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Smart Trolley with Automatic Master Follower using Microcontroller

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Abstract: *Nowadays, supermarkets are almost developed with much technological advancement. People purchase different items from the supermarkets and put them into a trolley because it is the easiest method used in supermarkets to carry goods. However, throughout the whole process of shopping, customer must push the trolley manually by their own effort and when it comes to the billing process customers must wait in long queues to pay their bills. This is a time wasting process due to the busy schedule of people. To avoid these problems the research group have introduced an effective and highly advance system. Although there is some existing Smart Trolleys which includes some of the above mentioned aspects there is no proper multifunctional automated trolley to make shopping life easier. The research "Follow Me" has developed a multifunctional trolley which makes shopping life easier and convenient to customers. Follow me consists of series of technologies such as automatic human guided travelling with use of anPIC controller. The research group has provided an accurate, user friendly smart shopping trolley to make customers shopping life more convenient and easier..*

Keywords: Follow Me, Smart Trolley, Ultrasonic Sensor, Automation, Microcontroller

I. INTRODUCTION

Shopping carts in the supermarkets in day today shopping activities is now mostly visible. Customers are pushing trolleys around them to carry the items they purchased. The usual process of travelling the trolley is done manually by the human with the effort of his/her. Therefore, if a customer carries a baby while doing shopping it is a real burden to the customer to push the trolley or to a disabled person with one hand is almost impossible to push the trolley. People can see huge rush in supermarkets on holidays and weekends the rush is even more when there are special offers and discounts. The main purpose of the research project was to address the above issues by developing a multi-functional automated trolley. Follow Me is an automated trolley that is capable of carrying goods while following the customer automatically without human effort, an android application has developed which gives suggestions about goods while purchasing, for this a tablet is fixed to the trolley with an android platform to function the above-mentioned task. Furthermore, the trolley is parking back to its slot automatically after the customer finishes his/her purchases, the trolley will be charged its battery automatically while the trolley is in the parking slot. Usage of this system will impact on modern day shopping market customers to do their shopping activities in an easy manner.

These days, supermarkets have practically reached the point of development in terms of technology. People buy various items from supermarkets and place them on a trolley because that is the simplest way to transport goods in supermarkets. However, customers must manually push the cart throughout the entire shopping experience, and when it comes to paying their bills; they must stand in line for a very long time. The busy schedules of people make this a time-consuming process. The research team has developed an efficient and highly advanced technique to avoid these issues. There isn't a true multifunctional automated trolley to make shopping easier, despite the fact that several Smart Trolleys already exist that include some of the aforementioned features. The "Follow Me" research team created a multipurpose cart that makes customers' shopping experiences more simple and easy. Follow-Me is a collection of technologies, including autonomous, human-guided navigation using an Arduino Microcontroller. A precise, user-friendly smart shopping cart has been made available by the research team to make it easier and more convenient for customers to shop.

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The main objective of the research project was to develop a multi-functional automated trolley in order to solve the aforementioned issues. An automated trolley called Follow Me can carry items while automatically following the consumer without any assistance from a person. The use of this method will influence how easily modern shoppers may complete their buying tasks.

II. LITERATURE SURVEY

An automatic line following trolley, this trolley is being guided behind the customer with use of traditional line following techniques. Considering the functional facts that they developed, the research group developed an automated trolley which follows the customer with use of an Arduino mega to ride the trolley the research group came up with the methodology sensors to track the path which the customers walks. Moreover, the developed research consists of a tablet which is fixed in front of the trolley to track the goods which the customers purchased and automatic billing system which is developed with use of Android operating system. Furthermore, the trolley to be developed is consisting of some multifunctional tasks of automatic parking to the slot and automatic charging while the trolley is being parked [1].

Electronic shopping cart based on Radio Frequency Identification (RFID) technology. This trolley contains a function to track the goods eg. Viewing the product name, expiry date and the cost, to display the items they have used a Liquid Crystal Display (LCD) screen. The drawback of the system is the trolley does only the functions that are mentioned above. Thus the trolley is electronic it does not cover the automatic travelling facility [3].

System designed to track the purchased items using a Quick Response (QR) code which developed a trolley to track the goods and do the automatic billing with the help of an electronic display. Through this system it does the billing process but the research is not completed with a fully automated trolley. However, the battery of the trolley must be charged manually. Considering these facts designed a trolley which saves man power is essential [4].

