Localization and Human Being Detection by using Dirty Algorithm

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Abstract

There are dual challenges for human detecting a robot are to detect and to have an accurate distance locating system. In indoor positioning, GPS receivers cannot be used due to reflections. To detect human beings, we use ultrasonic sensor for finite detection range with the help of Dirty algorithm from UWB technology. The ultrasonic sensor have to be in close of proximity to the victim in order to detect it. Unlike other human body detection system thermal images, visual images, CO_2 detection, our method is to detect object with high attenuation. Ultrasonic and sound signal pass through obstacles but with high attenuation, i.e., sounds are detected into a range closer to the victim than with the use of electromagnetic waves. Our process does bot discern between alive and dead human beings so it report the human bodies in an area.

Keyword- Human Detection, Motion Detection, Mobile Robot, Navigation, Rescue, Robotics, Ultrasonic Sensor, Urban Search and Rescue

I. INTRODUCTION

Natural disasters occur frequently nowadays. Many human beings are victims of such occurrences. Because of high rise buildings and other manmade structures urban and industrial areas can be consider to be more susceptible to disasters. These disasters can be categorized into natural and human induced disasters. Natural disasters include floods, storms, cyclones, bushfires and earthquakes whereas besides natural disasters, the urban environment is prone to human induced disasters such as transportation accidents, industrial accidents and major fires.

During such calamities, especially disasters, in order to prevent loss of life and property various essential services (like fire brigades, medical and paramedical personnel, police) are deployed.

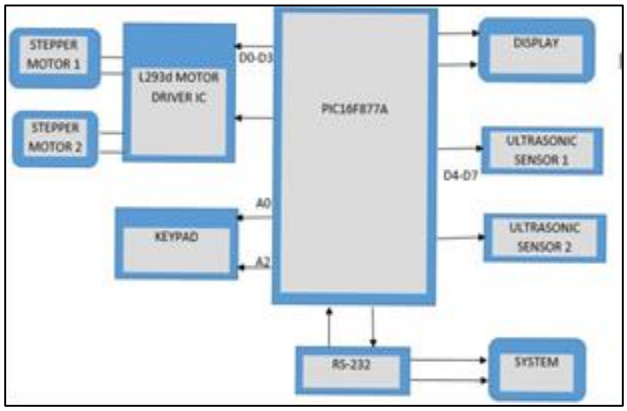
The main purpose of the robot is to detect alive human beings after the occurrence of natural calamities with the help of Ultrasonic sensor. The robot based system will sense the radiation of human being and condition the sensed signal to communicate to the control section of this robot. The rescuer may become a victim who needs to be rescued. This is why since some years mobile robots have been proposed to help them and to perform tasks that neither human, dogs nor existing tools can do. For this project, we will focus only on robots which will work in a disaster environment of manmade. The proposed system uses an ultrasonic sensor in order to detect the existence of living humans.

II. SYSTEM OVERVIEW

In this section, a brief discussion of some of the related work is presented; focusing on the used approach and its advantages and disadvantages. Remote Operated and Controlled Hexapod (ROACH): [12] ROACH is a six legged design that provides significant advantages in mobility over wheeled and tracked designs. It is equipped with predefined walking gaits, cameras which transmit live audio and videos of the disaster site, as well as information about locations of objects with respect to the robot's position to the interface on the laptop. Kohga: University of Tokyo - The most complicated task for most of the USAR robots has been working on a rough terrain.

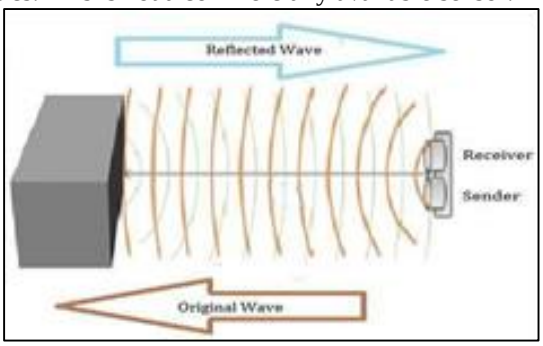
Specialized robots have been designed for these types of environments such as KOHGA the snake like robot. The robot is constructed by connecting multiple crawler vehicles serially, resulting in a long and thin structure so that it can enter narrow space.

