JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue

JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)

An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Contactless Helping Hand

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Abstract*— The COVID-19 outbreak was declared as a. Global pandemic. On March 11, 2020. Although social distancing. Is the most effective way to conduct out the out spread of this virus. It was not easy to implement for healthcare professionals who needed direct contact with COVID-19 patients and put them under an elevated risk of being infected themselves. This work results an automated contactless robot prototype that can be used in a hospital instead of human nurses to avoid the infection. This prototype helps the patient food, medicine then the robot takes the food, medicine from the nurse and serves it to the patient. This robot can avoid the obstacle and follows the predefined path using IR sensor. It also alerts the patient using voice output.

Keywords*— Robot, Line Following, Obstacle avoider, IR Sensor, Food delivery, Hospitals

I. INTRODUCTION

Robots are playing a significant role in combatting the coronavirus. We look at some of the ways in which robots are keeping people safe, fed, and able to access the care they need through the pandemic. A Tray which can be used for contactless delivery of food and medicine to Covid – 19 patients in isolation wards without human intervention. Due to lack of such solutions, many of the hospitals have started placing food and medicines in a Common Hall from where the patients must collect their items on their own. This further increases the risk and contaminates the area. On the other hand, delivering food/medicines by front line health workers is a huge risk to them and increases the spread. The deployment of these tray in the hospitals can help minimize the risk of the frontline health workers of getting infected with the deadly virus.

This system results in automated delivery of food to patients time to time in a ward without hand contact with the patient. When IR sensor detects the black line it follows the predefined path and stops near the bed based on condition. It stops near the bed and alerts or reminds them to take medicine or food through voice inbuilt using Arduino and speaker also using servo motors it opens the trays from both side and serves two patients at a time. This prototype is designed for one ward with 8 beds in a hospital.

The paper is assembled in this manner: Segment II presents the related literature review. Segment III presents the system design and methodology of the prototype.

Segment IV presents the results tested during experimentation, Segment V summarizes conclusion and future work of the system.

II. LITERATURE REVIEW

The literature survey provided us the required knowledge for our project. It showed us a general image of the existing knowledge on the topic under question. Some of the important conclusions we made after reading the papers are listed below.

Huseyin Yildiz, [1] There have been a number of studies on automatic food/medicine delivering in the past. In this paper, to overcome the problem line following robot has been Developed which will serve each and every Patient individually from time to time Comparing two different controller Sliding mode control(SMC) and Proportional-integral-derivative (PID), SMC Has proved to be better than PID. SMC is faster and tracks the path superiorly with low energy. One of the easiest and cheapest ways to control DC Motors is to interface the L298NMotor Driver with Arduino. It can control Both speed and spinning direction of two DC motors so that it can detect the turning. This line following robot provides effectual control and tracking on linear as well non-linear path. IR sensors are widely used for measuring distances, so they can be used in robotics for obstacles avoidance. IR sensors are also faster in response time than ultrasonic sensors. Mehran Pakdaman, [2] Generally, the path is predefined and can be either visible like a black line on a white surface. Components used are Arduino UNO, IR Sensor, Battery, Motor Driver, Motors, wheels and wires. To sense the line, Infrared Ray (IR) sensors are used which are

