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FOLLOW ME ROBOT USING INFRARED BEACONS

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ABSTRACT

It is desirable in many applications for a mobile robot to track and follow a person [1][3]. There have been various efforts in literature to create person-tracking robots. However, current person-tracking robots are not capable of operating in unstructured environments.

The problem of creating a person-tracking mobile robot has been studied by many researchers in literature. There are two main issues associated with this problem. The first issue is to equip a robot with proper sensory devices so that it is able to identify and locate the target person in a crowd in real time. Various approaches have been investigated, including vision, infrared sensors, ultrasonic sensors, and other approaches. The second issue is to control and navigate the robot so that it follows the target person within a certain distance. This seems simple, but in reality it is a fairly difficult task. For example, if the target person is in a busy corridor with many people standing and walking, the robot has to constantly avoid other people while following the target. There is still no reported evidence that a person-tracking robot has been implemented that is able to track a person in arbitrary environmental conditions.

By using an ultrasonic sensor system and infrared sensor, an intelligent person-tracking mobile robot is to be implemented that is able to follow the target person in unstructured, practical environments. The main focus of the thesis is development and implementation of control algorithms. We have used Ultrasonic sensor for Obstacle avoidance and IR sensor for target identification.

Keywords: Robotics, Ultra Sonic Sensor, IR Beacon, Person Tracking Methodology, Implementation with Obstacles and without Obstacles

INTRODUCTION

A person following Robot is a Robot that follows a specific person while simultaneously implementing obstacle avoidance. The Robot follows only the target person and regards all other objects as obstacles. This means that even if there are several people walking around the environment, the Robot should follow this specific person and avoid others. Therefore, any instances of the Robot following the wrong person should be handled in the implementation of person-tracking.

A Robot with an additional IR positioning system has been adopted to implement person-tracking. The first stage is person positioning. Infrared are transmitted from transmitter located on a specially made vest, which the target person wears. The signals are received by two receivers located on the top of the Robot. Those signals are then processed to produce a part of the control inputs, which are in the form of distances and angles, to the Robot algorithm. In the second stage, the Robot is equipped with Ultrasonic range finders [1], which has a 15 degree angle and 4cm to 4m range [2]. That Ultrasonic range finder transmits the Ultrasonic waves and receives the echoes sequentially to compute the distance between Robot and obstacles in every direction. Finally, using the range finder distance data along

with the readings from the IR positioning system, a potential field based motion algorithm is formed. Additionally, several specific sub-algorithms will be implemented when the Robot is too close to the obstacles. Therefore, person-tracking and obstacle avoidance can both be implemented concurrently in unstructured environments. The Ultrasonic rangefinders and IR positioning system operate using similar acoustic principles with partial differences.

OBJECTIVES

The main idea in this paper is to investigate the feasibility of developing a person-tracking robot system using an infrared positioning system, besides the ultrasonic sensors equipped on the robot. Furthermore, it will be proven to be the most reliable way to create a person-tracking mobile robot after completing the following steps:

1. Create the interface between the Infrared positioning system and the robot system in the operating program.
2. Design an algorithm that is able to simultaneously avoid obstacles and track the designated person in an unstructured environment.
3. Complete the task of person-tracking when there is no obstacle between the robot and the target person.
4. Complete the task of person-tracking when there is an obstacle between the robot and the target person.
5. Complete the task of person-tracking in an unstructured environment.

SEVERAL APPROACHES TO PERSON FOLLOWING ROBOT

Vision-Based Approach: [3]

Non-vision Based Approach:

Transmitter-and-receiver Based Approach:

Intelligent Space Approach:

Combined/Multi-Modal Approach:

PROPOSED SOLUTION

General/Overview of Our Proposed Solution

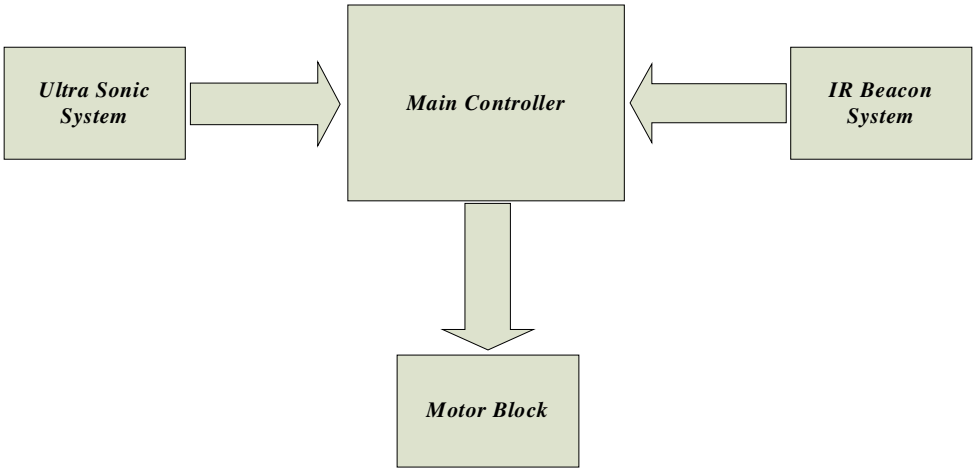

Figure 1. System Block Diagram

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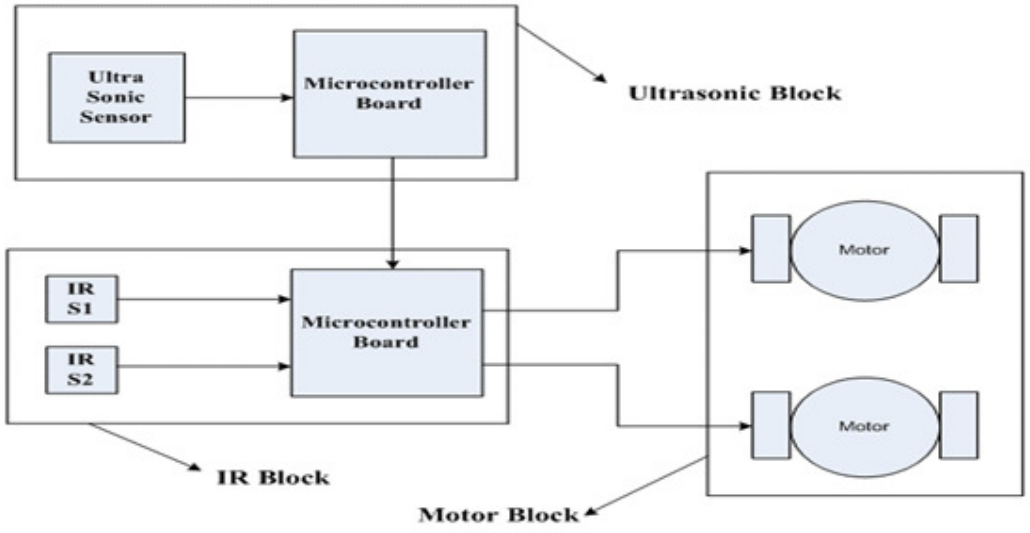

Figure 2. System Block Diagram

Breakup of Proposed System in Sub-System

IR Beacon System

This is main block diagram of IR beacon system [4]. IR receiver receives information from both receivers and both the signals of channel 1 and channel 2 is signal conditioned and then this signal is fed to main controller.