Quality work has been done in the field of robotics. These robots came into existence in the early 21st century but since then enormous improvements have been made in the concept, design owing to which their capabilities have improved significantly. Various rescue robots have been developed and some of these are – CRASAR (Centre for Robot-Assisted Search and Rescue): University of South Florida. This robot was used for first time in real conditions on 11th September 2001 in the World Trade Centre disaster. Different sensors like millimetre wave radar for measuring distance, a colour CCD camera for vision and a forward-looking infrared camera for the human heat detection are used in it.



Burion presented a project that aims to provide a sensor suite for human detection for the USAR robots. This study evaluated several types of sensors for detecting humans such as pyroelectric sensor, USB camera, microphone, and IR camera. The pyroelectric sensor was used to detect the human body radiation, but its limitation was its binary output. The USB camera was used for motion detection, but its limitation was its sensitivity to changes in light intensity. The microphone was used for long duration and high amplitude sound detection, but it was severely affected by noise. Lastly, the IR camera was used to detect humans by their heat image, but it was affected by other nearby hot objects. The main idea was to detect a change in the image scene by checking the values of the pixels. Several images for the scene were acquired and subtracted from each other to discover if a motion has occurred. The used technique was fairly efficient in detecting the victims. However, the robot was not fully autonomous and was dependent on the operator.

Gas analysis based bio-sensors CO_2 sensors allow to detect the carbon dioxide emission, and even the breathing cycle of a victim. It is thus possible to determine if he is still alive but the disadvantage is that the response time of a CO_2 sensor is very slow and that the sensor has to be very close to the victim to have useful data because it is very directional and depends much on the air conditions like humidity, temperature, wind, and dust. This makes it difficult to use it in a disaster area so this approach was not pursued in this project. Like the CO_2 sensor, SpO2 is used to determine if somebody is still alive. It needs direct contact with the person. SpO2 sensing of blood oxygen content requires only the pressing of a small, cool, red light on any bare inch of skin. It is not a common sensor in robotics. This is not a commercially available sensor.



Greer, Kerrow, & Abrantes 2002, represented a thorough understanding of the urban disaster environment and an appreciation for traditional search and rescue techniques are crucial to determining the success of a hovering robot solution. In this paper search and rescue environment is described, the applications of robots in urban search and rescue, an outline of robotic competitions in simulating a real rescue environment is described.

Bahadori presents an analysis of techniques that have been studied in the recent years for human body detection (HBD) via visual information. The focus of this work is on developing image processing routines for autonomous robots operating for detecting victims in rescue environments. The paper both discusses problems arising in human body detection from visual information and describes the methods that are more adequate to be applied in a rescue scenario.

Finally, some preliminary experiments for such methods in recognizing rescue victims are reported. Pissokas describe the social impact of urban devastations has given rise to the field of Urban Search and Rescue Robotics. The aim of this article is to present our experience and experimental results with various sensors designed and developed.

The velocity of the sound in air is given by the equation this is used to calculate the speed of the sound in air. The distance that sound travels is equal to the speed of sound in the medium multiplied by the time that sound travels.

