

Location Tracking And Detection Of Human Using Mobile Robot And Wireless Sensor Networks

Muntaha Sakeena
NUST College of E&ME
engr.muntaha@yahoo.com

Abstract—In order to avoid dangerous environmental disasters, robots are being recognized as good entrants to step in as human rescuers. Robots has been gaining interest of many researchers in rescue matters especially which are furnished with advanced sensors. In distributed wireless robot system main objective for a rescue system is to track the location of the object continuously. This paper provides a novel idea to track and locate human in disaster area using stereo vision system and ZigBee technology. This system recursively predict and updates 3D coordinates in a robot coordinate camera system of a human which makes the system cost effective. This system is comprised of ZigBee network which has many advantages such as low power consumption, self- healing low data rates and low cost.

Keywords—Stereo vision, Segmentation, Classification, human tracking, Zigbee module.

I. INTRODUCTION

In order to enhance efficiency in search and rescue system for disaster areas that caused by natural catastrophes, scientist are still in search of novel and efficient technology. In Computer and telecommunication, remote sensor systems are a dynamic examination territory with various workshops and gatherings organized every year. Intelligent robot has been gaining interest of many researchers especially those which are armed with advanced sensors.

In recent years, WSN have been connected to numerous information assembling and target restriction and following applications over substantial landscape zones. There are various activities managing debacle administration and crisis reaction that utilize remote sensor systems innovations [11, 12, 13, 14]. Compared to traditional ad hoc networks WSNs offer a good alternative. Monitoring of air pollution, detection of forest fire, prevention from natural disaster, industrial sense and control applications, spillage of gas, landslide detection, water level monitoring, vibration location to keep a quake and checking of radiation are illustrations of the wireless sensor systems applications identified with strategies of catastrophe administration. Robotics and WSNs are two base technologies that incorporate physical processes with computation, and contribute to solve real world problem in many areas.

The underlying standard in communication between the WSNs and robots is: the WSN system serves as the correspondence, sensing and calculation medium for the robots, though the robots give activation, which is utilized in addition to everything else for system administration and redesigning the system state.

In this paper Section II gives a brief introduction about different disaster management wireless sensor network technologies. Section III puts light on earliest projects issue. Section IV explains the proposed solution regarding architecture of mobile rescue robot and methodology of our proposed system. The conclusions and future trends in section V complete the paper.

II. RELATED WORK

In order to manage disasters and the emergency situations,

several projects have been proposed until now in which the technology of wireless sensor networks is used. It is so because as compared to traditional ad hoc networks, WSNs prove to be a good substitute.

SENDROM: SENDROM (Sensor Network for Disaster Relief Operations Management) was mainly proposed to be used in the case of earthquakes in Turkey as it is one of the most subject countries to earthquakes [1].

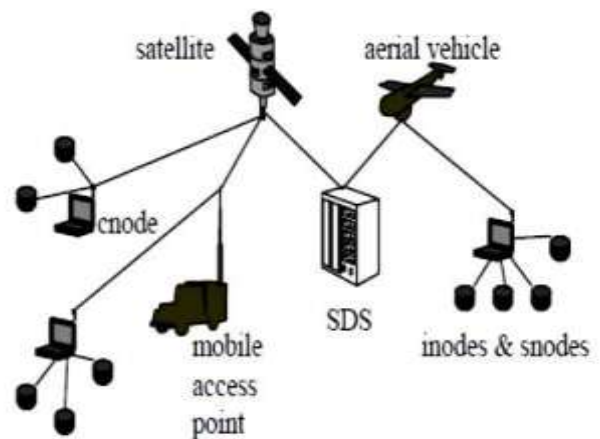


Figure 1: SENDROM after a disaster

The architecture of SENDROM made up of sensor nodes and central nodes. Sensor nodes positioned earlier to a disaster and central nodes kept nearby tactical centers and linked them to the SENDROM database.

Telemedicine with WSNs: This project was proposed to relay gathered information from the disaster scene with a telemedicine system [3].The project supports mechanism of

multi hopping to transfer the information that collect data from sensor nodes among multiple cells using Ad hoc relay stations. To route data from one location to other, some nodes are base station in case of emergency.