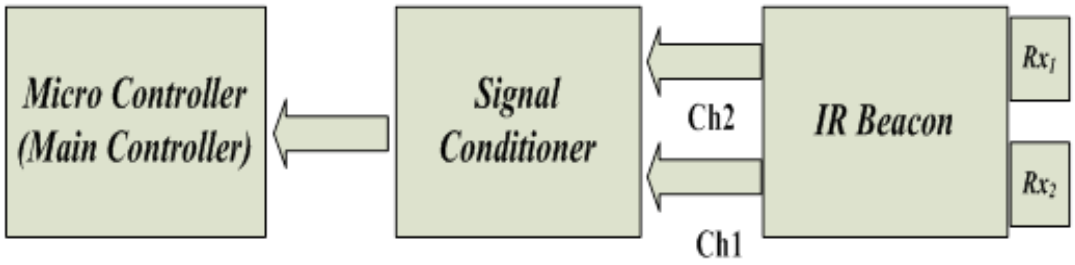

Figure 3. Block Diagram of IR Beacon System

Flow Chart of IR Beacon System

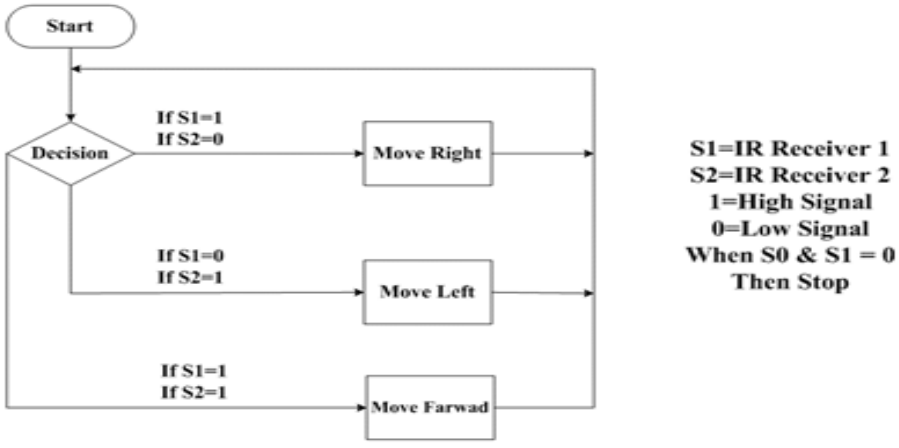

Figure 4. Flow Chart of IR Beacon System

Ultra Sonic System

This is ultrasonic system diagram. Ultrasonic have both transmitter and receiver the receiver receives information afterward signal is conditioned then fed to microcontroller. This microcontroller feeds information to main controller.

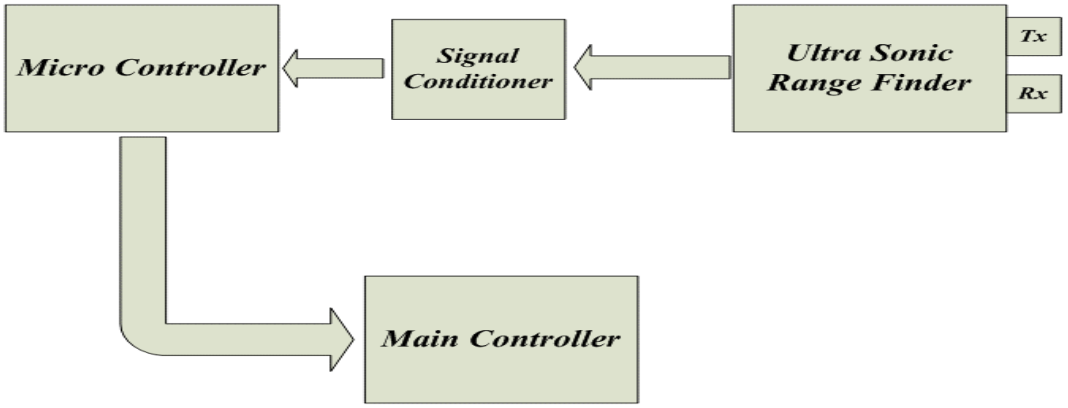

Figure 5. Block Diagram of Ultra Sonic System

Flow Chart of Ultra Sonic Sensor

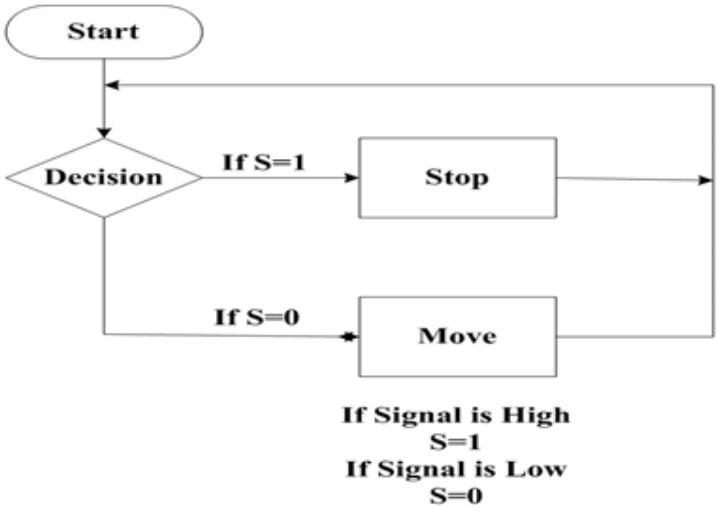

Figure 6. Flow Chart of Ultra Sonic System

PERSON TRACKING METHODOLOGY

Our approach to accomplish the goal is usage of different type of sensors which include Infrared sensor and Ultrasonic range finder. IR is used to locate the position of target and Ultrasonic is used to find distance between target and robot. These sensors are attached on body of robot and configured with different pins of micro controller for their controlling.