installed on the robot. IR sensors consist of two diodes that one of them sends ray and another one must receive it. If The Receiver receives the reflection ray, it means that the robot is on white and if it cannot receive it, so the robot is on black. The distance between sensors and ground surface must be 3 or 2 mm and the distance between each sensor is depending to your line Width. A driver is needed for controlling the motors. The L298 motor driver Has four inputs to control the motion of the motors and two enable inputs which are used for switching the motors on and off. The driver gives positive voltage to one of the motor pins and gives negative voltage to another one for which there are Three states: Both the motors are turned on and rotate forward simultaneously. (Move Forward).The right motor is turned on and the left motor is turned off. (Move Left). The left motor is turned on and the right motor is turned off.(Move Right).Tajim Md. Niamat Ullah Akhund, [3] Robots are reducing human work. Robots are broadly using in restaurants, Farming, Hospitals and various fields nowadays. This work results in a low cost IoT Robot that can work like a waiter in a restaurant. The developed robot can follow lines and avoid obstacles. The robot can take and serve orders to the customers. It reads RFID from tables to recognize particular orders from customers. The collected data will be saved in a cloud database. Taking orders by robots will automatically go to the chefs.Each order bill will also be generated on the robot. The robot will be able to take the bills also. The full system is made in very low cost than previously made systems. It will not increase unemployment problem too. Muhammad Farhan Fahim Adnan,[4] Robot is usually designed to reduce the number of human work where it is applicable. It's usually developed for reducing risk factor for human work and increase comfort of any worker. This project has been designed to make a line following robot using IR sensor to follow a delegated path which is provided and runs over it. Robot has sufficient intelligence to cover the utmost space provided, it will move during a specific direction specified by the user to navigate the robot through a black line marked on the white surface and vice versa or can be invisible kind of magnetic flux. We use mecanum wheels, Arduino Microcontroller (MEGA 2560) ,DC motors proteus software ,ultrasonic IR Sensors. Ultrasonic sensor is used to detect obstacles. 0110 is the output of the IR sensor that determines that The robot is at the Right position. 0011 or 1100 robot at wrong position to navigate Arduino will make the decision for the robot to move Right or left. Jagruti Chaudhari,[5]In this project, IR sensors are used for detecting paths. Also for controlling and running the robot, Arduino and motor driver modules are used respectively. This paper mainly focuses on the working of IR sensors. In this,two IR sensors are used with IR led and photodiode as a pair. Kazi Rabiul Alam ,[6] As the proposed system is overhead type so it needs no extra space in the ground. Most of the smart restaurants in the world are using line following robot to serve food to customer. The installation cost of line following robots is high. For this reason, it's difficult for developing countries to build a smart restaurant. So, we have designed a smart system for serving at restaurant by using overhead crane, which is cost effective. Also due to the ongoing Covid-19 epidemic, the restaurant business is in recession. With this proposed system, it is possible to provide food directly from the kitchen to the customer's table while maintaining social distance and following hygienic rules. K.Dautenhahn, [7] The study presented in this paper explored people's perceptions and attitudes towards the idea of a future robot companion for the home. Humanlike communication was desirable for a robot companion, whereas humanlike behavior and appearance were less essential. Results are discussed in relation to future research directions for the development of robot companions.

III. SYSTEM DESIGN AND METHODOLOGY

This segment will cover the design, features, algorithm and system model.

A. Features

This Helping Tray will follow the black line, moves along the path in hospitals, as it starts it will detect turns, stop position and obstacles, to reach its destination and serve the particular patient their food. Once it completes serving all the patients in particular ward it will come back to its starting point. This system can be charged and used anytime.

B. Algorithm

Algorithm of the system is along the lines :

Step 1: Start the Robot.

Step 2: Check black line

Step 3: If black line then continue and sense obstacle.
Else gather more IR sensor data.

Step 4: Check obstacle?

Step 5: If obstacle then gather more IR sensor data to avoid obstacle
Else stop

Step 6: For case 1 check position and turn left.

Step 7: Stops near the bed and open trays with voice module

Step 8: case 2 move forward and serve next bed

Step 9: case 3 turns right moves towards next bed

Step 10: case 5 if finished serving all beds come back to original position.

Step 11: Check finish?

Step 12: If delivery complete then Stop.

C. Hardware and software used

This project consists of two parts with software as well as hardware.

Software used:

- AVR Studio: It uses the WINAVR open source compiler at the back end. After writing and compiling the program it gives .hex file. This .hex file needs to be loaded on the robot using In System Programmer
- AVR DUDE : AVR Downloader Uploader – is a program for downloading and uploading the on-chip memories of AVR microcontrollers. It can be used effectively via the command line to read or write all chip memory types.
- Audacity : This application is used for the voice output in which MP3 file is converted into 16bit pcm followed by using encoder software in backend to store the exact length of added silence and able to automatically strip off the added silence.