IN.Sy.EME: IN.Sy.EME is Integrated System for Emergency. It was proposed for any integrated system which could support certain emergency actions that integrate a ubiquitous Grid structure with a wireless communication network [2]. The network contains many fixed nodes and mobile nodes.

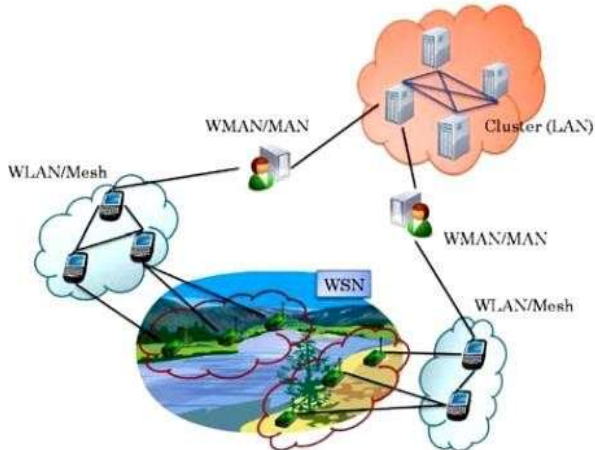


Figure 2: The forecasting model of INSYEME

USN4D : The goal of the project USN4D (Ubiquitous wireless Sensor Network For Development) is to provide early warning for Air pollution and to disseminate surveillance information for cities in order to support municipality service delivery and to provide enjoyment of the citizens and tourists [5].

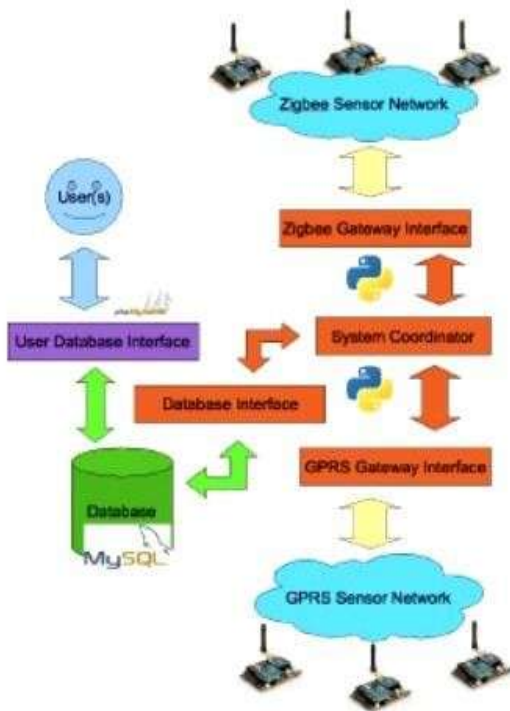


Figure 3: USN4D

WINSOC : WINSOC is a Wireless sensor Network with Self Organization Capabilities that help in risky and emergency applications. The aim of this project is to estimate the chance

occurrence of landslides by detecting rainfalls using wireless sensor networks [4]. For that purpose, the authors designed a Deep Earth Probe (DEP) installed in the ground. The whole landslide disposed area is separated into 3 regions namely, the Crown region, the Middle region and the Toe region with a set of sensors planted in each one by keeping in mind geological and hydrological properties of processing soil.

These frameworks are appropriate to use in a wide range of operations that are unsafe or dangerous for human, such as hunt and salvage operations after regular catastrophes, as well as assessment and reconnaissance in military or urban regions. In these operations, the utilization of camcorders and vision system machine methods is unique interest due to the riches of data they can give. Scientists have utilized ready for cam for remote sensing of backwoods fires [15, 16, 17, 18]. Coif man and Mccord gatherings created a machine vision-based roadway movement checking framework by utilizing altered wing unmanned ethereal vehicle [19]. Moreover various scientists have utilized vision-based procedures for target discovery and following.

