IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.301
Volume 3, Issue 1, May 2023

Implementation of Intelligent Navigation System for Shopping using Smart Robots

E. Swathi[1], S. Sivasangari[2], M. Priyadharshini[3], B. Sangeetha[4] and B. Sujitha[5]
Department of Electronics and Communication Engineering[1,2,3,4,5]
Dhanalakhmi Srinivasan Engineering College (Autonomous), Perambalur, India

Abstract: *The development of a path finding algorithm-based intelligent navigation system for a smart robot shopping cart is an exciting project that has the potential to revolutionize the retail industry. With the integration of advanced path finding algorithms, the system will be able to navigate through the store independently, avoiding obstacles and dynamically changing its course to provide customers with a seamless shopping experience. The inclusion of personalized product recommendations and store layout details will help customers find the products they need more quickly and efficiently. Additionally, the system's user interface will provide an interactive shopping experience for customers, making the process more engaging and enjoyable. By automating the shopping cart, the system will also alleviate the workload of store personnel, freeing them up to focus on other important tasks. This could lead to a more efficient and cost-effective retail operation, which may translate into cost savings for both the retailer and the customer. Overall, the successful implementation of the project could significantly enhance the shopping experience for customers, potentially leading to increased customer satisfaction and loyalty. The project could also have broader implications for the retail sector, as other retailers may seek to adopt similar technology to remain competitive.*

Keywords: Intelligent Navigation System, Smart Robots, Shopping, Mobile Application

I. INTRODUCTION

The proposed project is indeed a novel approach towards enhancing the shopping experience for customers by incorporating smart robots equipped with advanced sensors and algorithms. The integration of artificial intelligence and automation into the retail environment has become increasingly common and has thepotential to revolutionize the way we shop. The implementation of such a system is expected to provide several benefits to both retailers and customers. Retailers can increase their sales and reduce operational costs by streamlining the shopping experience and reducing the need for human assistance. Customers can enjoy a more efficient and convenient shopping experience, reducing thetime and effort required to find the products they need. The proposed project involves the development of software for the smart robots, the design and implementation of the navigation system, and the integration of the system with the existing retail infrastructure. Testing and evaluation of the system will also be necessary to ensure its effectiveness and reliability. Overall, the implementation of an intelligent navigation system for shopping using smart robots has significant potential to transform the retail industry. The project will explore the feasibility of such a system and provide a proof-of-concept for its implementation.

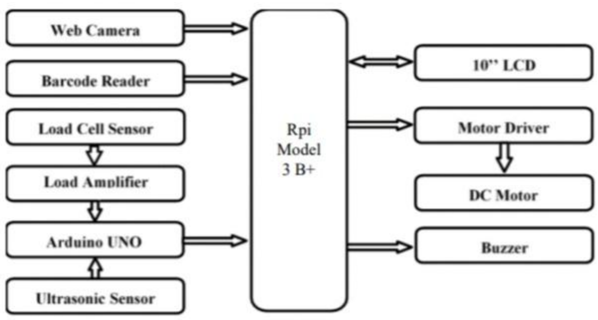
II. EXISTING SYSTEM

Robotic technology's rapid development has been aided by the proliferation of huge supermarkets and shopping centers around the world. They push the carts with both hands most of the time. As a result, if the customer only has one hand or has to hold her child's hand, pushing cart is a significant stress. One problem that keeps shoppers bothering is the hassle in calculating the accumulated cost of all the items being put in the cart, especially if there is only a limited budget for the groceries to be purchased .A conventional trolley was modified and was integrated with an image processing technique, it specifically senses the changes in color patterns to follow a certain user. As for this study, utilizing color alone to track and follow a person has a high risk of being disrupted by noise due to random changes in

