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Human Life Detection Using Robot

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***Abstract* — "Thousand of persons killed as a cause of earthquake". The above words aren't the headlines of the newspaper but such news come after the disaster destroyed the field. The disaster in the New York City at 'World Trade Center' claimed lives of more than 5000 people. It was said if survivors has been found and rescue earlier the numbers of victims have been lower. There is no end to the number of lives lost as the result of such disasters as landslides, collapsed tunnels and avalanches. In this paper a robust system for enabling robots to detect and identify humans in domestic environments is proposed. Robust human detection is achieved through the use of thermal and visual information sources that are integrated to detect human-candidate objects, which are further processed in order to verify the presence of humans and their identity using face information in the thermal and visual spectrums. Active vision mechanisms are employed in order to improve the relative pose of a candidate object/person in case direct identification is not possible. The response of the different modules is characterized, and the proposed system is validated using image databases of real domestic environments, and human detection and identification benchmarks of the RoboCup@Home research community.**

***Keywords* — Human Detection, Life Detection, Robot, Sensors.**

I. Introduction

Earthquakes, landslides, cyclones, floods are some of the natural disasters that time and again make us realize that there is no power bigger than that of the Nature around us. With the evolution of science and technology at an uncontrolled pace, and the creation of sky scraper buildings and dwellings and encroachments everywhere, the risks of losing life due to such calamities has all the more increased and added to the chaos.[1]

Moreover, with the advancement in nuclear technology, the risks of manmade calamities like nuclear explosions and nuclear radiation leaks have also reached an all time high. Many people get killed instantly due to these natural and manmade disasters when they hit a region.

Many others get trapped under debris for hours and days because their presence there cannot be detected by the rescue teams easily. Hence, they die a painful death as help could not reach them on time. A detection of the victims can save his life.

1.1 Need of life detection system over conventional system [1][2][5]

Existing ways to detect the human being under the earthquake rubble and collapsed buildings are utilization of the dogs, optical devices and acoustic life detectors.

Acoustical detectors such as geophones are simple to use but they require quiet working environments, a condition difficult to reach especially in critical situations [2]. The Rescue Robot can navigate deep into the rubble to search for victim by the use of temperature sensor. The rescue robot can be very helpful to detect life. And the dogs can detect the dead persons and this occupies the precious time which can be utilize to detect alive victims. Information about the location of buried person would be of great value for the rescue personnel, since it would help to reduce the time of operation and thus, help to save more lives. There is a need to construct a life detection system which can detect buried victims under earthquake or building debris most efficiently and as possible in short time. In rescue mission and also in some surveillance operations there is not only the need of detect life signals but also the identification of people in a given area, to facilitate rescue team operations in case of emergencies.

The Robot can also give the coordinates of the location where life is present with the help of GPRS.

But the rescue dogs need to be trained heavily before they can be used for these purposes. Moreover, a fully trained dog costs between $300 to $400 [2] and can be used for not more than 5 years. Being sensitive these dogs don't tend to work properly during an earthquake relief as there are aftershocks after an earthquake hits a region. On the other hand, the rescue team workers cannot enter certain parts in such calamity hit zones. And if they do, a rescue worker may end up being a victim himself. For these reasons and others, for past some years mobile robots are being introduced for such rescue purposes. The systems used before faced a few problems [3]:

1. High communication costs due to enormous transfer of images to the operator.
2. Noisy communication between system and the control unit ultimately breaking the communication link in wireless robots.
3. Microwave frequency based systems are sensitive but very expensive.
4. High processing cost due to continuous capturing, storing and transfer of images and hence system seems to be slow.
5. Continuous need for illumination or use of IR camera to work independent of light but may give ambiguous results in presence of other heat sources nearby.
6. Most motion sensors algorithms assume camera is stationary hence give unreliable results.