The use of vision for estimation and following of ground based targets has additionally been examined by bethky and Yorks bunches [20], [21]. Application of feature cams on unmanned aeronautical systems for tracking targets postures a few challenges. In first step, an calculation must be proposed to identify targets of investment, in second step, if the target will be discovered, its area must be estimated. At last, the UAV might use this data to track the target.

At the point when the target moves or the environment has a few hindrances, the capacity to gauge the definite area of a focus with single target could be constrained. Different frameworks for following targets can be helpful and give a more exact estimation of the target position.

In order to avoid dangerous environmental disasters, robots can work as efficiently as human rescuers. Intelligent robot has been gaining interest of many researchers especially those which are armed with advanced sensors.

III. PROBLEM STATEMENT

Due to narrow passages, it becomes quite difficult for the robots to locate bombs or search for survivors in the rubbles. Robots of different sizes tackle different issues. While small robots have the ability to go deeper into rubble pile, large robots are better in the case when there are large openings because in that case the small robots are often lost.

Even if the robots are lost or damaged due to unmanageable external factors, this should not count as a failure because the environment in which these search and rescue robots work is highly unstructured. Such losses should be considered as calculable risks and these risks should be merged with the normal operation cost. Therefore, instead of using large and complex search and rescue robots, we should deploy small low-cost robots in high volume to minimize operation cost.

IV. PROPOSED WORK

Following the above line of thought, to minimize operation cost and error rate, we propose to combine stereo vision based human detection along with human tracking using wireless network based on ZigBee technology. Stereo vision based system recursively predict and updates 3D coordinates of a human in a robot camera coordinate system which makes the human tracking system cost effective. The main objective of this paper is to rescue more & more number of people from the adverse condition.

1. WSN-based Human Existence Detection System

In this system, we have a wireless sensor network along with autonomous mobile robots.

Mobile Robot: The rescue mobile robot mainly consists of four units namely 1) Sensor unit, 2) Micro-controller, 3) Camera unit, 4) Transmission unit [6].

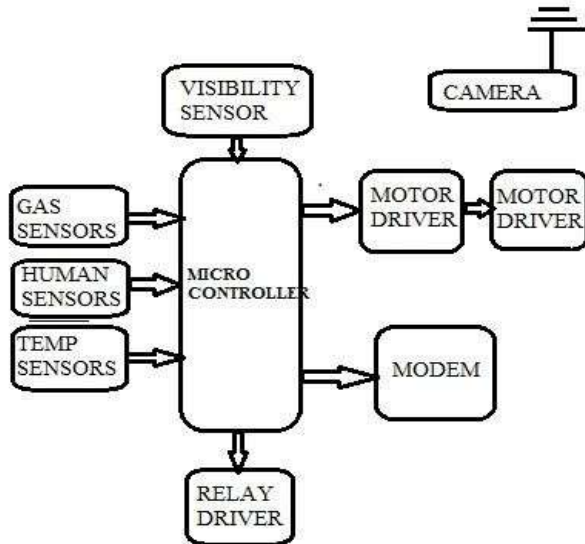


Figure 4: Architecture of Mobile Rescue Robot[6]

Microcontroller unit: The sensor unit is directly interfaced with micro-controller. Current readings monitor by sensor devices which send data to micro-controller. The controller designed at hardware level is responsible for transmitting the information to control room.

Sensor Unit: The sensor devices observe current data and sends data to controller. Sensors which mostly are used are Visibility sensor, Human sensor, Gas sensor, Temperature sensor & Bomb sensor etc. to sense the suspected materials in Rescue operations. The information provide by sensor helps in having good knowledge about the environment in disaster area.

Camera module: The camera module consists of a web camera and it is mounted on the robot. The camera module will transmit the video coverage of the paths and thus helps in easier mapping of the path to be taken by the rescue team.

Robot driver unit: The robot driver unit keep track about the movement of the robot in x-axis and y-axis.

Zigbee communication module: Zigbee communication module equipped with each mobile robot in order to track their location.

2. Working Of Mobile Robot:

Figure 5 shows the complete working of robots with sensors.