light intensity and position. Another study was conducted in creating an intelligent sensing following cart which consists of the Radio Frequency Identification reader. The reader is interfaced with the Arduino Microcontroller.
It's loaded with the law for seeing the RFID markers that are kept in the products. When the RFID markers are shown near the anthology the label is tasted and displayed on the TV screen. In the preliminarily stated study, it provides a result in automating the process of accumulating the cost of the particulars placed in the wain still it lacks the completely automated process of shopping since the wain must be controlled through a Radio frequency (RF) regulator. There is also a robot made by (1) that can track its proprietor using an ultrasonic detector ring through a signal it receives. It uses a camera and a ray range finder to do navigation and handicap discovery. In order to construct an independent mobile robot that can follow a mortal, they developed a robot shadowing system grounded on a camera and a light- emitting device. These experimenters had work on mortal ensuing robot, which employs the Kinect detector to track a mortal target and avoid collisions. This Kinect detector has mortal shadowing capabilities from a static position that can give full- body 3D stir prisoner. It also uses depth confines to check for handicap between the stoner and the robot to avoid possible collision. The limitation of the study mentioned preliminarily is that the robot would presumably undercut its stoner when covering a wind path and may conceivably follow a different stoner once it losses view of its proprietor. Computer vision (CV) is a branch of artificial intelligence that allows computers to prize data from prints, vids and other sources. As with the studies and their gaps presented above the experimenters wants to design and develop a jeer Pi- Grounded Shopping wain Following Robot that will be suitable to follow its proprietor and checks the price of the product through a bar law scanner device and automatically added up the total cost of particulars in the wain. This study specifically aims to (1) develop a medium for the Shopping Cart Following Robot;(2) use a jeer Pi Single Board Computer as the system's main regulator; (3) integrate a computer vision algorithm that could identify the shopping wagons stoner;(4) integrate an ultrasonic detector to determine the distance between the stoner and the wain and to avoid any handicap; (5) Integrate a cargo cell detector to determine the weight of the wain; and(6) Integrate a barcode anthology to read the price label. The jeer Pi- Grounded Shopping wain Following Robotics developed using jeer Pi microcomputer, web camera, ultrasonic detectors, cargo cell detector, buzzer, barcode scanner, and TV (Liquid Crystal Display)screen. This robot can only descry one (1) person as its proprietor. It's only suitable in a well- lighted area as it uses a web camera to capture images. The system has no automatic charging station it must be charged manually by the operations labor force. The prototype of the system has a weight limit of 15 kg due to the necklace limitation of its DC motor.

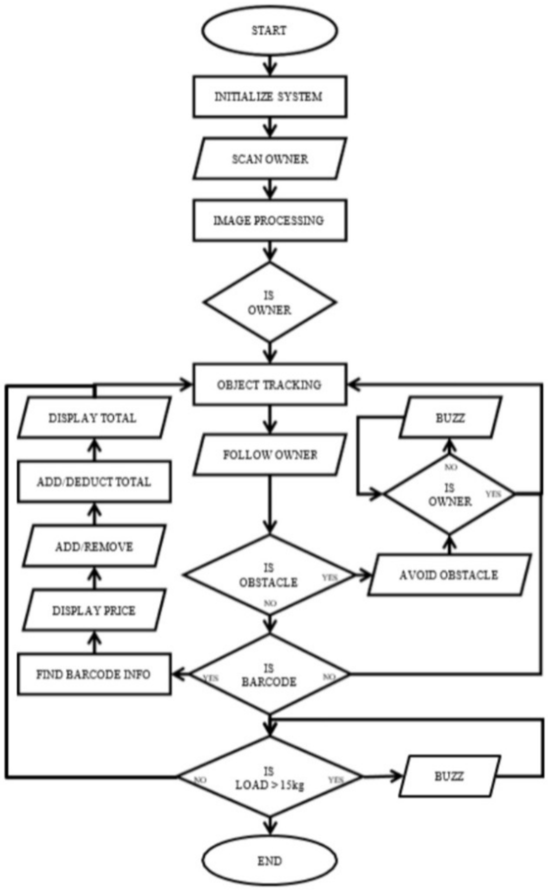
III. HARDWARE

3.1 Block Diagram



The block diagram of the proposed project that shows the flow of data and signal from one module to another module in the system denoted by the direction of the arrows. Raspberry Pi 3 B+ processes the image captured from the web camera and using object tracking method it analyzes the captured images identify and locate its owner. Once the owner or user of the cart has been tracked, the robot will now commence in following the shopper. Ultrasonic sensors are connected to the Arduino UNO and send ultrasound and listen for the echo when it bounces off of an obstacle and communicates to the Raspberry Pi 3 B+ so that the shopping cart can avoid hitting any obstacle and eventually follow the shopper. A barcode reader converts the barcoded tag into text that will search the product's price database and give the product's information then display it to the LCD. The load cell sensor is also connected to the Arduino to identify the weight of the cart if it exceeds the load limit then communicates to the Raspberry Pi 3 B+ so the buzzer buzzes to notify the owner.

