Modelling Robot Navigation to Assist Differently Abled Persons

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Abstract— *Attending requirements of differently abled persons have been a research challenge in the modern world. This matter is crucial in many situations such as waiting areas in receptions, lobbies, airports and hospitals. A research has been conducted to design a line-following robot for attending differently abled people by assisting in tasks such as collecting their documents and issuing the tokens in such situations. The line-following robot has been designed to identify the differently abled persons sitting in designated locations which are assigned with unique identification numbers. When a differently abled person takes a seat, a pressure sensor attached to the seat transmits the seat number to the robot. The robot maintains a database of seat numbers and corresponding paths from the robot original location to the relevant seat. The path description from the original location of the robot to the seat is a bit string denoting 0 for going forward and 1 for turning left or right as per the detected line. A panel of IR sensors has been fixed in 'V' shape to detect bends on the line. Another IR sensor has also been fixed in the front panel to detect obstacles on the straight-line segments. While on the move the robot receives information of new arrivals of persons. The robot operates on first-come first-served basis and attends to the persons on the return trip to the original location. This robotic system has been implemented by KST-TX01 technical transmitter and KST-RX806 super heterodyne receiver running on 16F877a pic microcontroller. This robot has been tested in real life for its accurate navigation capability.*

Keywords- IR Sensor, Signal transmitter, Line follower

I. INTRODUCTION

The patients are helped and treated well by a hospital. A hospital additionally helps to solve patients' issues regarding their sicknesses. Pregnant mothers, differently abled people and other patients have typically come to the hospital to meet their doctors and obtain the treatments. A patient has to do several things, before he meets the doctor. As example a patient should channel a doctor to shows his previous reports and etc. Patients have to wait in queues for a long time in both government and private hospitals. Thus, patients get frustrated and it makes the conflicts with the hospital staff. This robot can be used to resolve this problem.

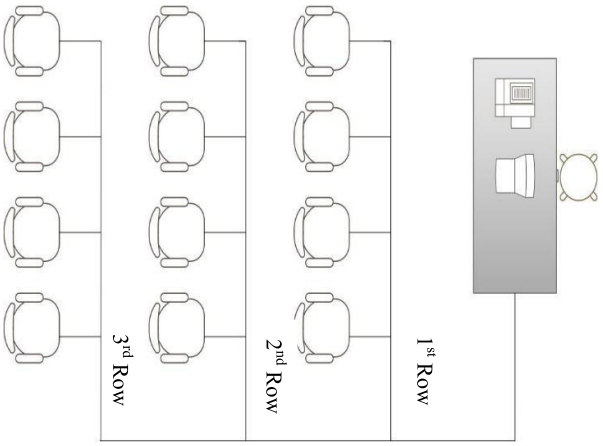

Figure 1. Line following path at hospital lobby

When a differently abled patient takes a seat, the robot issues tokens and helps along with his documents. Therefore exhausted situations at the hospital and payments for labours can be reduced with the help of this robot. It can prevent the issues that happen working with human beings. The robot can be named as a special working robot in hospitals.

II. BACKGROUND AND MOTIVATION

When talking about differently abled people their situation varies from each other. For example, some are blind, some cannot walk without a support and some cannot use their arms as they want to, etc. Because of the technologies man invents there are a plenty of individuals who have been affected adversely. And we know the modern technology is improving fast and due to that humans are experiencing new things every day whether it is good or bad. And we know there are lots of adverse effects like humans becoming disabled due to accidents, Excessive use of computers have lots of side effects many result in bad vision. Becoming addicted to the computers deteriorates human health and resulting high blood pressure, heart attack etc. So we find a noticeable growth in people who are becoming differently abled.

When we consider this kind of differently able people they cannot do their stuff in an efficient way as a normal human being, they might take time. Specially, in a place like a hospital, where lots of differently able people come for their needs, will become crowded because they take more time. So it is better to have a system which supports them to make it convenient.

The line following application can be used in an efficient manner to help differently able people, specially in places such as hospitals, as mentioned above, to deal with inconvenient situations faced by differently abled people. Line followers can be created to support differently abled community to do work with documentations, it will stop the place from getting crowded because it will be faster than a differently abled person etc. For example, it could take the necessary documents from the patient and it can handover it to a given place so the procedure of that particular place will continue while the patient is waiting, seated. This will be a huge convenience to the patient who is differently abled.

III. PROBLEM DEFINITION

Governments of all countries have been trying to implement various solutions to increase efficiency of the health care system, airports, lobbies and receptions in their countries. But they haven't able to find the proper strategy due to expensive budget, high cost equipment and non-availability of skilled staff. Furthermore this will be effecting and wasting the time of the patients as well the energy, morale and resources are spent on treating to the mankind. In order to reduce costs and deliver better service should be the new solution of this era. But the rising question is 'how to provide efficient service?'

