

## **Waiter’s Bot – An Overview**

**Dr. A. N. Jayanthi**  
**Associate Professor**

Department of Electronics & Communication Engineering  
Sri Ramakrishna Institute of Technology  
Coimbatore, Tamil Nadu, India  
&

**Ms. Aishwarya Jothi R**  
**Final Year Student**

Department of Electronics & Communication Engineering  
Sri Ramakrishna Institute of Technology  
Coimbatore, Tamil Nadu, India  
&

**Ms. Roshna Sherlin P R**  
**Final Year Student**

Department of Electronics & Communication Engineering  
Sri Ramakrishna Institute of Technology  
Coimbatore, Tamil Nadu, India  
&

**Ms. Tharani C A**  
**Final year Student**

Department of Electronics & Communication Engineering  
Sri Ramakrishna Institute of Technology  
Coimbatore, Tamil Nadu, India

### **Abstract**

Line following is a fundamental robotic navigation technique, wherein a robot automatically follows a predefined path, typically marked by a line on the ground. This process is achieved using sensors, such as infrared or camera-based systems. This system detects the contrast between the surrounding surface and the line. Control system of the Robot processes the received sensor data to adjust the robot’s steering and maintain its trajectory along the line. Moreover, by using line following robot as the basic design, Waiter’s Bot is designed. Moreover, it is used to carry the order placed by the customers and deliver it to the respective table and after delivering the order it goes back to the pantry to fetch the other order. This study explores to understand the principles, sensor technologies, control algorithms, and practical applications of line-following robots.

**Keywords:** Line Follower, Automatic Guided Vehicles (AGV), Waiter’s Bot, Robotics, Artificial Intelligence

## Introduction

The shortage of manpower has become a huge challenge for corporate owners, mainly in the beverage and food industry. Even with the arrangement of virtuous chefs and qualified managers, restaurants have a tendency to run into a confusion with inadequate servers. Therefore, a swift solution could be to have attendants carrying heavyweight loads to rise the effectiveness. However, this answer quickly degrades as attendants become tired and hence, unable to stay in working condition. It is basically that the foremost responsibilities of attendants are to bring dishes from the pantry(kitchen) to customers, wherein robots can be used for this task. With the support of robots, the problematic issue can be removed as robots can remain working untiringly (Chaudhari et al., 2019). Also, as servers are mandatory to be proficient, part-time employees have a tendency to contribute to a depletion of resource. Additionally, as part-time employees have asymmetrical agendas, restaurant proprietors may find themselves having a lesser number of staff at a particular time. Therefore, to handle with a sudden surge of clients during festivals, extra robots can be positioned as an alternative of hiring extra momentary staff. There will be a programmed computer-controlled communication arrangement between the various stakeholders - cafeteria staff, patrons and robot waiters. Once the robot has acknowledged an order placed, it will estimate and steer its way towards the patron's table and these paths will be improved so that the obstacles can be avoided.

A line following robot is a vehicle that is capable of moving and can distinguish and track a pictorial contour on a surface, such as a dark line on a surface that is white or vice versa. The robot uses IR transmitters and receivers, also known as photodiodes, which has been used to detect the line. When IR light hits a white surface, it reflects to the IR receiver, causing voltage changes that the Arduino analyses. Conventional line following robot uses the on/off methodology. It means that when the robot changes its direction to the left, the robot switches off the right motor. In this situation, left motor is working as usual. This is a very simple robot control method; however, the limitation of this method is that the robot does not move very smoothly. Moreover, this line following is commonly used in various applications, including Automated Guided Vehicles (AGVs) in industrial settings, educational robotics, and competitions (Pakdaman et al., 2010). Furthermore, this shaking disturbs the drive speediness of the robot, wherein the stability is reduced and loss of energy takes place.

The limitation of this 'Bot' is that it uses only sensors to detect the line and does not distinguish the angle between the robot and line to be followed. The line is at the centre of contour sensor, but the robot is steering away from the target route. The waiter robot is a mobile robot, which does the job of the waiter in hotels. It carries the food to the desired table in hotels and waits for the programmed time and return to pantry. This waiter robot chooses the path and moves to the desired table. Moreover, IR sensor is used to detect the obstacles, and the robot follows the black line which is given as the path. Line Following Robot is modified as the 'Waiters Bot'. A typical line following robot always trails the dark/black line and stops when black line ends. Thus, it reduces manpower and time.

## **Literature Review**

### **Line Following Robot Using Arduino for Hospitals**

Line following robot using Arduino is analysed in this study. Moreover, measuring, scrutinizing and enhancing the transportation of required ingredients inside the health care institutions, industries are carried out in this research. The system proposed in this work spots the dark/ black path and advances in its path and reaches the ground finally. Also, material conveyance and minimization of the manpower are the advantages of this study. This goal of this research is to comprehend and device a tool for the precise movement of robot by fine-tuning controller parameters to get better performance. This robot is largely considered to advance in a predefined pathway. In furtherance, for locating this path two sensors are used. Robots are largely applied in industrial plants having pick and place ability. This robot transports machineries from anticipated source to destination by subsequent secured path (Chaudhari et al., 2019). Nowadays, research has been carried out to allow the automation in health care systems and industries. This robot is made to transport the important goods such as medicine, equipment, etc.