IV. SOFTWARE



Process Flowchart

Python is a fantastic and powerful programming language that is simple to use (both to read and write) and allows you to connect your project to the real world using the Raspberry Pi.

The Arduino Integrated Development Environment (IDE) is a cross-platform (Windows, macOS, Linux) application developed in C and C++ functions. It's used to write and upload programs to Arduino-compatible boards, as well as other vendor development boards with the support of third-party cores.

Proteus is used for electronic circuit simulation, schematic capture, and PCB (Printed Circuit Board) design. Commonly used for digital simulations such as microcontroller and microprocessor.

SketchUp, formerly Google Sketch up, is a 3D modeling computer tool used in architectural, interior design, landscape architecture, civil and mechanical engineering, film and video game

V. PROPOSED SYSTEM

Implementation of an Intelligent Navigation System for Shopping using Smart Robots refers to the development of a shopping system that utilizes a smart robot shopping cart to provide customers with personalized product recommendations, product information, and navigation assistance in a shopping environment. The system is designed to improve the overall shopping experience while also reducing labor costs and improving inventory management.

The project involves the use of pathfinding algorithms to enable the smart robot shopping cart to navigate the shopping environment and guide customers to the location of products. The algorithms consider factors such as the location of the customer, the location of the product, and the presence of obstacles to determine the optimal path for the smart robot

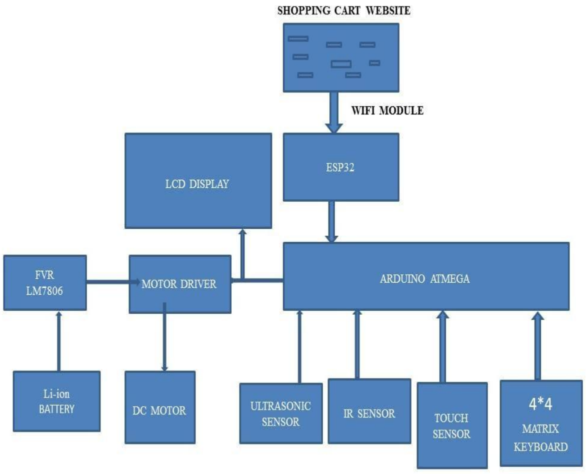
IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.301
Volume 3, Issue 1, May 2023

shopping cart. The system also utilizes advanced artificial intelligence and machine learning algorithms to enable the smart robot shopping cart to learn and adapt to changes in the shopping environment, improving the performance of the system over time.

The implementation of the intelligent navigation system involves the integration of sensors and cameras on the smart robot shopping cart to create a map of the shopping environment. The system also includes a user interface for customers to interact with the smart robot shopping cart and request assistance. Customers can input their preferences and previous purchase history, and the smart robot shopping cart will provide personalized product recommendations and information.

The benefits of the system include improved customer experience, increased efficiency, and reduced labor costs. By providing personalized recommendations and navigation assistance, the system can improve the overall shopping experience and increase customer satisfaction. The system can also reduce the need for human labor in tasks such as product stocking and inventory management, reducing labor costs for the shopping environment. Overall, the implementation of an intelligent navigation system for a smart robot shopping cart using pathfinding algorithms represents an innovative approach to improving the shopping experience while also reducing costs and improving efficiency.

5.1 Block Diagram



5.2 Ultrasonic Sensor

An ultrasonic sensor is an electronic device that measures the distance of a target object by emitting ultrasonic sound waves, and converts the reflected sound into an electrical signal. Ultrasonic waves travel faster than the speed of audible sound.

A. Working

Ultrasonic sensors work by emitting sound waves at a frequency too high for humans to hear. They then wait for the sound to be reflected back, calculating distance based on the time required. This is similar to how radar measures the time it takes a radio wave to return after hitting an object.

IJARSCT

ISSN (Online) 2581-9429

International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)

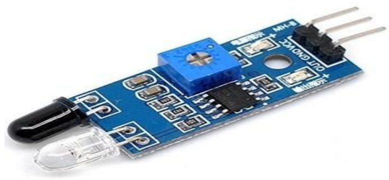
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal

Impact Factor: 7.301

Volume 3, Issue 1, May 2023

5.3 Line Following (IR) Sensor:

A line follower consists of an infrared light sensor and an infrared LED. It works by illuminating a surface with infrared light; the sensor then picks up the reflected infrared radiation and, based on its intensity, determines the reflectivity of the surface in question.