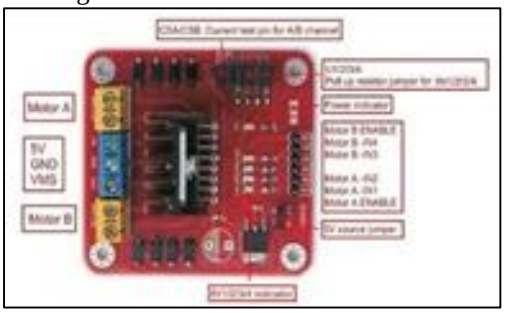
A. Ultrasonic Sensor

In general, the ultrasonic sensors often use the approximately frequencies as 40 kHz with an 8 pulses signal waveform. The sensor radiates a pulse signal, Tx, to the object and then receives the reflected signal, Rx, back to the sensor. The distance is measured by calculating the time used between the reflector

$$v_{sound\ in\ air}\left(\frac{m}{s}\right) \approx 331.4 + 0.6T\left(\frac{m}{s}\right)$$

B. Motor Drive

Double H driver module uses ST L298N dual full-bridge driver, an integrated monolithic circuit in a 15- lead Multiwatt and PowerSO20 packages. It is a high voltage, high current dual full- bridge driver designed to accept standard TTL logic levels and drive inductive loads such as relays, solenoids, DC and stepping motors. Two enable inputs are provided to enable or disable the device independently of the input signals. The emitters of the lower transistors of each bridge are connected together and the corresponding external terminal can be used for the connection of an external sensing resistor. An additional supply input is provided so that the logic works at a lower voltage



C. Micro Controller

Microcontroller is an important tool in the system because it can control Sensor. Thus the microcontroller 16F877A is selected as key components in the transmitter and receiver system.

III. POSITIONING ALGORITHM

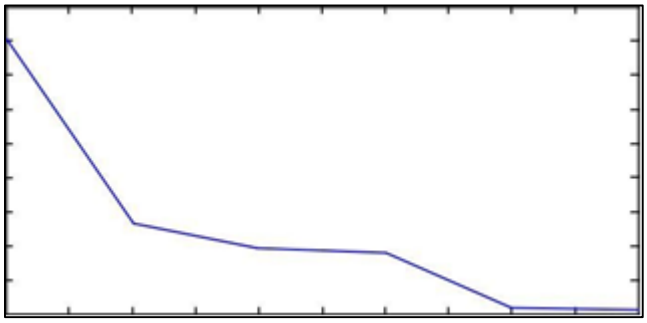
In this section, we present our positioning algorithm. The dirty template algorithm determines the time of arrival of the signals.

Dirty Template Algorithm

In order to perform time-based ranging successfully, the ToA of the received signal should be estimated accurately. The conventional ToA estimation technique is performed by means of matched filtering or correlation operations. Fine time resolution of UWB signals makes accurate identification of the first Multi Path Component (MPC) possible. However, this may not be easy in many scenarios due to non-line-of- sight (NLOS) propagation and a vast number of MPC. Estimation of the ToA could be affected by several errors (multipaths, interference, attenuation, clock drifting, etc.).

Therefore, finding a good estimation of the ToA could be a challenging task in the presence of multipath and interference. In this paper, we consider only the LOS case and we use the dirty template algorithm which allows estimating the ToA in the presence of MPC.

The dirty templates algorithm is a low complexity ToA estimator which operates on symbol-rate samples. The basic idea behind this algorithm is as follows. The optimal template signal is not available during ToA estimation. However, the received signal itself can be used as a correlate template, which is noisy (“dirty”). Then, using cross-correlations of the symbol-length portions of the received signal will lead to estimate the ToA.



IV. CONCLUSION

The goal of this research was to provide a low cost rescue robot for human detection in a disaster environment. Though, the existing Urban Search and Rescue Robots are equipped with various sensors, but the problem with them is the cost. The sensors used in the development of this project are easily available and cost effective.

In this paper, a new method for detecting surviving humans in destructed environments using simulated autonomous robot is proposed. The robot uses two levels of sensing in order to achieve higher cost -effectiveness in the detecting process in terms of the actual cost of equipment, the processing cost, the communication cost, the storage cost, and the power cost. The first level is an ultrasonic sensor that is used as the primary sensor in order to detect the existence of living humans in a scene. The second level is a human body shape sensor. This level uses low-cost web camera in order to confirm the existence of a human shape. The robot is assumed to be equipped with a simple Temperature sensor in order to detect fire in Rescue scenario and suspected metal.

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