IV. LITERATURE SURVEY

There are many systems invented in robotics, which has different applications in different fields. A new kind of robots are made by using new systems for research and manufacturing. A two wheels balancing robot has developed by Maniha Abdul Ghani which can follow a line and for balancing it, the infrared distance sensor is used to solve the problem in inclination (Ghani, Naim & Yon, 2011), (Peter, 2008). Pakdaman has designed a small line following robot which used IR sensors to detect the line drawn on floor (Pakdaman & Sanaatiyan, 2009). Colak has design a line following robot to use in the shopping malls for entertainment. That system has used 4.8cm wide black line to carry maximum load of 400kg. They have used a manual control with the help of remote controller (Colak & Yildirim, 2009). Gomi makes a physical robot which can generate 50 individual controls. It also has the ability, gait to lift the body can be improved. That robot has functions to move its legs in forward motion and tested in different conditions (Gomi & Ide, 1998). Intelligent line following robot was designed by Roman Osorio and it can modify the performance of the movement with the help of different type of magnetic sensors. That robot was based on the V2X sensor that is a type of digital compass (Osorio, 2006).

V. APPROACH

A. *Input*

When the patient takes a seat pressure sensor activated and provides a signal to the transmitter. Transmit the signal to the receiver. The receiver takes the signal and work according to the signal. The robot gets the data from IR sensors which are mounted in the bottom of the robot to follow the black line. Another IR sensor that is situated in front of the robot and find information about barriers.

B. *Process*

This system recognizes the visitor by a unique number which consists of digital values, according

to the row of the seat that the visitor has been seated on. Therefore the signal varies from patient to patient. Seats in a lobby area have been fixed in an ordered manner and a separated part has been reserved for difficultly able people. When a patient takes a seat, a pressure sensor emits a signal to the robot and is navigated to the patient. KST-RX806 Super Heterodyne Receiver that has been fixed to the robot will receive the signal and guides the robot to the patient. As an example, the 3rd digit from right of the sequence 10100, which is '1' indicates the 3rd row. The next two digits, which are 10 indicates the second seat of that row. IR sensors which emit IR rays, are used to travel the robot on the white line. Sensor absorbs when the ray strikes on the black surface and reflects when the ray strikes on the white line. The IR sensor panel has fixed in 'V' shape because it avoids lots of matters happens when the robot turns on curves and bends. The robot waits until the path is cleared when it meets obstacles on the way and waits until the path is cleared. When the line is free, it again starts to follow the line to the designated area.

C. *Output*

A patient come and take a seat the robot came immodestly to the patient. Then robot issues the number by maintaining the queue and take patient's document and go to the receptionist.

D. *Features*

This robot can identify every junction in the path. Also can identify the obstacles in the path and can avoid them perfectly. The transmitter can transmit their signals in an area 1500m range. The robot can maintain queues. If the emergency patient arrives in the hospital lobby and seated in emergency chairs, Robot gives priority to that patient and lead to him immediately. Later on that robot comes back to the patient who is at the next in the queue.

VI. SYSTEM OVERVIEW

This line following robot has been designed to help differently abled persons in many crucial situations. It has been built with sensing, motor driver, Operational Amplifier, actuators, transmitter and receiver. (Datasheets of microcontroller AT89C51, LDR sensor, IR proximity sensor, Motor driver L293D, Comparator, 16*2 LCD, 2003-2014) This system use IR proximities and use pressure sensors for sensing purposes. IR proximities are used to detect the line drawn on the floor and used to detect obstacles on the straight-line segments. Pressure sensors are used to detect if a person occupies a seat. Motor driver is used for controlling the motor, and transmitter and receiver are used to pass signals from a particular seat to the robot. And actuator is used for make the robot dynamic. The system connects with the PIC microcontroller to make the system automatically.

