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Smart Waiter using Line Following, RFID and Object Detection

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***Abstract:** This model makes usage of various techniques like decision making, RFIDs, and IR-Sensors to establish a programable software. This paper describes how Radio Frequency Identification (RFID) can be used in indoor navigation with line following Method for restaurants. None of the previous systems work seamlessly in restaurants which gave rise to our idea of using lines and RFIDs. And this will eventually lead to better results as compared to the previous work.*

***KEYWORDS:** Line Following Device, Radio Frequency Identification (RFID), RFID Tag, Decision Making, Object detections*

I. INTRODUCTION

Food Serving is one of the most important tasks if considered in the scenarios of reputed restaurants. This gave rise to the requirement of automated method to avoid faults that are normally seen being done by a common human and to have a method that can work without any leave(fatigue) under any circumstance.

The main purpose of our project is to automate the picking of food from the kitchen and serving it on the appropriate table with minimal error which in turn will remove the dependencies of the restaurant manager the waiters hence will improve efficiency and productivity of the restaurants. The most important factor is to avoid fatigue, it is required to give break time to human labour and this can be overcome by using this solution.

Another important factor of this project is that this device will work even when there is no internet connectivity which in turn will also remove the internet dependency of the machine and will help to make the machine work in even those scenarios in which there is less internet connectivity and can also be a key factor to make it affordable for restaurants with less budget or the restaurants which are located in the areas with no connectivity like mountains or forests. Another important point to notice is that the device is a low maintenance in which it is required to collaborate the machine just once and the device will work on its own as the RFIDs (explained in next paragraph) used have a great battery life and are less prone to damage. and the lines which are followed by model can be made permanent.

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Hence this prove that the device has very low maintenance to begin with, which can also be used to as an advantage to this machine.

RFIDs are the form of wireless communication medium which uses electromagnetic coupling to uniquely identify each RFID tag uniquely. We use this uniqueness of each tag for our advantage as each tag can be used to uniquely identify the direction in which the model has to move.

Computer vision a field which mostly deals with problems concerned with images or videos or any visual content that is obtained through computer camera or a pre-stored data. We use computer vision in the process of identifying the table on which the order is to be served. This paper mainly uses a sub field of computer vision which is object detection, a field of computer vision that deals with finding and recognising object from the live feed of video from camera of machine.

II. RELATED WORK

Sarabudla Harshith Reddy, Bharadwaj Vangipuram and Gattu Vishal suggested in [1] a robot that uses multiple sensors. The uses multiple sensor in turn increase the complexity, maintenance and error possibility which this project removes by using minimal sensors and no net connectivity.

barcodes are prone to torn N worn which our model enhances by using RFID which have more lifetime.

Myungsik Kim, Nak Young Chong, Hyo-Sung Ahn and Wonpil Yu suggested in [3] uses RFID and dual directional antenna to navigate the model**,** The uses of RFID and dual antenna increases complexity and this is overcome by our system by using simple methodology which makes model repairable by even non-specialised persons**.**

Lucky Gautam, Rahul Kr. Verma, Chinoy Sharma in [4] make their robot a manual controlled robot using IR sensor**,** uses of controller to control their model makes their model dependent on the human**,** our project overcomes this by being an autonomous model.

R Dhianeswar, Ademola Abdulkareem, Victoria Ogunles, Adeniran S. Afolalu and Adaobi Onyeakagbu in [6] uses RFID and line following to navigate their robot to the destination table, uses RFID in every plate makes their model costly to implement in every scenario, here our model overcomes this problem by using limited no of RFIDs which makes it economically feasible. Hence by overcoming all these problems faced in previous papers our model provides the great functionality.

There are many methods already existing to do indoor navigation in the domain of robotics. And not like bar codes they don't even require a clear line of sight to get the accurate results.

There are four categories in which all of the navigation techniques fall under: -

1.- dead-reckoning-based technology

2.- landmark-based technologies
3.- vision-based technologies
4.-behavior-based technology.
Each navigation technology has their particular advantages and disadvantages.
Dead reckoning: This is a method which allows the positioning, linear and angular velocity of the autonomous robot
Advantages: - Simplicity and Low Maintenance are the key features that made it popular.
Disadvantage: - There are small errors, sensor accuracy drifts the cumulatively lead to an error in navigation of robot's position and orientation.
An independent frame is used to overcome this error which is referenced periodically to correct the error. Another method (landmark based navigation) was introduced to
J.Thirumurugan, M. Vinoth, G. Kartheeswaran and M. Vishwanathan suggested in paper[2] uses line following device that uses barcode reader to navigate**,** As to overcome this extra requirement of frame for error correction.
Landmark based navigation: This is the technique that depends on the identification and subsequent recognition of the surrounding landmarks either the objects are known before hand or are tracked dynamically
Disadvantages: Due to the error in the sensors and the images taken and the surrounding change this method was not appropriate.
Vision based navigation: Here the machine uses visual features to navigate itself in the surrounding.
Disadvantages: Insufficient information depth which is not having enough details of the image that is fetched using camera.
complex image processing algorithms means the algorithm used are complex to begin with which require a specialized person for error solving
high computational power required refers to increase in computation power which make the device more expensive
dependent on the environment which in turn makes the device prone to errors if used in different environment.
Behaviour based navigation: Paradigm suitable for unstructured environment because of high number of sensors used alongside with tools for calculating intelligence such as fuzzy logic, neural networks, genetic algorithms, and their numerous combinations.
Disadvantage: Require high computational power which in turn makes it more model more expensive.
Prone to errors due to unavoidable noise associated with sensors which makes it unsuitable in every environment.
To overcome these disadvantages integrating RFID systems have been seen as the promising alternatives for navigation. In some project's RFID tags have been already placed on predefined locations on the canvas and the models are already made equipped with RFID readers to communicate with the tags during its navigation in the environment.