The target person has an IR transmitter when he switches on the IR transmitter the IR receiver locates the target person's position for this purpose we have used two IR receiver. One on left side of the robot for left side target detection and one on right side for right side target detection. On our robot we have placed both receivers on front of the robot and separated by a PCB sheet in order to avoid interference because if we don't separate them then it is difficult for actual identification for target location due to interference of both IR receivers.

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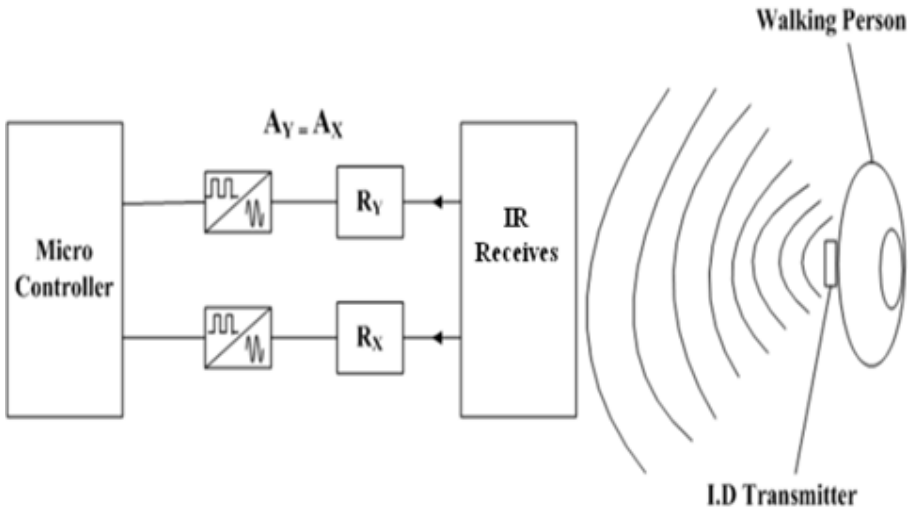

Figure 7. Diagram of Person Tracking Methodology

We have used Ultrasonic sensor on the robot which sends hi frequency sound waves, which are not audible by human ear these waves strikes to different objects and come back to sensor in eco form. The time taken by whole process tells us about distance between robot and different objects. If a condition occurred that one sensor tries to follow the target and other says to stop then here subsumptive behavior will shown.

It is behavior in which one sensor over rules the other sensor. There are certain conditions in which IR receivers getting transmitter signals but there is a obstacle in the way of robot and ultrasonic range finder shows that if robot moves more in that direction it will collide with that obstacle in order to avoid collusion it will over rule IR sensor and change robots position to a extent in order to avoid collusion.

Figure shown below shows the robot range where it can easily detect its target. Firstly the robot detects the target and then tries to follow the target person until he reaches the point PMM. PMM is the minimum distance between robot and target person that's should be maintain by robot in order to avoid collision between robot and target person.