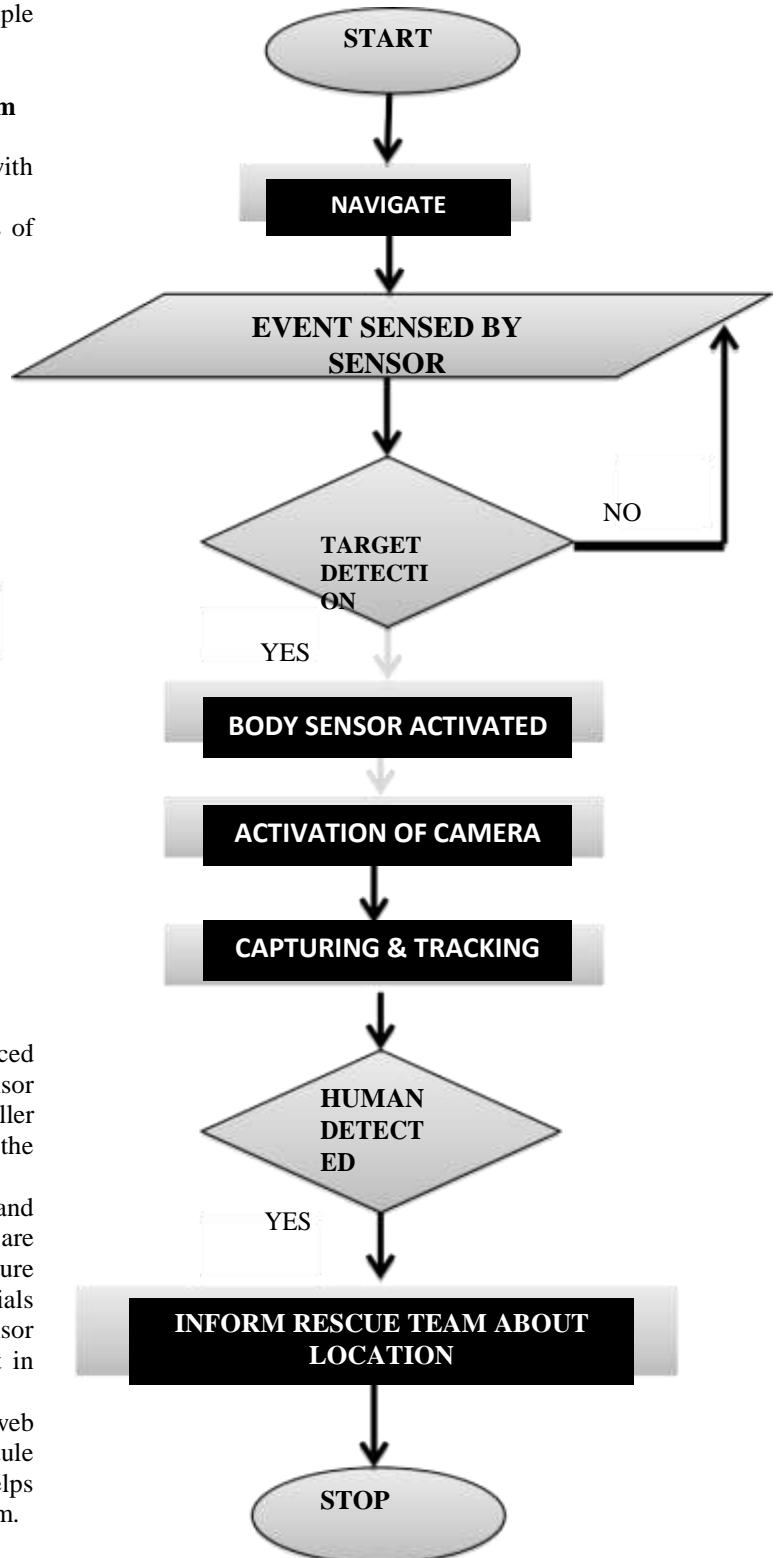


Figure 5: The Flow chart of Proposed System

It is basically a monitoring system which uses sensor units and camera module for recording, analyzing human body conditions and transmitting data [8].