### **Restaurant Serving Robot with Double Line Sensors Following Approach**

The era of industrial 4.0 is emerging across the globe. Robotics have been functional in many facets of human lifetime. The researchers have highlighted the development within the restaurant serving through robot. They have used two line-sensors with PID (Proportional-Integral-Derivative) controllers for stability (Thanh et al., 2019). The robot is designed by analysing the surveys taken with respect to the magnitude and appearance requirement in restaurants. Furthermore, the data is mapped so that the serving robot comes to a specific table by programming. Line reading algorithm is used in this study, wherein two LED array line sensors are used along with a microcontroller in which the robot tracks the line on floor. In this technology, the robot moves to the chosen table and proceeds towards the service counter after finishing its task. Also, the mathematical model is built and simulated using MATLAB Simulink. The PID parameters are estimated by using the PID Tune App from Simulink, and then interfaced to microcontroller that regulates the width of pulse input to the motor.

### **Implementation of an Autonomous Delivery Robot for Restaurant Services**

Field of robotics has faced a drastic technology advancement by assisting the human in accomplishing tasks, by which, daily lives of human being are more comfortable. In the current scenario, collecting, fetching, transporting & billing and service are the important tasks carried out by robots effectively, wherein they perform a smarter work is carried out by them within the time. A study conducted by Yanmida et al. reported the tasks in a conventional restaurant by presenting a prototypical delivery robot as a waiter and a wireless system for engaging in getting orders (Yanmida et al., 2020). An innovative approach for table detection by a moving robot uses RFID (Radio Frequency Identification) and an indoor setting has been proposed. A line following robot utilises programmed Arduino unit to distribute dishes from pantry to the appropriate table from which the request has been made. This is done by sensing an RFID tag at table (target) position through the onboard RFID reader available in the robot. An android application is developed for placing orders from customer's smartphone to a protoboard (receiver) containing a Bluetooth module placed in the kitchen. The performance of robot has

been assessed to regulate the appropriateness and effectiveness of the detection of table and localization using the RFID technique as in this paper. It has been found from the results that an average error of only 5 percent is recorded, which seems to be very promising.

## **Need & Relevance**

Waiter's Robots are autonomous machines designed to assist humans in various tasks, particularly in the service industry. Robots used here come along with cutting-edge sensors, actuators, and artificial intelligence algorithms that qualifies them to cross multifaceted surroundings and environment, interact with humans, and accomplish specific responsibilities efficiently. In the hospitality sector, serving robots are often deployed in hotels, restaurants, and cafes to deliver food and beverages to customers' tables, thereby streamlining operations and enhancing the dining experience. These robots can navigate crowded spaces, avoid obstacles, and ensure timely delivery of orders (Mashaghi, 2008). The following reasons for focusing on Waiter's Robots are:

- Waiter's bot helps with delivering food in the hotels and restaurants.
- In the Covid period, a version of waiter's bot [serving robot] is used in hospitals and medical centers.
- It reduces manpower in hotels and restaurants.
- Waiter's bot reduces difficulty levels in the hotels for serving food.
- It reduces time by carrying all items ordered on a particular table at a time.

## **Objective**

To conceptually understand the waiter bots and its importance

## **Methodology**

The study intends to provide a conceptual process towards reducing manpower to cater to customers' needs through timely services and substantiate the financial resources required to provide them with salaries in the hotels. Keeping this in view, the present research intends to provide an understanding on the importance of waiter bots (Hymavathi & Vijaya Kumar, 2011). The entire study is based on secondary data sources from books, journals, conference proceedings, etc. Hence, descriptive research method has been adopted by the researchers to explain the observation and discussed in accordance with the objective of this research study.

## **Conceptual Process**

The waiter's bot delivers the dishes to the table of the customers as per the order given. They select the path according to the table to be served. IR sensors are used to sense the obstacles and tackle them (Thanh et al. 2019). It delivers the food and waits for programmed time until the food is taken by the customers and then return to the pantry. In healthcare settings, serving robots assist the medical staff by transporting supplies, medication, and equipment within hospitals and clinics. Thus, reducing the burden on human workers and allowing them to focus on patient care. Additionally, waiter's robots are increasingly being utilized in homes to perform household chores such as cleaning, organizing, and even cooking. These robots offer convenience and assistance to individuals with mobility issues or busy lifestyles. However,

this aforesaid idea has been proposed by the researchers for developing the same through a structured experimental study in the future.