A. Working

Line sensors detect the presence of a black line by emitting infrared (IR) light and detecting the light levels that return to the sensor. They do this using two components: an emitter and a light sensor (receiver).

5.4 Touch Sensor

Touch Sensors are the electronic sensors that can detect touch. They operate as a switch when touched.

A. Working

Touch sensors work similar to a switch. When they are subjected to touch, pressure or force they get activated and acts as a closed switch. When the pressure or contact is removed they act as an open switch.

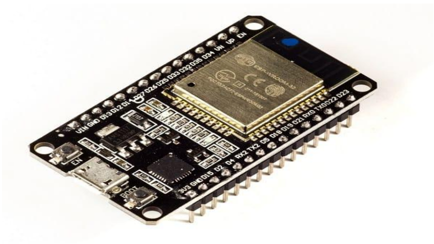
5.4 Arduino (MEGA)

The Arduino Mega 2560 is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

5.5 ESP32

ESP32 is a low-cost System on Chip (SoC) Microcontroller from Espressif Systems, the developers of the famous ESP8266 SoC. It is a successor to ESP8266 SoC and comes in both single-core and dual-core variations of the Tensilica's 32-bit Xtensa LX6Microprocessor with integrated Wi-Fi and Bluetooth

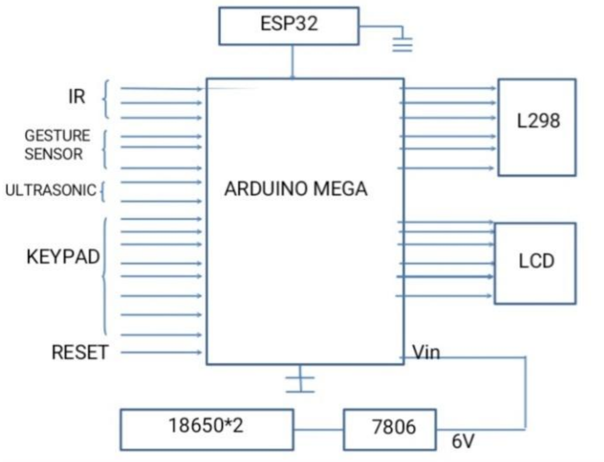
IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.301
Volume 3, Issue 1, May 2023



5.6 Components Range

- **Ultrasonic sensor:** Ultrasonic sensor less than 8cm pause and resume after more than 8cm obstacle
- **Touch sensor:** no range for touch sensor touch to pause and touch to resume
- **Line following sensor:** no range for line following sensor, black line gives +5v and white area gives 0v
- **Keypad:** no range for keypad, there are 12 buttons

5.7 Circuit Diagram



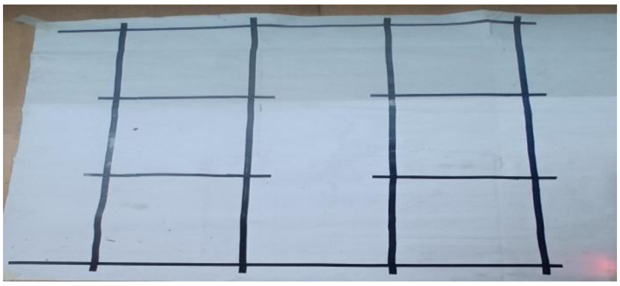
Procedure for Path Finding using Dijkstra Algorithm:
Start
Initialize and define components
Define and initialize the LCD, Keypad, Graph, Ultrasonic sensor, and Motors
Run the setup() function
Call the motor_init(), lcd_init(), general_init(), sensor_init(), and initial_sequence() functions to set up the components
Enter the main loop()
Check the mode_flag
If mode_flag is 'A' (Offline Mode)
Call chose_node() to select the startNode and endNode from the user input
Calculate the shortest path using dijkstra() function
Move along the shortest path with printPath() function
Update the cval (current value) with the result from printPath()
If mode_flag is 'B' (Online Mode)
Call get_data() to retrieve data from Serial2 and update the startNode and endNode accordingly
Calculate the shortest path using dijkstra() function
Move via the shortest path with printPath() function
Wait for the user to press 'D' to continue to the next node
Repeat step 5 indefinitely