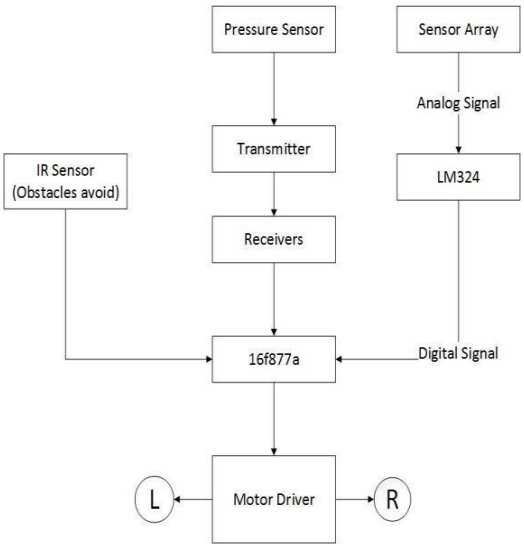

Figure 2. Block diagram of Line Following Robot

A. Sensors

This robot has used two type of sensors. One is an IR Proximity and the other one is a pressure sensor.IR proximity is sensing based on infrared signal acquisition. It has two parts an IR LED and an optical sensor. The infrared LED beams toward the sensing object, a portion of that signal reflected and is detected by the infrared optical sensor. (Datasheet of reflective optical sensor with transistor output, 2009)

Then it gives the output. Through analog-to-digital conversion, the digitized infrared signal can be post-processed by a microprocessor.IR proximity is used for two purposes one is detect line drawn on the floor. Another is to detect obstacle on the straight-line segments as shown in figure 4. A panel of IR sensors has been fixed in 'V' shape to detect bends on the line as shown in figure 3. It has also been fixed in the front panel.

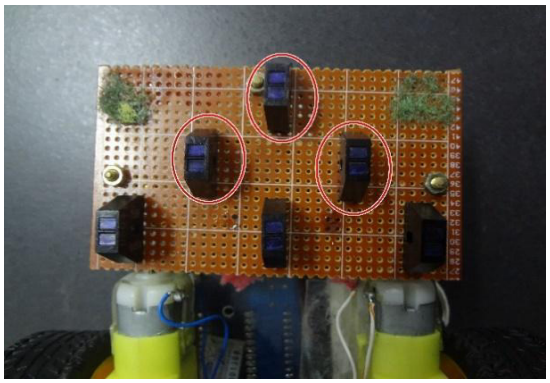

Figure 3. IR Sensor panel

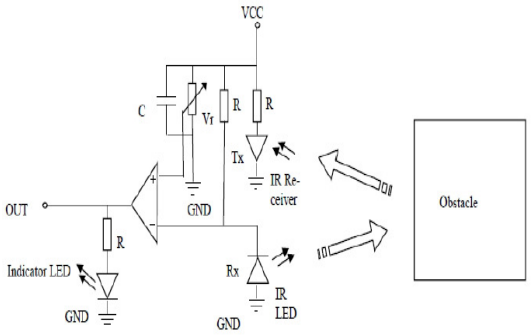

Figure 4. Circuit diagram of IR sensor

The special seat occupancy pressure sensor mat detects if a person occupies a seat as shown in figure 5. (Pressure sensor mat, 2005).This technology is highly flexible in size, number of sensor areas, design. Sensor mat is **water-resistant sealed.**

Figure 5. Pressure sensor mat

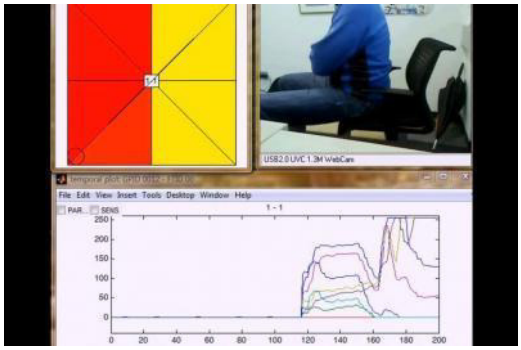

Figure 6.How pressure sensor work

Operational Amplifiers (Op-amp)

Operational Amplifiers are simple IC, which can be used as an amplifier. This is widely used in electronic technology. This can be used in various cases, like a transistor. Most of the time it is used as an amplifier or a voltage comparator. As shown below in figure 7, we could use an Op-amp as a voltage comparator. In here we should give the voltage related to compare limit to V_{ref} terminal and the voltage to be compared should give to the V_{input} terminal. Then comparator will compare voltage. If $V_{input}<V_{ref}$ we will get 0 for V_{out} and if $V_{input}>V_{ref}$ we will get + 5V for V.