Hardware used

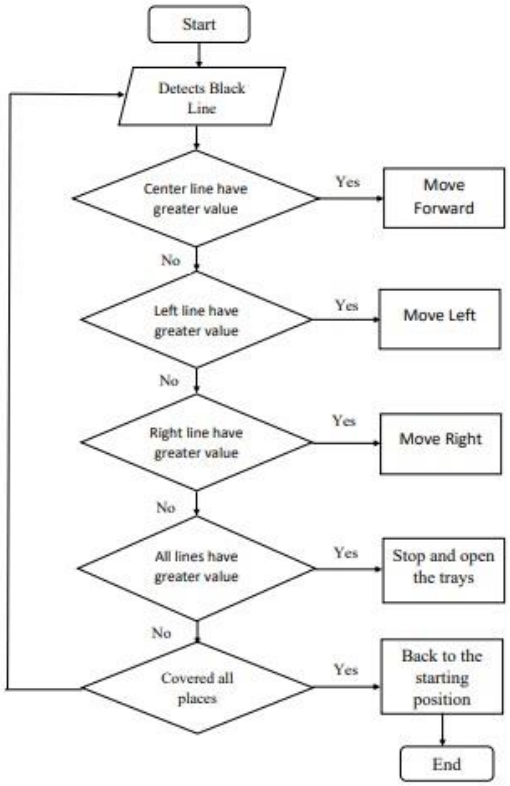
- FIREBIRD V ATMEGA2560 : This is used as base of our project which follows the black line using IR sensor present at the bottom.
- Arduino Uno : It is used for the voice output which is connected with firebird v port J ,also speaker connected to Arduino and firebird v.
- MG995 servo motor : There are two servo motors connected to firebird v in slot S1 and S2 which are

used for mechanism of tray which serves the patient. Servo Motor rotates 90° in each direction making it 180° servo

motor. It is a Digital Servo Motor that receives and processes PWM signal faster and better. It equips sophisticated internal circuitry that provides good torque, holding power, and faster updates in response to external force.

D. Design of the prototype

The full prototype is narrated in the flowchart given in (Fig. 1). It needs black line to wander around hospital ward using IR sensor and obstacle detector. Using Arduino Uno it



alerts or reminds patient for their food/ medicine time.

Fig. 1. Working flow chart of the robot.

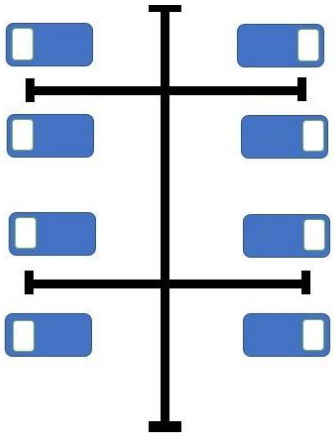


Fig.2. Diagram of path to be followed

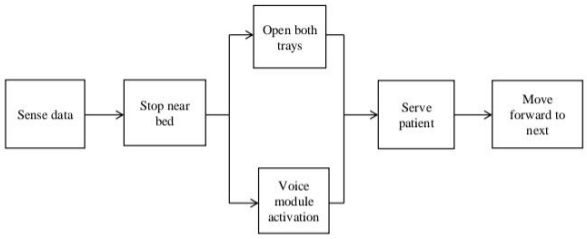


Fig. 3. Working block diagram of automated system.

In conducive to use our helping tray in the hospitals we need to add black line beside the beds of the hospitals. This system which has base of firebird v atmega2560 has IR sensors for line detection, they sense the data and sends it to DC motors present below the bot. The total system working is explained through flow chart in fig 1.

The path needed to be followed by the bot is shown in fig 2. The bot will move along and line and stop near the bed. Near all the beds there will a path sensed to stop using IR sensor with higher threshold values.

Once it stops near the bed it will start it's automated designed system as shown in fig 3. It will give voice output through Arduino and speaker connected to it once it get data or signal from firebird v and using the servo motor slots of firebird v we have connected 2 servo motors MG995 which act as support for trays to come out.

The helping hand's total image is shown in fig 4.and opened trays which automatically comes out after reaching beds is displayed in fig 5. Followed by voice module circuit in fig 6.

E. Calculations

Case 1: Robot is moving forward or backward (encoder resolution is in mm)

Wheel diameter: 5.1cm Wheel circumference: 5.1cm * 3.14 = 16.014cm = 160.14mm

Number slots on the encoder disc: 30

Position encoder resolution: 163.2 mm / 30 = 5.44mm / pulse.

