Wireless Sensor Networks**	Tracks the location of exit and boundary of hazardous areas and achieves mild congestion at the cost of a slight detour.
2	**Sensor Network Navigation Without Locations**	Embeds a road map in the sensor network without location information and rebuilds the road map in the event of changes in dangerous areas.
3	**Connectivity-guaranteed And Obstacle-adaptive Deployment Schemes For Mobile Sensor Networks**	Achieves connectivity for a network with arbitrary sensor communication/ node densities, at the cost of a small moving distance.
4	**On Oscillation-free Emergency Navigation Via Wireless Sensor Networks**	Uses the concept of moving speed to evaluate the congestion degree to accurately estimate the evacuating time and reduces the direction oscillations due to the network communication delay.
5	**Does Wireless Sensor Network Scale?A Measurement Study On Greenorbs**	Aims at all-year-round ecological surveillance in the forest, collecting various sensory data,
6	**Distributed Navigation Algorithms For Sensor Networks**	Uses the idea of skeleton graph to find approximate safe paths with much lower communication cost.
7	**Sensor Network Based Emergency Response And Navigation Support Architecture**	Integrates the WSN based knowledge with the soft knowledge acquired from various data sources for the emergency navigation support.
8	**Efficient Emergency Rescue Navigation With Wireless Sensor Networks**	The Emergency Rescue Navigation strategy takes both pedestrian congestion and rescue force flexibility into account to save trapped people.
9	**Energy-efficient Data Reporting For Navigation In Position-free Hybrid Wireless Sensor Networks**	Reports event packets in an energy-efficient manner and significantly reduces the energy consumption and maximize the HWSN lifetime.
10	**An Adaptive Guiding Protocol For Crowd Evacuation Based On Wireless Sensor Networks**	The protocol guides moving objects with load balancing among multiple navigation paths to multiple exits and avoids congestion to reduce the evacuation time.

VARIOUS EMERGENCY NAVIGATION TECHNIQUES

III. CONCLUSION

This survey paper presents an overview of various emergency navigation techniques implemented using wireless sensor networks. One of the main challenges in emergency navigation systems is that quantifying the safety of a path is not possible all the time. After the emergency alert has triggered, the user will not be able to find the shortest path to exit efficiently, because of unknown place. The congestion caused by rushing trapped users to the nearest exit is also a major problem. The ultimate

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objective of any emergency navigation must be to guide people to the nearest exit for the sake of timeliness which causes extreme congestions at the exit and significantly prolong the emergency navigation time while leaving other exits of low usage. An alternative path must be shown while ignoring a roundabout way temporarily replacing part of a route.. In this paper, we have surveyed various emergency navigation schemes taking into account scalability, congestion avoidance, evacuation time, survival rate, communication cost, reaction to emergency dynamics and navigation efficiency with guaranteed safety.

REFERENCES

[1] Y.Yanning, "Opportunities for WSN for facilitating fire emergency response," in IEEE International Conference on Information and Automation for Sustainability, pp. 81–86, 2010.

[2] M. R. J. A. A. V. G. K.Lorincz, J.David and M.Welsh, "Sensor networks for emergency response: Challenges and opportunities," Pervasive Computing, 3(4), pp. 16–23, 2004.

[3] K. M. L. Yang, R. Prassana, "On-site information systems design for emergency first responders," Journal of Information Technology Theory and Application (JITTA), pp. 5–27, 2010.

[4] X. P. L.Shen, A.Zhan and G.Chen, "Efficient emergency rescue navigation with wireless sensor networks," in Journal of Information Science and Engineering, vol. 27, 2011.

[5] S.Gamwarige and E.C.Kulasekere, "An energy efficient distributed clustering algorithm for ad-hoc deployed wireless sensor networks in building monitoring applications," Electronic Journal of Structural Engineering (eJSE) Special Issue: Sensor Network on Building Monitoring: from Theory to Real Application, pp. 11–27, 2009.