III. PROBLEM AREA

Restaurants suffer a great deal of problem when the serving of food is considered to a table, as humans are prone to faults and there can be scenarios where the food

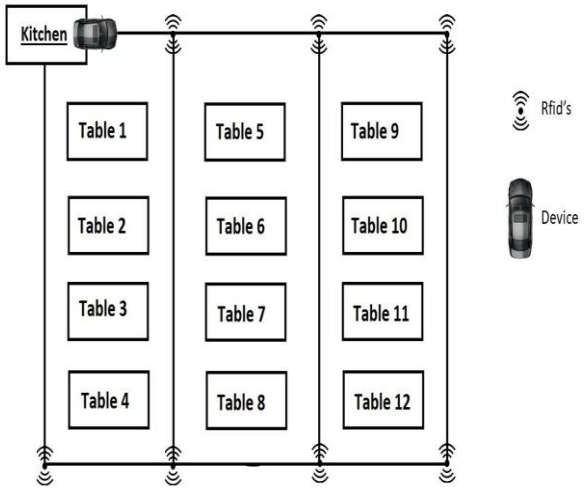

Fig.1 Installation Layout

the direction of motion of machine the database will update dynamically using algorithm in python.
Then if the model turns on any joint than the camera on machine will see each table's tag and finds out which table is the one to which that number is written to it and recognises that table to which the food is to be served this stooping at appropriate table is done using object detection and image processing by using OpenCV library. As soon as the food is served to appropriate table the model will go back to kitchen to pick up another order.

RFid	Left	Right	Front	Back
540062A35F	NILL	TABLE NO. 1 – 8	TABLE NO. 5 – 12	KITCHEN
540062A86A	NILL	TABLE NO. 5 – 12	NILL	KITCHEN
540062A98S	NILL	TABLE NO. 9 – 12	NILL	KITCHEN
540062A1SS	NILL	TABLE NO. 9 – 12	NILL	NILL
540062A2SR	NILL	TABLE NO. 9 - 12	NILL	NILL
540062A36A	NILL	TABLE NO, 1 – 8	NILL	NILL
540062A25D	NILL	KITCHEN	NILL	NILL

Fig.2 Database Structure

ordered from one table is delivered to some other table when there is huge rush. This may lead to customer vexation and may even hamper the restaurant reputation.
This paper illustrates a system to overcome all such problems using IOT and Object detection. This Model will just need some initial human involvement to setup the environment as shown in fig.1 and then the model will work autonomous.

This model will save the reference id of each RFID sensor with the information of the table numbers that are associated to it with directions. For example: -

The Database will contain RFID with four more columns associated with each id namely left, right, front and back.

As shown in fig.2. As soon as the model crosses the RFID the database will update according to the relative positions of the tables and what is associated to that id so as to tell machine that now on right these tables are associated if in case the machine needs to come back same route.

This whole process is done using the offline database and as soon as the model gets the internet connectivity the local database updates to the database stored on web thus making network independent.

IV. CONCLUSION

In this paper we propose an autonomous device that can control itself using line following and can be sent to desired table by combining RFID with it. Each joint in the line will be fitted with RFID tags which would help to navigate the system to reach the desired location. This model also performs obstacle detection to stop at the desired table.

The RFID was preferable for this model because in small area location GPS technology cannot provide the accurate location of the desired table within range of 50 meters and that can be achieved using RFIDs.

REFERENCES

1. [1] Sarabudla Harshith Reddy, Bharadwaj Vangipuram and Gattu Vishal "Line Tracking Pick and Place Robot using RFID Technology",MVSR Engineering college, Hyderabad, India 10-oct-2015.
2. [2] J.Thirumurugan, M. Vinoth, G. Kartheeswaran and M. Vishwanathan , "Line following robot for library inventory management system", Sri Ramakrishna Institute of Technology, Coimbatore, India 2010
3. [3] Myungsik Kim, Nak Young Chong, Hyo-Sung Ahn and Wonpil Yu, "RFID-enabled Target Tracking and Following with a Mobile Robot Using Direction Finding Antennas", North South University Dhaka, Bangladesh 2018.
4. [4] Lucky Gautam, Rahul Kr. Verma, Chinoy Sharma, "Developing Manual Control for a Line Follower Robot", Amity University, Noida, India. 2013
5. [5] R Dhianeswar, M Gowtham and S Sumathi "Smart Trolley with Automatic Master Follower and Billing System" 2019
6. [6] Ademola Abdulkareem, Victoria Ogunles, Adeniran S. Afolalu and Adaobi Onyeakagbu "DEVELOPMENT OF A SMART AUTONOMOUS MOBILE ROBOT FOR CAFETERIA MANAGEMENT" 2019
7. [7] Asif Ahmed Neloy, Aziz Arman, Mohammad Samiul Islam and Tamanna Motahar, "Automated Mobile Robot with RFID Scanner and Self Obstacle Avoiding System", North South University Dhaka, Bangladesh 2018.
8. [8] Takanori Washiro "Application of RFID over power line of smart grid", Technical Development Group, Sony Corporation, Tokyo, Japan 2012.
9. [9] Inian Roy, Karthick Raja, Chakkaravarthy. G, Arun Prakash, "Line Following Robot Based on Vision Technique", Development of Mechanical Engineering, SSN College of Engineering, Chennai, India 2015.
10. [10]Omer Gumus, Murat Topaloglu, Dogan Ozcelik, "The use of Computer Controlled Line Follower Robots in Public Transport", Trakya University,Kesan Yusuf Capraz School of Applied Science, Turkey,2016.

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