## **Observation & Discussion**

Waiter's bot requires a comprehensive methodology to ensure efficiency and user satisfaction. The specific tasks of waiter's robot will be performed and designed accordingly, considering factors like mobility, manipulation, and interaction with users. A user-friendly interface for the communication and operation has been developed. The implementation using robust sensors and perception algorithms for environment awareness and safe interaction with humans has been carried out. It is prioritized through safety collision detection, emergency stop mechanisms, and compliance with industry standards. The regular maintenance and update about the critical situations is required for ensuring the optimal performance and adaptability to evolving needs. Additionally, incorporate machine learning techniques for continuous improvement based on usage patterns and user feedback. Finally, establish clear protocols for troubleshooting and customer support to address any issues promptly. Also, continuous refinement of this methodology will enhance the functionality and reliability of serving robots in various contexts (John, 2003). The Waiter Bot process are as follows:

- Firstly, the bot moves in the black line by sensing the path using IR sensors.
- When it detects an obstacle, it turns left or right for the desired direction and moves in it.
- If it faces an obstacle again, it waits until the obstacle passes and moves in the path.
- By moving in the path, it reaches the desired table and waits until the customers take the food that and wait until the programmed time.
- After waiting, it moves back to the pantry.

It reduces manpower and speeds up the work in hotels in the peak time. Also, it helps in managing the hotels easily. This conceptual research employs Arduino-controlled line follower robots thereby optimizing efficiency by handling multiple orders simultaneously during the peak hours. Moreover, successful tests with both prototype and full-scale robots in restaurant settings demonstrate the system's effectiveness. The next hurdle is scaling-up to incorporate multiple robots within the restaurant. Despite the initial high development costs of the smart ecosystem, it promises long-term efficiency and cost-effectiveness once fully operational. The Waiter's Bots represent a remarkable fusion of human ingenuity and technological advancement. It is to be noted that from their humble origins to current state of sophistication, wherein these robots have revolutionized various industries, offering efficiency, convenience, and even companionship. In future, the trajectory of serving robots appears promising, with ongoing advancements in AI, robotics, and sensory technologies (Pakdaman & Sanaatiyan, 2009).

## **Suggestions**

Waiter's Bot is a basic model of Line Following Robot, which just follows the line, wherein this Bot follows the line and performs the assigned work. It can be used in various sectors like hospital, hotels, etc. However, the future research to focus on Waiter's Bot to attend customers regardless of seating styles in restaurant or hotels. The Waiters' Bot shall be modified to use it in different type of industries i.e., hazardous industries to protect the health care of human

resources. Furthermore, the technology can be modified and used for the differently abled people to make their day-to-day routines and tasks easy.

## Conclusion

Waiter's Bot has been designed and simulated using the fritzing software and its program verified. The waiter's bot helps in serving the food in the desired table and returns to pantry. In the pandemic times (Covid period), a version of waiter's bot i.e., serving robot has been used in few hospitals. The basic idea of this research study is depicted from the concepts of line following robot. However, with any transformative technology alongside ethical considerations regarding their deployment and impact on society must be carefully addressed. Ultimately, the history and future of serving robots highlight our enduring quest to leverage technology for the betterment of humanity, underscoring the importance of responsible innovation, ergonomic process and thoughtful integration into our lives and communities at large.

## References

Chaudhari, J., Desai, A.A., & Gavarskar, S. (2019). Line Following Robot Using Arduino for Hospitals. *2019 2<sup>nd</sup> International Conference on Intelligent Communication and Computational Techniques (ICCT)*, 330-332.

Hymavathi, V., & Vijaya Kumar, G. (2011). Design and implementation of double line follower robot. *International Journal of Engineering Science and Technology*, 3(6), 4946-4953.

John, A. S. (2003). The PID control algorithm: How it works how to tune it and how to use it. *2<sup>nd</sup> Edition*, Process Control Solutions.

Mashaghi, M. (2008). Robotic Guide, Kanone Oloum Publication.

Pakdaman, M., & Sanaatiyan, M. M. (2009). Design and Implementation of Line Follower Robot. *2009 Second International Conference on Computer and Electrical Engineering*, 2, 585-590.

Pakdaman, M., Sanaatiyan, M. M., & Rezaei, M. (2010). A line follower robot from design to implementation: Technical issues and problems. *2010 The 2<sup>nd</sup> International Conference on Computer and Automation Engineering (ICCAE)*, 1, 5-9.

Thanh, V. N., Vinh, D. P., Nghi, N. T., Nam, L. H., & Toan, D. L. (2019). Restaurant Serving Robot with Double Line Sensors Following Approach. *2019 IEEE International Conference on Mechatronics and Automation (ICMA)*, 235-239.

Yanmida, D. Z., Alim, S. A., & Imam, A. S. (2020). Design and implementation of an autonomous delivery robot for restaurant services. *ELEKTRIKA-Journal of Electrical Engineering*, 19(3), 66-69.