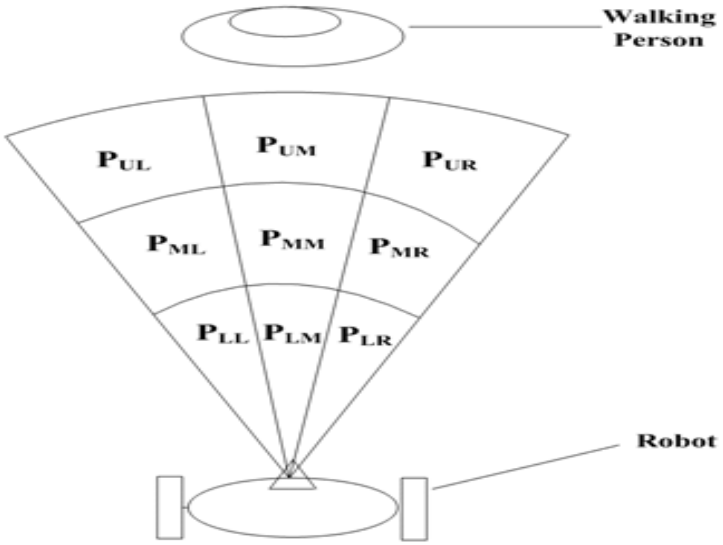

Figure 8. Diagram of Person Tracking Methodology

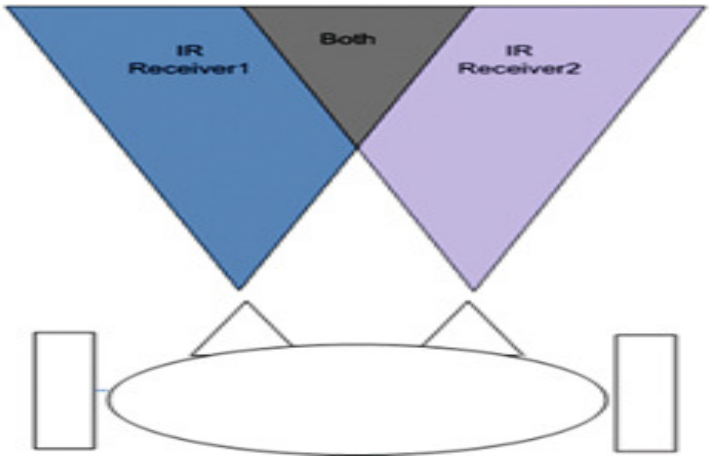

Figure 9. Diagram of Person Tracking Methodology

Case-1

In case 1 as shown in the figure the target person is on the right side of the robot, then in that's condition the robot will move its position and take the target person in the centre both range, as shown in the figure 10, and then follow the target person

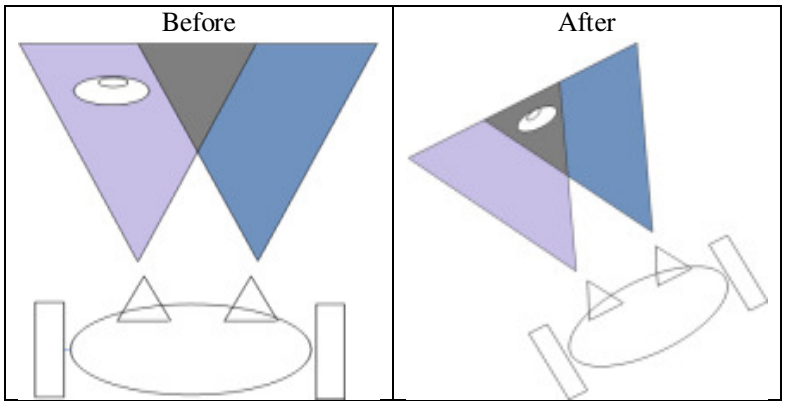

Figure 10. Diagram of Case-1

Case-2

In case 2 as shown in the figure the target person is on the left side of the robot, then in that's condition the robot will move its position and take the target person in the centre both range and then follow the target person straightly. As shown in the figure11.

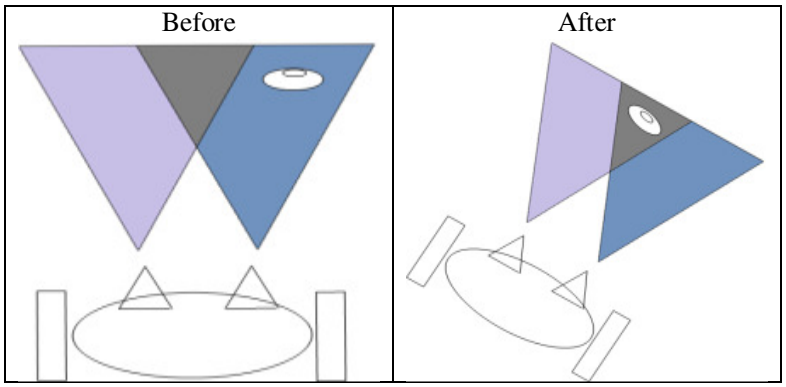

Figure 11. Diagram of Case-2

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Case-3

In case 3 as shown in the figure the target person is on the centre of the robot, then in that's condition the robot will not move its position, its straightly follow the person. As shown in the figure12.