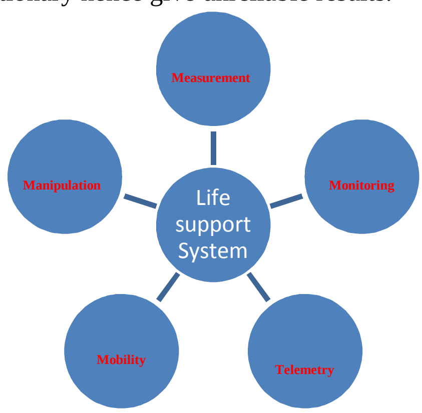

Fig.1. Operation of life and human detection system

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Mobile Robot monitors continuously and senses presence of human with the help of sensors. Manipulates or changes its location to give exact location of the victim. Through telemetry it then forwards information about co-ordinates to the computer.

II. PROPOSED TECHNIQUE

The system used just two motors, LED torch, a simple VGA camera and CO_2 [4] sensor is highly compact and also save on the need of expensive and powerful hardware and complex algorithms thereby reducing its cost and energy consumption [1], [2]. Many other such robots highly equipped with sensors, actuators etc, are autonomous and efficient but lack cost and power efficiency. Also they are less compact thereby less capable of slitting through the debris and are complex. Such robots not only have high initial costs but also incur high rear and tear costs with most parts needing replacement soon. Since a disaster afflicted area is generally large and requires quick rescue using a no. of rescue teams simultaneously, a large no. of such economic robots can help speed up the rescue work and incur minimal cost due to wear and tear. While this system simplifies all these and many other limitations by using real time audio monitoring through LCD/television sets. As humans are very good at sound processing this system transmitting real time audio to TV set is more reliable to distinguish a human sound timely and also help recognize unusual sounds like regular banging by victim. Also this robot moves very smoothly thereby making least noise which could otherwise interfere with the victim's shouts. Thirdly since CO_2 are highly directional therefore the various levels help the remote operator to direct robot in direction of increasing CO_2 [4] content thereby locating the source of the emissions i.e. the trapped survivor. The proposed robot uses CO_2 sensor [4] to detect any signs of human life in its vicinity. The sensor triggers the buzzer on reaching a region with higher level of CO_2 than the set threshold value of alive human region. It also has a low cost camera fitted in its front to capture the audio, video of the region and transmit both audio/video signals on a LCD/TV screen using cost-effective RF (radio frequency) transmitter and receiver. The robot also has an LED made torch to light the areas where robot enters and give a clear footage to the camera thereby working even in improperly lit regions. LEDs are economical and consume less power as well.

Robot is fitted with the following things:

1. A low-cost camera to monitor audio/video signals from the region and transmit them to TV screen.
2. A CO2 sensor which triggers a buzzer when level of CO2 in the region is above a set threshold value.
3. DC motors to provide torque to wheels of robot to move even in rugged surfaces.

A legged robot design is very capable of moving on various terrains but involves a no. of control methods, actuators and sensors. A track flipper robot like Plasma-RX [2] can travel uneven track with less actuators etc but still very heavy, power consuming and results in high wear and tear.

However this design involves only two wheels driven by two motors respectively at one end and the other end is supported by caster wheel. This design helps to maintain the overall balance of robot and prevents it from skidding.