Case 2: Robot is turning with one wheel rotating clockwise while other wheel is rotating anti clockwise. Center of rotation is in the center of line passing through wheel axel and Both wheels are rotating in opposite direction (encoder resolution is in degrees)

Distance between Wheels = 15cm

Radius of Circle formed in 360° Rotation of Robot = Distance between Wheels / 2

= 7.5 cm

Distance Covered by Robot in 360° Rotation = Circumference of Circle traced

= 2 x 7.5 x 3.14

= 47.1 cm or 471mm

Number of wheel rotations of in 360° Rotation of robot = Circumference of Traced Circle / Circumference of Wheel

= 471 / 160.14

= 2.941

Total pulses in 360° Rotation of Robot = Number of slots on the encoder disc / Number of wheel rotations of in 360° Rotation of robot = 30 x 2.941

= 88.23 (approximately 88)

Position Encoder Resolution in Degrees = 360 / 88

= 4.090 degrees per count

Case 3: Robot is turning with one wheel stationary while other wheel is rotating clockwise or anti clockwise. Center of rotation is center of the stationary wheel (encoder resolution is in degrees) In this case only one wheel is rotating and other wheel is stationary so robot will complete its 3600 rotation with stationary wheel as its center.

Radius of Circle formed in 360°Rotation of Robot = Distance between Wheels

= 15 cm

Distance Covered by Robot in 360° Rotation = Circumference of Circle traced

= 2 x 15 x 3.14

= 94.20 cm or 942 mm

Number of wheel rotations of in 360° Rotation of robot = Circumference of Traced Circle / Circumference of Wheel

= 942 / 16Wheel

= 5.882

Total pulses in 360° Rotation of Robot = Number of slots on the encoder disc / Number of wheel rotations of in 360° Rotation of robot = 30 x 5.882

= 176.46 (approximately 176)

Position Encoder Resolution in Degrees = 360 /176

= 2.045 degrees per count

IV. RESULTS AND OUTCOME

Trial point 1: Black line following, after 50 try it can successfully follow right line 45 times with our algorithm, so accomplishment rate is 90%

Trial point 2: Obstacle detection, if it detects obstacle in between it sense it through obstacle detector sensor and stops. So during experimentation it stopped 49times out of 50, so success rate is 99%

Trial point 3: Detects the value to stop near the bed using IR sensor and send data to Arduino for voice output. So after trying it was successful over 95%.

Trial point 4: Food delivery, it opened it's trays at the point near the bed and served patient time to time. After 50 try it worked 47 times so accomplishment rate is 94%

Trial point 5: Recognize the Customer with RFID, after 100 try it can successfully recognize the customer correctly 98 times with our algorithm, so success rate is 98%.

Fig 4. Total proposed prototype

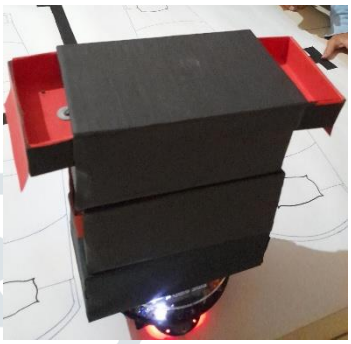


Fig 5. Working of trays

Fig 6. Working voice output module

Furthermore, the helping tray is made in with low cost and affordable components, and as the base firebird v is critical and sensitive it can hold upto 2-3 kg of weight so the body of the project is made light weight so food can accommodate that weight.

V. CONCLUSIONS

Therefore, this paper focused on the automated food delivery for patients without need of any ward boy or nurse to go inside the ward and serve each and every patient by themselves. This automated system once started follows the path and performs as per direction and conditions given to it. This system will not increase unemployment as it will require maintenance and get charged time to time. Also it will not cost too much so it is affordable too.

A. Future Work

We plan further research to:

- A camera can be placed in the line following robot from which the status of every patient can be handled from a single room.
- In the bed of the patient an accelerometer can be placed form which If a patient gets a heart attack then the disease can operate an alarm circuit or GSM module can be placed with the line following robot, so that if any untoward incident occurs then the system can make a call to the doctor.

- It also helps the doctor for remote diagnosis of patients, even when he's away from the hospital by remote presence. The line following robot can also be improvised by using RFID tags so that accuracy of the system increases.
- Robotics is very big field for the new innovations and research. By using the robots in real time applications or healthcare system can be managed in an effective way.

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Received: 17 june 2020 / accepted: 25 september 2020 (springer)

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