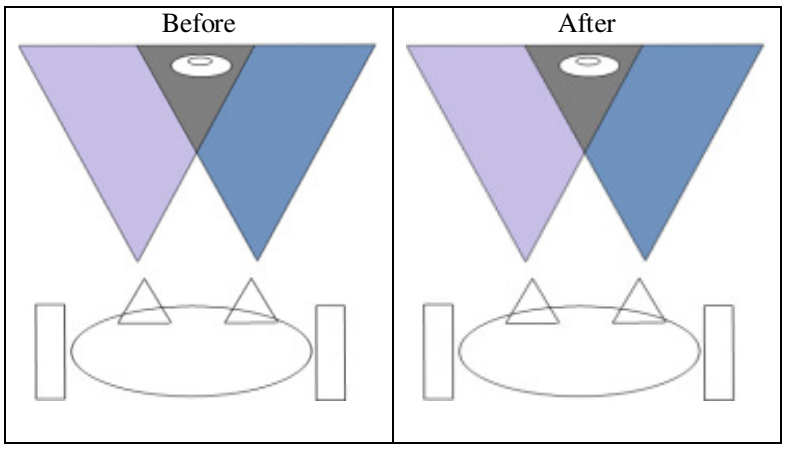

Figure 12. Diagram of Case-3

PERSON-TRACKING IMPLEMENTATION WITHOUT OBSTACLES

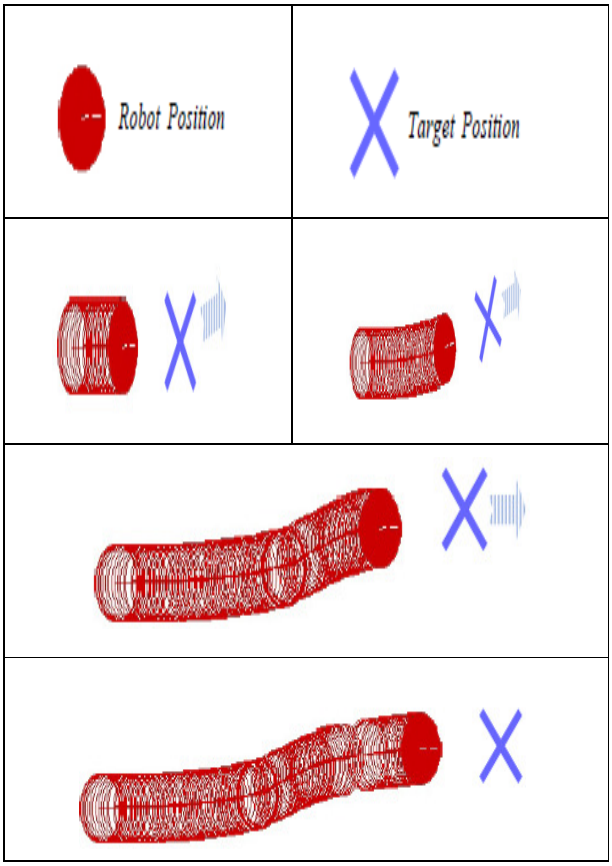

Figure 13. Diagram of Person Tracking without Obstacles

PERSON-TRACKING IMPLEMENTATION WITH AN OBSTACLE BETWEEN THE ROBOT AND THE TARGET PERSON

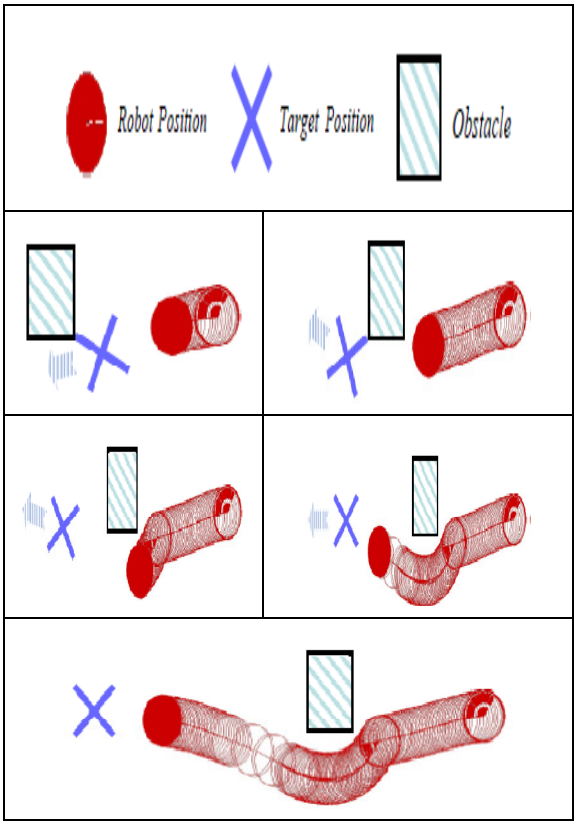

Figure 14. Diagram of Person Tracking with Obstacles

PERSON-TRACKING IMPLEMENTATION IN AN UNSTRUCTURED ENVIRONMENT

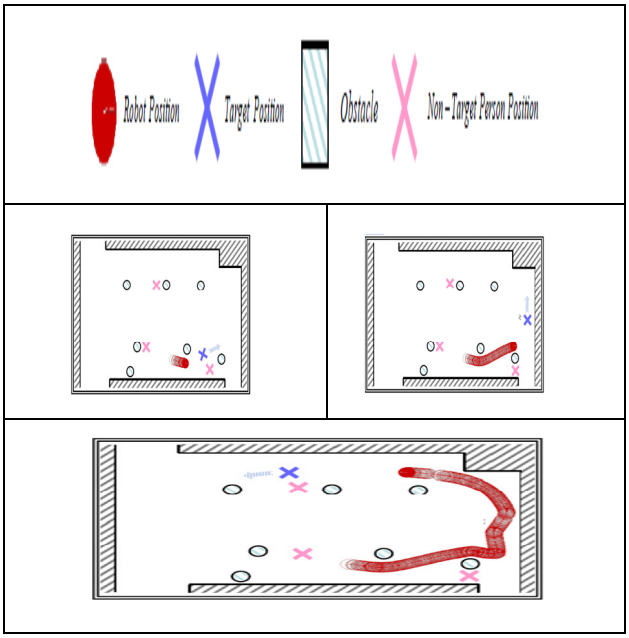

Figure 15. Diagram of Person Tracking with Unstructured Environment

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PHYSICAL MODEL (Robot)