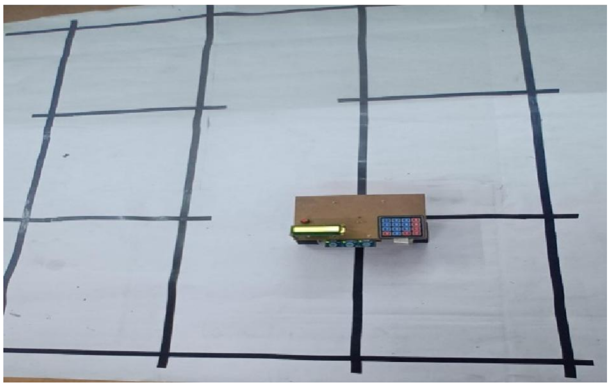
VI. CONCLUSION

The implementation of an intelligent navigation system for shopping using smart robots has the potential to revolutionize the shopping experience for customers. These smart robots can navigate through the store efficiently and guide customers to the products they are looking for. This system can also collect data on customer preferences and shopping behavior, which can be used to optimize store layouts, inventory management, and personalized marketing.

Furthermore, this system can improve the efficiency of store operations by reducing the workload of human staff and minimizing the time customers spend searching for products. However, the implementation of such a system requires significant investment in robotics technology. Additionally, it is important to address privacy and security concerns related to the collection and use of customer data. Overall, the implementation of an intelligent navigation system for shopping using smart robots can bring significant benefits to both customers and retailers, but it requires careful planning and execution.

VII. OUTPUT AND RESULT





REFERENCES

[1]. Novie Dave Perez , Jocelyn Villaverde , Wellie Cereneo , Aila Custodio , “Design and development of a Rasperry PI – Based Shopping Cart following Robot through Computer vision and object tracking method”, IEEE Region 10 Symposium (TENSYMP) ,2022,Surigao city , philippines.

[2]. Siddharth Sanghavi ,Palash Rathod , Preet Shah, “Design and implementation of a human following smart cart ”, IEEE Region third international conference(ICSSIT) ,Oct-2020 , Mumbai , India.

[3]. Aiswarya Padma B , Arun Aravindakshan ,Amal Pragesh , "Automation of shopping using technology", IEEE Region 5thInternational conference for convergence in tech ,Mar 29-31,2019, Thiruvananthapuram, India.

[4]. Sudipta Ranjan Subudhi, Ponnalagu R. N. "An intelligent shopping Cart with automatic product detection and secure payment system ,IEEE Region 16 India counsil international conference, 2019, Rajasthan, India.

[5]. V.Mekala, R.Keerthana, M.Kawya, S.Kaviprasth , "IOT based guidance and assistive system for supermarket shopping", International journal of scientific and technology research ,Mar-2020,volume 9 ,India.

[6]. Sales, Jorge & Marti, Jose & Marín Prades, Raul & Cervera, Enric & Sanz, Pedro. (2016). CompaRob: The Shopping Cart Assistance Robot. International Journal of Distributed Sensor Networks. 2016. 1-15. 10.1155/2016/4781280.

[7]. Kohtsuka, Takafumi & Onozato, Taishi & Tamura, Hitoshi & Katayama, Shigetemo & Kambayashi, Yasushi. (2011). Design of a Control System for Robot Shopping Carts. 280- 288. 10.1007/978-3-642-23851-2_29.

[8]. F.S. Samidi, I.S. Mustafa, N.A.M. Radzi. (2019). International Journal of Recent Technology and Engineering (IJRTE) ISSN: 2277-3878, Volume-8 Issue-4, November 2019

[9]. A.R.Revathi, S Gokulnath, S Giridharan, BKrishnan,& N Dhamotharan (2016). An Intelligent Sensing Follower Cart. International Journal of Innovative Research in Computer and Communication Engineering (An ISO 3297: 2007 Certified Organization)Vol. 4, Issue 4, April 2016

[10]. Pradeep Gurunathan, Vishal Guruprasad, & Ganveer N. Object Recognition In Shopping Cart. International Journal of Advances in Electronics and Computer Science, ISSN: 2393-2835