Firstly mobile robot starts moving in disaster area. When any event sensed by sensor and sensor detects target in its surrounding, then all the other sensors will activate. If any target is detected in disaster area, then proposed system asks the camera to show the place around the target and track the location. Capturing and Tracking camera is stereo vision based. If it detects a human then the system will send its location information to the rescuer team so that they can track the location as soon as possible.

As this is distributed wireless robot tracking system so for continuously tracking locations through evaluation of a combined set of feedbacks from numerous sources include the ZigBee communication module, stereo vision based tracking and detection using body sensors (sense the body by sensing heat).

3. Stereo Vision Based Human tracking:

Stereo is used for gathering information from different areas of objects, which also includes humans. The picked up image pair is used for calculating a difference map called disparity map which is computed by the resemblance between two images right and left. Afterwards segmentation technique is applied to select the interested area. Then classification is applied to detect the human on the data collected by computing 2D and 3D features. This system recursively predict and updates 3D coordinates in a robot coordinate camera system of a human which makes the system cost effective.

Figure 3 shows the stepwise working of the Stereo Vision Based Human tracking system.

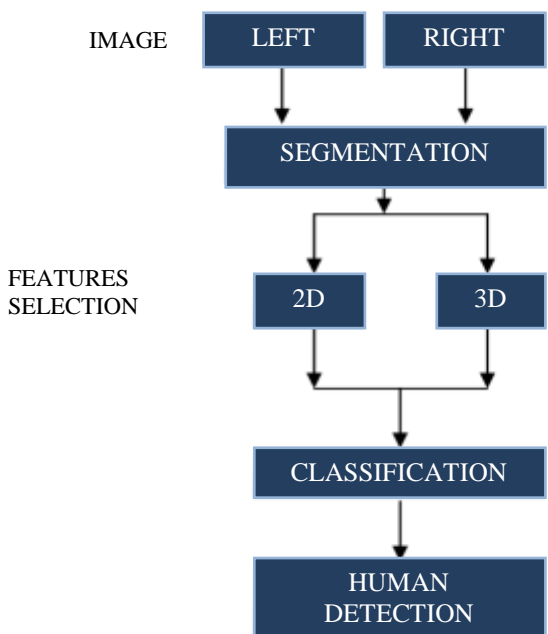


Figure 6: StereoVision based System

4. ZigBee wireless communication technology

ZigBee is a new technology in wireless communication. As it is a wireless technology so there is no problem with wiring. It is robust against disasters like fire, earthquake.

ZigBee technology is very similar with Bluetooth and WIFI but not same as them. ZigBee is based on 802.15.4 IEEE standard developed for simple structures in data communication e.g. sensors. Devices uses for ZigBee are mainly of three types.

- 1) *Coordinators: for security and formation of network.*
- 2) *Routers: for communication between networks*
- 3) *End devices: for some specific task*

ZigBee devices consume low power and cost. When these devices are not in use they put themselves in sleeping mode. Using this technology large amount of small sensors can communicate with each other. [9] In order to avoid collision while transmission ZigBee uses CSMA/CA. If any node in the system breaks or changes its position ZigBee has the feature of automatically detect the change and repair itself. Without human involvement, it can make the system to work error free. [10]

V. CONCLUSION & FUTURE WORK

This system is mainly used in different cases including nuclear disaster areas, mined lands, arenas and chemical attacks where the environmental conditions can prove to be risky or precarious for human life. This system resolves the main issue of continuously tracking the location by using multiple feedback sources in a cost effective way.

Still some challenges are there that should be considered while designing these types of projects. Energy consumption is a fundamental issue in wireless sensor networks that should be considered. In order to benefit from our work we plan to perform the detection of human body by using heartbeat sensing sensors and the combination of ZigBee module and RFID can be a better option for tracking.