Multitasking shopping trolley with use of RFID technology. This is embedded with the aspect automatic product identification and billing. To track the products, it uses the technology RFID which contains readers and tags placed on the products. Though this identifies the product through RFID the proposed system uses bar code reader to track the goods. Considering all the facts this trolley does not perform multitasks as it describes. The developed research is based on more functionalities that is more time consuming and easy to handle [5].

A system named Intelligent Shopping Cart developed using RFID technology in additionally this module consist of a technology Zigbee go get product details from the main server. This project improves the time consumption such as it reduces the time which waste on long queues to pay the bills. Although the system consumes the time, developed trolley which travels automatically saves more time and human power [6].

IOT Based Intelligent Trolley which is developed in India is tracking the purchases using RFID tags. When a customer puts any goods into the trolley the RFID tags will detect the product and will display the specifications of the product. A system with RFID tags are placed in all the trolleys. All the products in the mall are equipped with RFID tags. Therefore, there is no way to travel the trolley automatically but to put goods the trolley [7].

Shopping and automatic billing using RFID technology was developed by Vidyavardhaka College of Engineering in India. They have come up with an architecture with Radio frequency identification (RFID) and wireless technology to provide on spot billing in super markets. It uses the RFID based system application in the shopping trolley and the RFID tags which is used security of the products. A Liquid crystal display (LCD) that is fixed to the trolley displays the product name, cost and the total of all purchased products. The bill is transmitted to the server end through the ZigBee technology. There's no Automatic travelling system to the trolley. The research group has focused only in purchase tracking and billing only [8].

This research was developed for disabled customers. The research group implemented a trolley which follows the customer. To chase the customer accurately and measure the position a laser beam and laser range sensor is used. A gyrosensor and a rotary encoder also used for fared chasing and have developed a mapping algorithm and an estimation method for searching the position of the customer. This trolley is capable of following the customer only [9].

Automated shopping trolley which can control using a remote. The structure of this trolley consist of robotic structure and a keypad which is used to navigate the trolley along the particular way. The Keypad has the inbuilt product code

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reader to read the bar codes and track the goods purchased. The wireless billing system is made up of the ZigBee communication module [10].

III. METHOD OF DISEASE DETECTION

A society accepted revolutionary items are one that improves our daily comfort and productivity. The metro cities, buying and shopping at broad malls has been a regular occurrence. On holidays and weekends, these malls would be crowded. People buy various things and place them in a trolley. The trolley follows the user continuously, Once Trolley is powered on and it captures the user image and it will start to follow him/her in any direction with proper distance between them and help user by reducing physical efforts. When a customer approaches a smart trolley and turns it on, the trolley will start to follow the user no matter which direction they are walking in and will also detect any obstacles in its path. The PIC microcontroller, ultrasonic sensor, and infrared sensor used in this system. The model uses an ultrasonic sensor to detect people. With a range in the prototype of between 30 cm and 100 cm. The model uses two IR sensors to direct (turn) the trolley: a left-side IR sensor and a right-side IR sensor. When the trolley turns on, an ultrasonic sensor detects a person in front of it. When that person moves, the sensor begins to follow that person while maintaining a 30 cm space between the user and the trolley in the prototype. Additionally, the trolley rotates to the left when a human turns to the left, thanks to an IR sensor on the left side. In a similar manner, when a person turns to the right, an IR sensor on the right side activates, turning the trolley to the right. The trolley automatically stops if the person stops moving. The prototype trolley's range is from 30 cm to 100 cm, so when the person in front of it moves past that distance, the trolley likewise stops automatically.