[6] P. R. Y. L. Yang, Y., "Opportunities for WSN for facilitating fire emergency response," Proceedings of ICIAfS 10, pp. 81–86, 2010.

[7] L.-W. Chen, J.-H. Cheng, Y.-C. Tseng, L.-C. Kuo, J.-C. Chiang, and W.J. Lin, "LEGS:A Load-balancing Emergency Guiding System Based on Wireless Sensor Networks," in *Proceedings of IEEE International Conference on Pervasive Computing and Communications (PerCom) Workshops*, 2012.

[8] Q. Li, M. D. Rosa, and D. Rus, "Distributed Algorithms for Guiding Navigation across a Sensor Network," in *Proceedings of International Conference on Mobile Computing and Networking (MobiCom)*, 2003.

[9] M.-S. Pan, Y-C. Tseng, and Y.-Y. Tsai, "A Distributed Emergency Navigation Algorithm for Wireless Sensor Networks," *IEEE Computer*,vol. 39, no. 7, pp. 55–62, Jul. 2006.

[10] C. Buragohain, D. Agrawal, and S. Suri, "Distributed Navigation Algorithms for Sensor Networks," in *Proceedings of IEEE International Conference on Computer Communications (INFOCOM)*, 2006.

[11] W.-T. Chen, P.-Y. Chen, C.-H. Wu, and C.-F. Huang, "A Load-balanced Guiding Navigation Protocol in Wireless Sensor Networks," in *Proceedings of IEEE Global Telecommunications Conference (GLOBECOM)*, 2008.

[12] Chen wang ; Hongzhi Lin; Hongbo ,Jiang, "Cans: Towards Congestion-adaptive And Small Stretch Emergency Navigation With Wireless Sensor Networks,2016.

[13] Ziliang Wang; Zhenjiang Li; Mo Li; Yunhao Liu; Zheng Yang, "Sensor Network Navigation Without Locations",2013.

[14] Guang Tan; Stephen A. Jarvis; Anne – Marie Kermarrec, "Connectivity-guaranteed And Obstacle-adaptive Deployment Schemes For Mobile Sensor Networks",2009.

[15] Lin wang; Yuan He; Wenyuan Liu; Nan Jing; Jiliang Wang; Yunhao Liu, "On Oscillation-free Emergency Navigation Via Wireless Sensor Networks",2015.

[16] Yunhao Liu; Yuan He; Mo Li; Jiliang Wang; Kebin Liu; Luferng Mo; Wei Dong; Zheng Yang; Min Xi; Jizhong Zhao; Xiang – Yang Li, "Does Wireless

Sensor Network Scale? A Measurement Study On Greenorbs",2011.

[17] Dilusha Weeraddana; Ashanie Gunathillake and Samiru Gayan, "Sensor Network Based Emergency Response And Navigation Support Architecture",2013.

[18] Shen Li , Andong Zhan, Xiaobing Wu, Panlong Yang and Guihai Chen, "Efficient Emergency Rescue Navigation With Wireless Sensor Networks",2011.

[19] Gaddafi Abdul-Salaam, Abdul Hanan Abdullah and Mohammad Hossein anisi, "Energy-efficient Data Reporting For Navigation In Position-free Hybrid Wireless Sensor Networks",2017.

[20] M. Kuderer, C. Sprunk, H. Kretzschmar, and W. Burgard, "Online generation of homotopically distinct navigation paths," in Proceedings of 31st IEEE ICRA, 2014.

[21] Chi-Han Lin ; Po-Yu Chen; Wen –Tsuen Chen, " An Adaptive Guiding Protocol For Crowd Evacuation Based On Wireless Sensor Networks", IEEE 77th Vehicular Technology Conference (VTC Spring), 2013.

[22] S. Bhattacharya, N. Atay, G. Alankus, C. Lu, O. B. Bayazit, and G.C. Roman, "Roadmap query for sensor network assisted navigation in dynamic environments," in Distributed Computing in Sensor Systems. Springer, 2006, pp. 17–36.