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Logistic waitress Robot Mark 1

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ABSTRACT : *This paper describes a waitress robot which is delivered as a part of smart restaurant. Robotics is the branch of electronics that deals with the design, construction, operation and application of robots and computer systems for their control, sensory feedback and information processing. This robot is designed to take order and to deliver the order from counter to the customer. System works on the concept of line follower. The robot can deliver different messages intelligently and can sense any object within 1metre. The design is integrated with different sensor modules, motors and ICs to achieve the desired goal.*
Keywords: *Robotics, Line follower, Smart waitress, Hospitality robot*

I. INTRODUCTION

Robotics and automation are the need of future for achieving better accuracy, time optimization and higher efficiency. Robotics has become the integral part of almost all the fields ranging from a small application to very complex applications like open heart and brain surgery where accuracy is the prime concern, assembly lines of automobiles where time optimization is very important and many more applications. These days hospitality is a big industry and involves huge manpower and cost. The logistic waitress robot Mark 1 is a step toward making hospitality industry more efficient and cost effective. Apart from hospitality industry, this robo may be modified to utilize in other industries as well as household applications.

The idea came from the line follower robot and later decided that the concept should be taken to some other level. Keeping the line follower as base concept, other transducer and control modules are integrated to realize the logistic waitress robot Mark 1.

II. METHODOLOGY

Robotic system should work very smoothly as a small jerk may topple the waitress robo structure. For smooth functioning of the robo, PID algorithm has been implemented. In conventional approach, two numbers of IR photo detectors are used. This approach may be used for small structures but for tall structures this approach is very inappropriate. In present system an array of photo detector is used on both the sides of robo vehicle to sense the reflected light. Complete system can be presented using block diagram (Fig. 1) as shown below. The path reference (Ref) is the virtual central line of the designated path (Fig. 2) and the error is the angle between virtual central line divides the robo vehicle (Robo ref) in two symmetrical parts(Fig. 3) and the path reference(Ref).As the vehicle take a turn, one motor rotates in one direction and other in opposite with variable motor speed control using pulse width modulation(PWM). Motor speed (w) changes in proportion with error angle (Θ) by varying to pulse width. Error may be countered by integrating small fixed step i.e. keeping a small constant pulse width until the error is reduced to tolerance band but it slowdowns the system at turning points. It is better to use dynamic step size i.e. step size varies proportional to error angle with a little differential control to optimize the jerk. One ultrasonic front sensor is also mounted to sense the obstacle proximity. Here also the stopping and starting should be smooth to avoid toppling of the robo structure. This is also achieved by optimizing PID parameters.