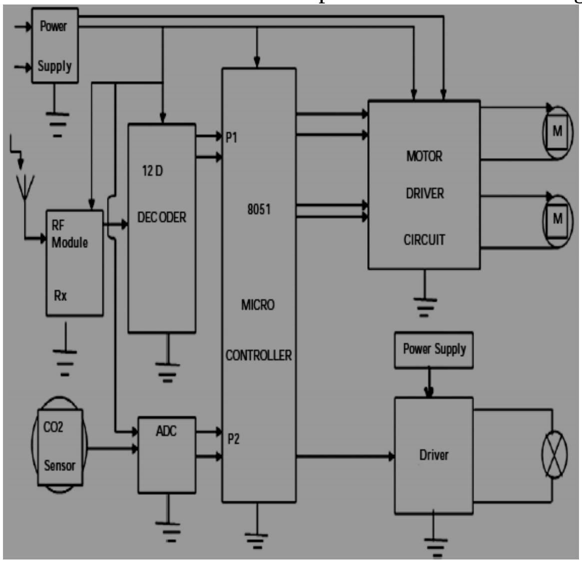

Fig.2. Block Diagram of Human Detection System

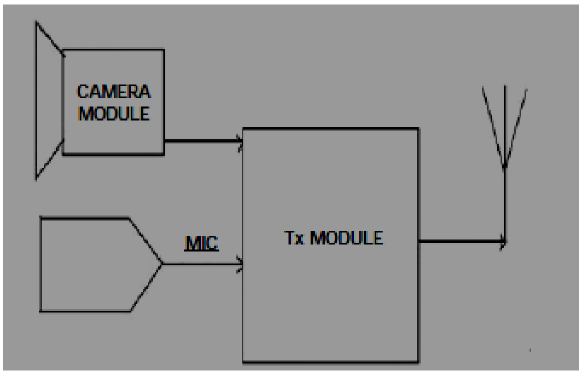

Fig.3. Integral elements of Robot

2.1 Motor Used

Since the robot is very light around just 1.5 kg and has to move on rough surfaces hence very powerful motors are not required. Here two 12V DC geared motors providing a torque of 1.2 kg cm were used as the power requirement of the design is quite less.

2.2 Sensor Calibration

Indoor CO_2 [5] levels usually vary between 400 and 1200 ppm (parts per million). Outdoor CO_2 levels are usually 350–450 ppm [3]. Therefore CO_2 [5]sensor is calibrated to trigger the buzzer through ADC (analog to digital converter) when CO_2 level in its vicinity gets above 1000 ppm or .10% which is the amount in a crowded or industrial area and resembles this situation of an improperly ventilated enclosed space.

2.3 Robot Interfacing and Control

The robot is remote controlled to enable broader control of the human operator viewing the footage in LCD in rescue. As human brain is better at real time audio, video processing and understanding alien situations rather than an autonomous robot and since there are few parameters to be observed and controlled by the operator this manual control provides reliable conclusions about presence of a survivor.

As CO_2 sensor is highly directional, hence various levels of CO_2 indicated through different LEDs of ADC guide the operator to direct robot towards the target. Real time audio, video is best processed by human operator and help to understand the environment effectively, hence resulting in appropriate actions.

III. Conclusion

Though many other systems are available like the Urban Search and Rescue Robots (USAR) with more number of sensors [4], but the problem with them is the cost efficiency and the power consumption and considerable size.

The robot uses three levels of scrutinizing criteria – CO_2 sensor, audio and video capturing of the area by the camera and being economical at the same time. It is power efficient, equipments are available easily in the market, cost effective and outputs generated are reliable as well. The robot is designed to have minimal wear and tear, therefore incur minimum cost on maintenance. Light weight and compact size are added advantages.[4]

With the implementation of this design, it sure will be a great help to the society to fight such mishaps in the future. Since this robot is developed on a small scale and is still cost and energy efficient, its future is bright and wide. Robot can further be equipped with a speaker or recorder to interact with survivors and assure them of nearby help. Also it can be facilitated with two way communication and to transfer analog data of CO_2 [3] directly to operator thereby giving broader two way communication to transfer analog data of CO_2 sensor directly to operator thereby giving flexible interpretation of the same.

The robot can also be equipped with a rotating robotic arm with camera and sensors fitted on its free end providing closer reach to target and enabling wider view.

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References

[1] Chen,K. M.,D. Misra,H. Wang,H. L. Chueng,et al.,"An Xband M/W life-detection system," IEEE Trans. Biomedical Eng., Vol. BME-33,697–701,[July 1986].

[2] M. Donelli,"A rescue radar system for the detection of victims trapped under rubble based on the independent component analysis algorithm." Progress In Electromagnetics Research, M, Vol. 19, 173-181,[2011].

[3] V. Colla, A.M. Sabatini, "A composite proximity sensor for target location and color estimation," IMEKO Sixth International Symposium on Measurement and Control in Robotics, Brussels, [1996],pp. 134–139.

[4] L. Korba, S. Elgazzar, T. Welch, "Active infrared sensors for mobile robots," IEEE Transactions on Instrumentation and Measurement, vol. 2(43), [1994], pp. 283–287.

[5] A.M. Sabatini, V. Genovese, E. Guglielmelli "A low-cost, composite sensor array combining ultrasonic and infrared proximity sensors, IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), Pittsburgh, PA, vol. 3, [1995], pp. 120–126.

[6] H.R. Everett, Sensors for Mobile Robots, AK Peters, Ltd., Wellesley,MA, [1995].

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