VI. REFERENCES

- [1]. E. Cayirci and T. Coplu. "SENDROM: Sensor Networks for Disaster Relief Operations Management". *Wireless Networks*, Vol. 13 Issue 3, June 2007. pp. 409-423.
- [2]. R. Fantacci, D. Marabissi and D. Tarchi; "A novel communication infrastructure for emergency management: the In.Sy.Eme. vision". *Wirel. Commun. Mob. Comput.* 2010. pp.1673-1681.
- [3]. N. Ahmad, N. Riaz and M. Hussain."Ad hoc wireless Sensor Network Architecture for Disaster Survivor Detection". *International Journal of Advanced Science and Technology* Vol. 34, September, 2011. pp. 9-16.
- [4]. M. V. Ramesh. "Real-time Wireless Sensor Network for Landslide Detection". In *Proc. of the Third International Conference on Sensor Technologies and Applications (SENSORCOMM)*. 2009. pp. 405-409.
- [5]. Bagula, M. Zennaro, G. Inggis, S. Scott and D. Gascon."Ubiquitous Sensor Networking for development (USN4D): An Application to Pollution Monitoring". *Sensors* 2012. Vol. 12. pp. 391- 414.
- [6]. Trupti B. Bhondve, R.Satyanarayan, Moresh

- Mukhedkar "Mobile Rescue Robot for Human Body Detection in Rescue Operation of Disaster" International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering (An ISO 3297: 2007 Certified Organization) Issue 6, June 2014, Vol. 3.
- [7]. Aamir Shaikh, Siraj Pathan. "Research on Wireless Sensor Network Technology" International Journal of Information and Education Technology, October 2012, Vol. 2, No. 5.
- [8]. A joint network for disaster recovery and search and rescue operations journal homepage: www.elsevier.com/locate/comet 2012
- [9]. Wireless Medium Access Control (MAC) and Physical Layer (PHY) specifications for low Rate Wireless Personal Area Networks (LR - WPANs), IEEE 802.15.4.
- [10]. Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for Low-Rate Wireless Personal Area Networks (LRWPANs), IEEE Standards 802.15.4TM-2003.
- [11]. J. H. Huang, S. Amjad, and S. Mishra, "Cenwits: A sensor-based loosely coupled search and rescue system using witnesses," in Proceedings of ACM SenSys, 2005.
- [12]. P. Juang, H. Oki, Y. Wang, M. Martonosi, L. Peh, and D. Rubenstein, "Energy-efficient computing for wildlife tracking: design tradeoffs and early experiences with zebranet," in ASPLOS, 2002.
- [13]. T. Small and Z. J. Haas, "The shared wireless infostation model - a new ad hoc networking paradigm (or where there is a whale, there is a way)," in ACM MOBIHOC, (Annapolis, Maryland), June 2003.
- [14]. T. Small, Z. Haas, A. Purgue, and K. Frstrup, "A sensor network for biological data acquisition," in CRC, 2004.
- [15]. L. Merino, F. Caballero, J.R Martinez de Dios, J. Ferruz and A. Ollero, "A Cooperative Perception System for Multiple UAVs: Application to Automatic Detection of Forest Fires", Journal of Field Robotics, 23, 2006, pp165-184.
- [16]. L. Merino, F. Caballero, J.R Martinez de Dios and A. Ollero, "Cooperative Fire Detection using Unmanned Aerial Vehicles", IEEE International Conference on Robotics and Automation, Barcelona, Spain, 2005.
- [17]. D. Casbeer, S. Li, R. Beard, R. Mehra and T. McLain, "Forest Fire Monitoring With Multiple
- [19]. B. Coifman, M. McCord, R. G. Mishalani, M. Iswalt and Y. Ji, "Roadway traffic monitoring from an unmanned aerial vehicle", Intelligent Transport Systems, IEEE Proceedings, 153:11-20, 2006.
- [20]. B. Bethke, M. Valenti and J. How, "Cooperative Vision Based Estimation and Tracking Using Multiple UAVs", Conference of Cooperative Control and Optimization, Gainesville, FL., 2007.
- [21]. G. York, D. J. Pack, "Ground Target Detection Using Cooperative Unmanned Aerial Systems", Journal of Intelligent & Robotic Systems, Vol. 65, Issue 1-4, 2012, pp 473-478.