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DESIGN OF INTELLIGENT RESCUE SYSTEM USING POWER ALLOCATION ALGORITHM

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***Abstract-* This Paper describes the modified design of a wireless sensor network capable of automatically evacuating a building. Efficient emergency evacuation plans are needed to ensure that no human life is lost in the case of emergency situations like natural disasters or even man-made disaster conditions. During an emergency situation (such as fire inside a building), personnel safety and evacuation time are the main criteria to be considered. Upon detection of an emergency event, evacuees are guided to the safest and shortest path with help of display. Power routing algorithm is developed which will find shortest route to the exit also by taking into account power consumption of nodes which will improve the life time of nodes. System is required to interface with a control room which updates evacuation data and battery status of nodes.**

I. INTRODUCTION

Densely populated buildings are increasing in number day by day as a direct result of booming economic conditions. In these buildings, there is a need to optimize the execution of emergency evacuation plans to ensure that no human life is lost in the case of emergency situations. It is not always possible to rely on human intervention, even though the role of Emergency Response Teams and firefighters are crucial.Presently as a measure of safety against emergency events buildings were required to practice their evacuation strategy -mock drills periodically Also in most of the buildings floor plans showing different exit paths are displayed in main areas of building. Nowadays mostly people use the elevators in buildings as a convenient and fast way.In an emergency situation, elevators are returned to the main lobby and shut down. So in case of any emergency, people are assumed to use the stairs for evacuation. Staircases are often quite narrow and they can easily get congested during evacuation. All the above methods are effective for only permanent building inhabitants and avoid evacuation procedure awareness for once-off visitors.

As a solution for the above mentioned problems automatic emergency evacuation plans are developed to guide the people away from an affected region into safe area, and to minimize the time and risk it takes to get there. The best route for anyone depends on the specifics of the incident, the actual state of the building, the condition and location of the evacuees and so on. Present day evacuation plans are static: they are predefined, and the routes to the exits do not change for whatever reason. Sometimes predetermined evacuation routes may be blocked by smoke or fires, and corridors may be too narrow for the number of evacuees. Dynamic evacuation routing is the solution which will dynamically determine the fastest routes to the exits.

Efficient design and implementation of Wireless Sensor Networks(WSNs) can be used to save people by detecting accidents in a large-scale area and alarming the people inside.WSN consist of a number of resource constrained nodes densely deployed for a specific purpose such as detection, localization/tracking and estimation of a given phenomenon. Sensor nodes consist of a separate sensing, processing, memory and communication unit.Proposed network consist of nodes arranged in mesh topology in which each and every node has information about other neighboring nodes so that even if a node is lost during emergency event, network functions properly.Battery power is thus very crucial in WSN and replacement or recharging is impossible in certain environments.

Proposed system aims at developing a wireless sensor network which is able to automatically evacuate a building which is having multiple exits.This paper focuses on creating a sensor network to collect evacuation data and to perform evacuee distribution.Low power operation is achieved not only through selection of efficient hardware, but also through low duty cycling and by Adaptive Power algorithm implementation. Thus power routing algorithm is developed for selecting

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shortest and safest evacuation route which also takes into account power consumption of nodes. RTOS is used as operating system of choice.The operation of the evacuation system is dynamic in the sense that safe exits are re-evaluated continuously to adapt to the way fire expands in the building. The remainder of paper is organized as follows: Section (II) focuses on related work. Section (III) emphasizes on proposed system which includes automatic evacuation techniques and adaptive power algorithm using variable power and transmission rate. Section (IV) gives the result and section (V) concludes the paper.

II.RELATED WORK

In the past few years several approaches have been presented for emergency evacuation. Some of the previously proposed evacuation strategies are briefly described in this section.

Kruger describes the work carried out to develop a wireless sensor network capable of executing automatic building evacuation.Evacuee detection sensors were designed and beam sensor which had excellent recovery time between detections was used for detection. Software implementation consists of a distributed computing cloud which was created in nesC for Tiny OS. LED display boards guides evacuees to the nearest exit. Control room software was developed to display evacuation data to a control room operator and used a building overlay together with graphs and charts to display information in several meaningful ways. System failed to maintain accurate head count of evacuees and beam sensors failed as soon as evacuees start moving as crowd.System is deployed at Council of Scientific and Industrial Research (CSIR) and was a tremendous improvement on existing evacuation method.

Dany.M.Qumsiyeh present and analyze a distributed system for building evacuation. The system uses simple, cheap components, and is more economical. It produces sweeping patterns of light that guide occupants to safety, and can respond to changing threats and damage to the network. The distributed algorithm for this behavior combines a self-healing gradient with a phase-locked loop to produce sequences of lights. System has to resolve many issues during its implementation. Power should be distributed through many small back-up batteries in such a way that electrical shorts and other damage in one part of the network does not interfere with other parts. The system also needs a physical design that is unobtrusive, and easy to install and maintain.

Another paper by D.Efstathiou, demonstrate an application in the event of a fire inside a monitored building in which the information from the deployed sensor network can be used to lead evacuees out of a building successfully.The deployed sensor network consists of 12 TelosB sensor nodes. One of the TelosB motes acts as the base station of the network (Sink) which is connected to a desktop PC and runs the evacuation path displayed using a JAVA application. Moway robot is developed to guide evacuees to exit and Dijkstra shortest path algorithm is used to find shortest path. Low level programming is done and the system was able to re-route evacuees based on congestion estimates.