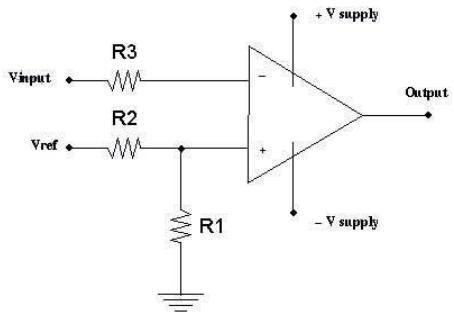

Figure 7. Comparator circuit

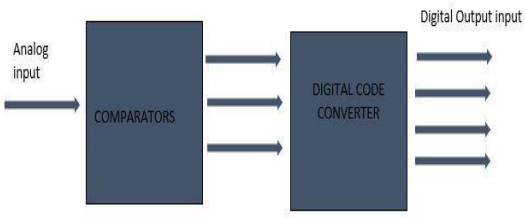

Figure 8. Block Diagram Analog to Digital Converter

B. Motor driver

L298 IC is mainly consisted with two H-bridge circuits as shown in figure 9.A h-bridge circuit is a circuit with a shape H on it and it contains 4 switches. When give 5 V to a terminal and 0 V to another terminal S1 and S4 switches will turn on. Then the motor will turn, rotate in a one direction. When we exchange the voltage of S2 and S3 switches will be on due to switches will be on due to that the motor will change its direction rotation. In L298 circuit we use 4 transistors instead of these switches Here we should only know the voltage to be given to terminal get the particular direction.

C. *Actuators*

For the proper movement of the system two DC motors has been used in the circuit. By using two DC motors robot can move any direction easily. These motors are controlled by motor driver. For controlling the complete system a 16F877A microcontroller is used. And this complete system needs a small power supply of 9 V, which can be provided by a battery.

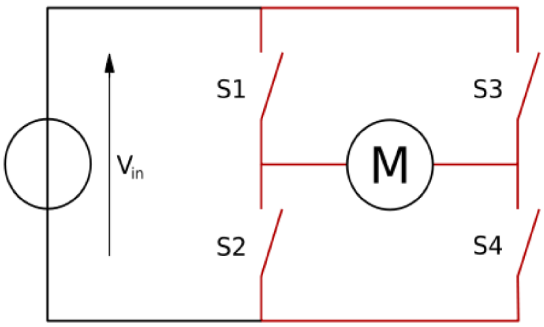

Figure 9. H-bridge circuits

D. Transmitter and receiver

This robotic system has been implemented by KST-TX01 technical transmitter and KST-RX806 super heterodyne receiver. (Datasheet of KST-TX01 technical transmitter and KST-RX806 super heterodyne receive, 2014) When a differently abled person takes a seat, a pressure sensor attached to the seat transmits the seat number to the receiver which is attached to the robot.

VII. EXPERIMENTAL RESULT

The first experiment we did was testing the line follower robot in a structured environment. We have used sensor panel in three IR sensors in a 'V' shape. By using the reflection of IR rays, we can figure out the different between black surface and white. The robot can find out T junctions, Y junctions and 90^0 curves with the shape of sensor panel and it helps the robot to travel accurately on the line at an identical speed.

Table 1. Movement of robot

Movement	Left senor	Middle sensor	Right sensor
Go Straight	0	1	0
Turn left	1	0	0
Turn right	0	0	1
Stop	1	1	1

We have used pwm method and voltage which emits as an occasionally pulse to control speed of the two motors that are fixed to the wheels. By using this method, the speed of one wheel reduces and increases the speed of other wheel in simultaneously. Therefore, this robot gives a high efficiency and accuracy.

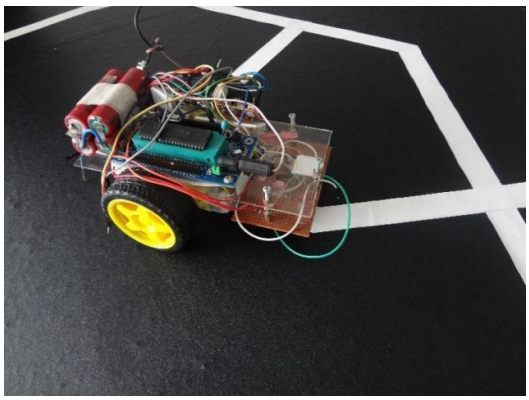

Figure 10. Snapshot of line following robot

VIII. CONCLUSION & FUTURE WORK

Our main objective is to design a robot for attending differently abled people. We have used IR sensors, 16f877a, transmitter and a receiver to control the robot. The robot has ability to identify each and every seat separately in the reserved area. A bit string using 0 and 1 denotes the way robot should move fetch data in order to follow the correct path. The robot operates on first come first served basic with have special features.

To make this system more sophisticated, we can use a camera which is attached to the robot for face detection. Then the robot doesn't appear in

front of the same patient more than once. And also when a doctor issues a prescription which include a unique number, to the patient, the robot would go to the pharmacy and will display the prescription to the pharmacist and the pharmacist would place the drugs on a separate compartment of the robot according to the unique number and then the robot will distribute the drugs among the patients. For this robot will use the given unique number to identify the patient.

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