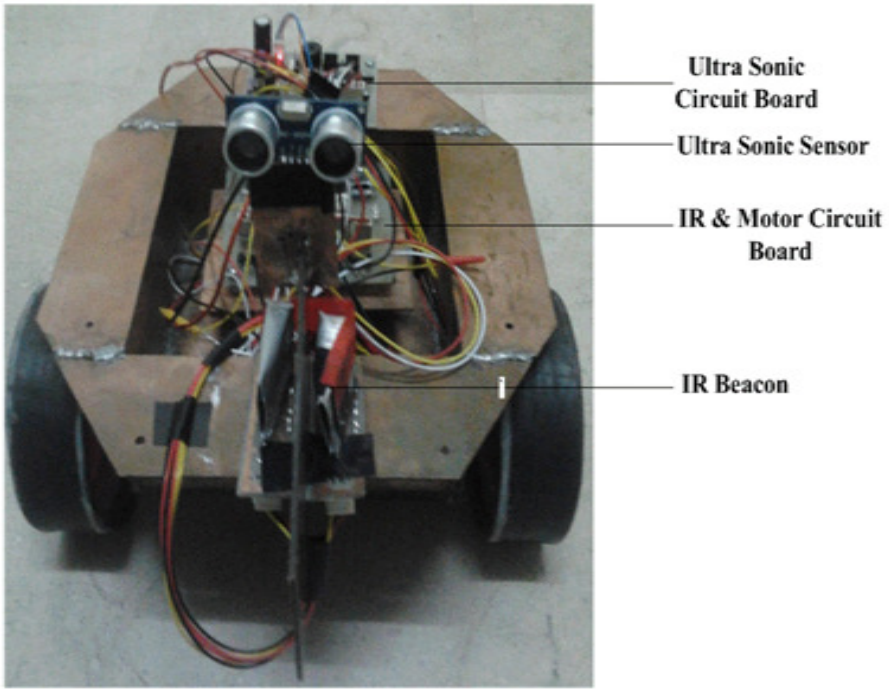

Figure 16. Diagram of Final Design

APPLICATIONS

1. Medical application [7]
2. Use in Warehouse [6]
3. Use at Airport
4. Use in Military

CONCLUSION

In this paper we have presented the small design of small person following robot. This robot tracks and follows target person by using infrared sensor and avoid obstacles by using ultrasonic sensor. Its range is from 2 cm to 4 meter. This is a cheap model of person following robot then the robots available in market and this is a easily implemented technology.

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