A Practical Performance Analysis of Low-Cost Sensors for Indoor Localization of Multi-Node Systems

[1]Ola A. Hasan, [1]Abdulmuttalib T. Rashid, [1,2]Ramzy S. Ali, [2]Jamal Kosha
[1]Electrical Engineering Department, University of Basrah, Basrah, Iraq
[2]Faculty of Engineering and Informatics, Bradford University, Bradford, UK

***Abstract*— In this work, we conducted a study for choosing suitable sensors for indoor localization of multi-node systems. This study is used to compare the performance of the cheapest and most appropriate sensors for measuring the distances among nodes at indoor environments which are the ultrasonic and the infrared sensors. Practical circuits for these sensor types are built and tested in an environment which has cylindrical nodes with different colors. These experiments are repeated for different angles of view to produce a complete analysis for the performance of these sensors.**

Keywords—IR sensor; localization; multi-node; ultrasonic sensor.

I. INTRODUCTION

Sensor is a gadget to sense or measure some physical quantity and converts it through a relationship to a signal that is readable by humans for being display or for further processing. Sensors are used for different kinds of measurements such as: motion, temperature, pressure, sound, light ...etc. [1]. In wireless sensor networks (WSN), sensors maybe used for communication, distance or angle measurements, tracking, obstacle detection, routing …etc. [2-5].

Localization (the ability to compute the position of some node in a system) represents a great issue in WSN and as long as localization is being used, there will be a dilemma for choosing which sensors to be used for ranging (distance measurement) [6-7]. A lot of equipments such as: laser scanner, camera, linear variable differential transducer (LVDT), infrared and ultrasonic sensors can be installed on a node for distance calculation [8]. Taking into consideration that in many applications we are looking for sensors that are low in cost and provide precise distance detection, the laser scanner, camera and LVDT will excluded despite being accurate because unfortunately, they are expensive [9-11]. The accuracy and inexpensiveness of the ultrasonic (US) and infrared (IR) sensors make them very suitable choices for being used in distance measuring [12-13].

This paper aims to address the performance of sensors that are concerned with the distance measurement, having a low price and providing accurate calculations (ultrasonic and IR sensors) to avoid any misunderstanding that may face the industrial people while measuring the distance of objects with different colors. Section II describes the system hardware where all the experiments and comparisons have been done while section III includes the conclusion.

II. SYSTEM DESCRIPTION

This section includes the description of all sensors that have been used in this paper for measuring distance. This section also includes the electronic circuits, schematic diagrams and all the experiments that have been done and the results of them. All the experiments were performed on a white board of 120 cm wide and 200 cm long. The board is equipped with an arm of 200 cm which one of its ends is fixed at the center of the board upper edge while the other end is capable to rotate at 180°. On this arm, there is a sliding part which enables us to move objects easily while measuring distance. Also, at one side of this arm, gradations in centimeters can be seen to make distance obvious for the operator. The board and the arm with all of its details are shown in Fig.1.

Fig.1. Illustration of the white board with the rotating arm and all of its other

A. Sensors for measuring distance

As we mentioned earlier, several types of sensors will be used for calculating the distance of object which are:

1) Sharp Infrared Sensor: Sharp IR is a range measuring sensor, it uses the principle of triangulation and small linear charge coupled device (CCD) for computing distance where a pulse of infrared light will be emitted and in the case of the pulse hitting some object the pulse will be

978-1-5090-4815-1/17/$31.00 ©2017 IEEE