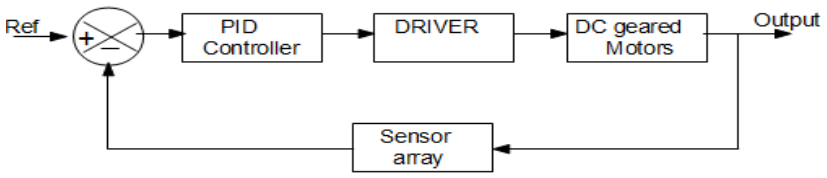

Fig1. Block diagram

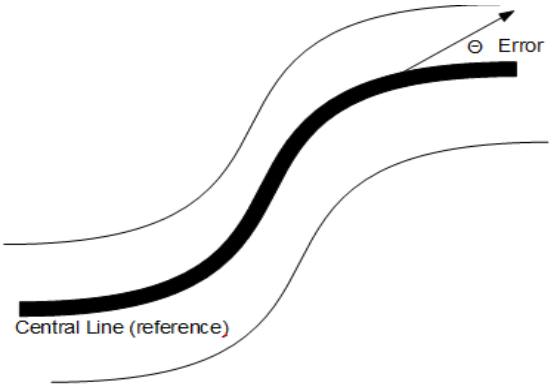

Fig2. Path

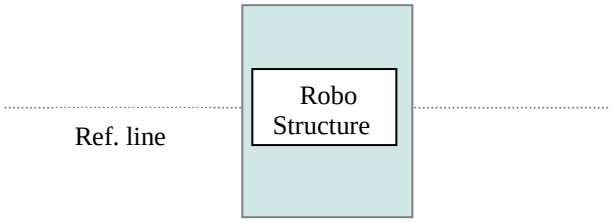

Fig3. Robot Ref

III. IMPLEMENTATION

The logistic waitress robot concept is implemented using PID control. A sensor network comprising of IR photo transistor array and ultrasonic sensor is the heart of present system. Four no. of DC geared motors operating in all wheel active modes are controlled by the processed signal coming from the sensor network feedback. Over this platform a servo motor is fitted to control the angular motion of the dummy from 0 (look Forward) to 180 deg (look Backward).Two no. of IR photo transistor array are placed on front and two at the back on both sides of the robo structure. Front sensor arrays govern the robo movement in forward direction that is from order counter to the guest table and back sensor arrays are meant for backward movement that is from guest table to order counter. Ultrasonic transceiver module is meant for sensing the presence of obstacle or human on the path. Text to Speech converter module generates prerecorded message or dynamic message coming on its serial port via 433 Mhz transceiver module. This robo may work in autonomous or RF control mode. Operation of the robo is initiated by the manager sitting on the counter by transmitting table no. information on its serial via 433 Mhz transceiver module. Controller will direct the robo toward the designated guest table. After reaching on the designated table robo will generate pre-recorded greeting and menu voice message. Reply of the guest is recorded using the microphone fitted at front. After the completing the order guest will press go button fitted on the table interfaced with RF transceiver module.

IV. FIGURES AND TABLES

Fig4. Overview of Robot

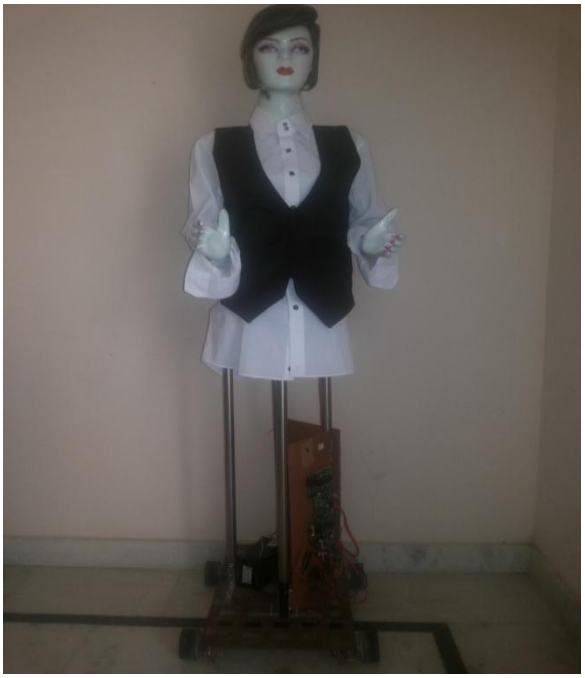

Fig5. Inner view of Robot

Fig6.Closer view Of Robot Circuit

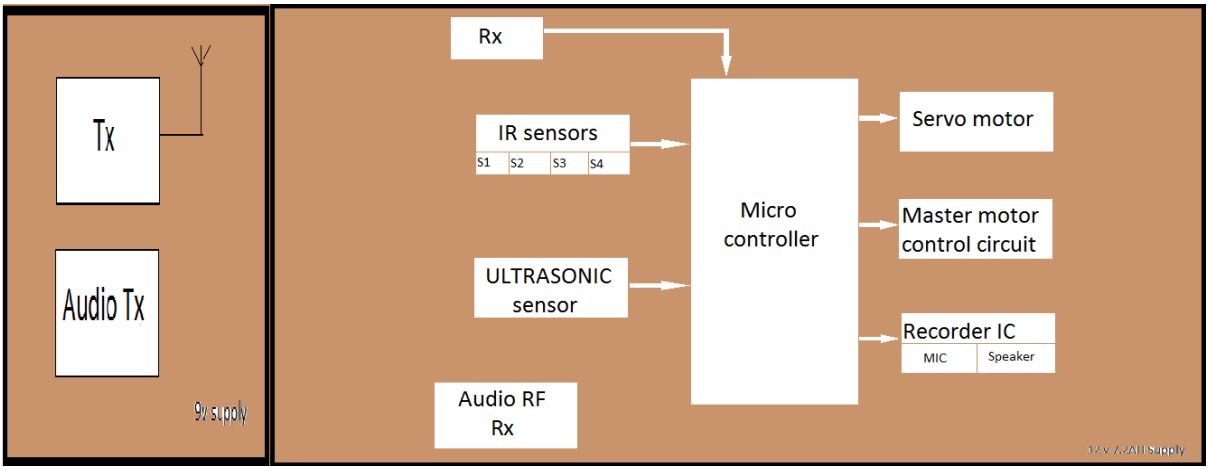

Fig7. Block diagram of Mark 1

V. CONCLUSION

The robo system is tested and demonstrated a number of times. System worked as per expectation but response can be improved using magnetic rail and reluctance sensor. System is energized using 12 volts battery with 7 AH and the lower motor can take load up to 25 kg (approx) and the upper servo motor can take load up to 4 kg (approx) with 180 rotations. This robot system can be used in smart restaurants as a smart delivery system. Further it can be modified for other applications like fire fighting robot, border security robo and many more. By integrating a camera, GPS, GPRS and Zigbee the performance and diversity of the system can be increased many fold.

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