Several algorithms have been proposed by utilizing large-scale sensor networks to monitor disasters and move people out of danger. Javier Matamoros explains Opportunistic Power Allocation(OPA) schemes for decentralized parameter estimation in wireless sensor networks Only sensors experiencing favorable conditions participate in the estimation process by adjusting their transmit power on the basis of channel state information. Main goal is to minimize distortion and transmit power and enhancement of network life time. Computer simulation results reveal that the OPA schemes provide a performance close to the optimal strategies by reducing complexity and signaling which are key factors in WSNs.

Awad put forward a method for distance estimation using RSSI measures. According to him the most important factor for proper distance estimation is to choose a transmission power according to the relevantdistances. If the power is too high the RSSI differences between different distances are not significant enough for agood interpretation and if it is chosen too small far-field effects take place.

III.PROPOSED SYSTEM

The proposed automatic evacuation system tries to improve the rescue system in building through the deployment of a wireless sensor network which detects the emergency event (like fire) and then guides the evacuees to the designated safe assembly points by displaying the shortest and safest path. During an emergency situation, personnel safety and evacuation time is given importance. The system can be broken down into following functional units:

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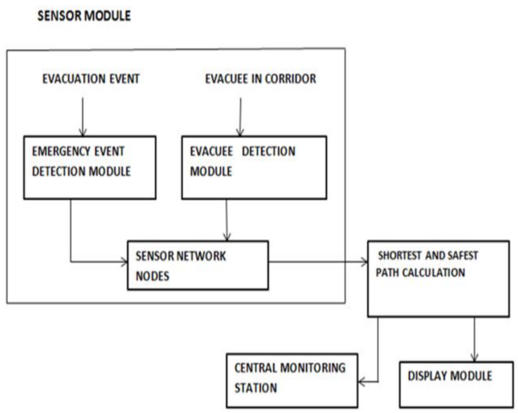

Fig1.Functional Diagram of Proposed system

*A.*Event *Detection Module*

Sensor network module will be designed to remain in a low power consumption state until an evacuation event is detected by the evacuation module or an evacuee is sensed in the corridor by the evacuee detection module. Event may be fire or some other disasters. Event detection module will consist of a temperature sensor and smoke sensor. If the value of sensors rises above a particular threshold value, the circuit will be triggered on.

B.Evacuee Detection Module

The first attempt at solving the evacuee detection problem was to attach a sensor to each individual entering the building. It did not account for many buildings where security tags are not used properly.Evacuee detection module in this system will either use motion or body heat to detect human presence and feed this analog signal into sensor network node. PIR sensor is the best choice which will detect motion by variation in infrared emitted by surrounding objects.

C.Power Routing Algorithm

An algorithm is developed to minimize the power consumption of the WSN node and also to find shortest as well as safest path to exit. Power efficiency is very important in wireless sensor networks because the sensors typically run on batteries and long lifetime is highly desirable. All the radio modules available in the market are utilizing constant power transmission during its operation. Hence significant reduction in energy consumption is possible by adaptive power algorithm that uses both RF output power and transmission rate which will maximize the battery life time.

The algorithm used here is to set the transmission strength of the route update message. By setting the transmission strength, nodes can store the RSS(Received Signal Strength) and with the known transmission setting, distance to the transmitter can be estimated the node. RSSI is inversely proportional to distance. Based on the estimated distance the node will then adjust its transmission power.

µCos which is a pre-emptive real time operating system is OS of choice. RTOS is integrated in system to perform multitasking, scheduling and concurrency check operations.µCos can manage more number of user tasks and it can be ported to many microprocessors and microcontrollers. Source code is written in C and it is comparatively simple to implement. Inter process communication takes place using semaphores, message queues and mailboxes.

D.Display Module

Visual indication units will be present at all exits and intermediary locations of interest. Display boards use green arrows to direct evacuees along the selected shortest path and red arrows to indicate that particular path is not to be followed. Display units are compact and light so that they can be easily suspended from roofs or walls.

E.Central Monitoring Station

A central monitoring station is provided at main entrance which will monitor battery status of sensor nodes and updates evacuation data.Monitoring station operators must be able to use the system without any special training .System consists of building floor plan with evacuation information on it. The nodes were displayed using circles that change color depending on the node status. The system has a built in safety check that could determine if all the nodes in the system were capable of communicating with the control room software, without starting an evacuation. After completion of test it will display list of failure nodes. The user interface consisted of several menu options and a tabbed main display.The first tab displayed only routing information. The second tab showed evacuee density information. The third showed two bar charts that summarized evacuee distributions is the various zones of the building. The fourth tab showed graphs which indicates information associated with each node rearranged togive a global overview of all the nodes based on temperature, light, heuristic and battery level reading. The last tab showsa table that displays a short summary of the database data.The control room software stores all information in a CSV text file.

IV. RESULT

The system functioned as expected; directing evacuees along optimal paths to safety.The adaptive routing algorithm saves the power to a great extent and converged on optimal evacuation path. Uncomplicated display boards were easy to understand by evacuees. The transmission time is almost half than required by 1Mbps rate. Hence the battery life can be further increased.

V.CONCLUSION

The core objective of this project is to provide real time assistance to rescue operations in densely populated buildings. The system was a tremendous improvement on the existing evacuation method, by adding real time intelligence which ensures that no human life is lost in the case of emergency situations. It is considered as could be an excellent additional safety feature for densely populated residential and industrial buildings when linked with a primary fire detection or emergency management system. The result could not be used to locate injured or disabled building occupants, since the sensors used did not have the necessary

intelligence to accurately detect evacuees moving in crowds. The system could however not maintain accurate headcount of evacuees.

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