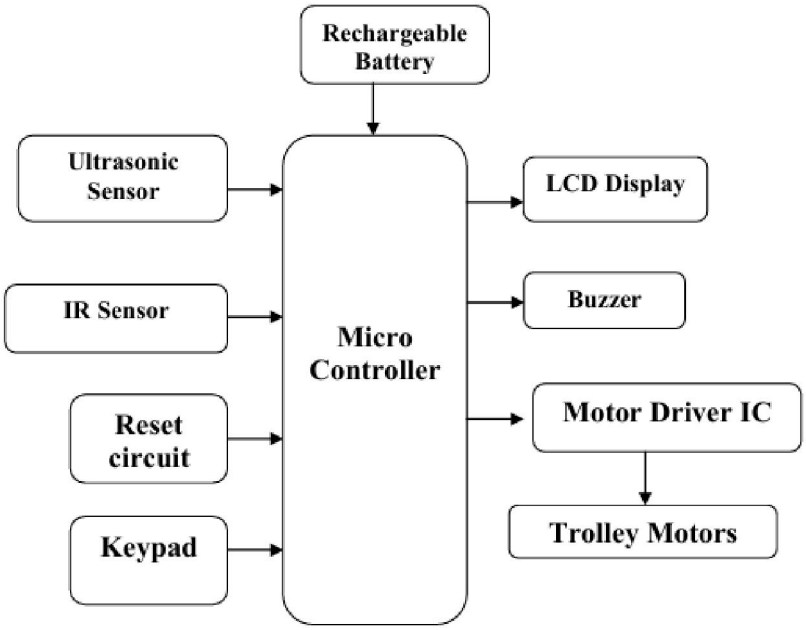

Fig. 1. Block Diagram

PIC18f4520 Microcontroller

PIC18f4520 is a 40 PIN Micro-controller from Microchip with 13 channel 10 bit Analog to Digital Converter.
Special PIC16f886 Micro controller Features

- Power- Up to 10 MIPS Performance at 3V
- C compiler optimized RISC architecture
- 8x8 Single Cycle Hardware Multiply System

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- Internal oscillator support-31 kHz to 8MHz with 4xPLL
- Fail-Safe Clock Monitor- allows safe shutdown if clock fails
- Watchdog Timer with separate RC oscillator
- Wide operating Voltage range; 2.0V to 5.5V
- nanoWatt Power Managed Modes

Fig. 3. PIC18F4520

IR sensor

Infrared Obstacle Avoidance IR Sensor Module (Active Low) has a pair of infrared transmitting and receiving tubes. When the transmitted light waves are reflected back, the reflected IR waves will be received by the receiver tube. The on board comparator circuitry does the processing and the green indicator LED comes to life.

The module features a 3 wire interface with VCC, GND and an OUTPUT pin on its tail. It works fine with 3.3 to 5V levels. Upon hindrance/reflectance, the output pin gives out a digital signal (a low-level signal). The on board present helps to fine-tune the range of operation; the effective distance range is 2cm to 80cm.

Fig. 4.IR Sensor

Ultrasonic Sensor

This ultrasonic sensor module can be used for measuring distance, object sensor, motion sensors etc. High sensitive module can be used with microcontroller to integrate with motion circuits to make robotic projects and other distance, position & motion sensitive products.The module sends eight 40Khz square wave pulses and automatically detects whether it receives the returning signal. If there is a signal returning, a high level pulse is sent on the echo pin. The length of this pulse is the time it took the signal from first triggering to the return echo.

Features of HC-SR04 Ultrasonic Sensor

- Sensor Type: Ultrasonic
- Output: Digital Sensor

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- Voltage: 5VDC
- Detection distance: 2cm-400cm (0.02M - 4.0M)
- Static current : < 2mA
- Level output: high-5V
- High precision: up to 0.3cm

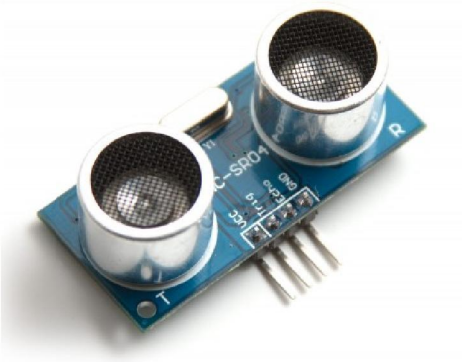

Fig. 5.Ultrasonic Sensor

LCD Display

A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD.

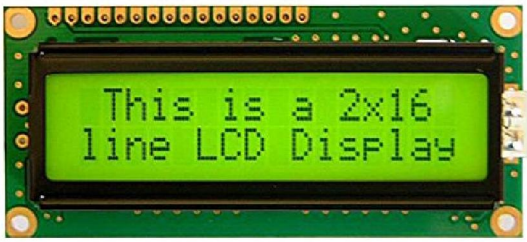

Fig. 6.LCD Display

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IV. RESULT

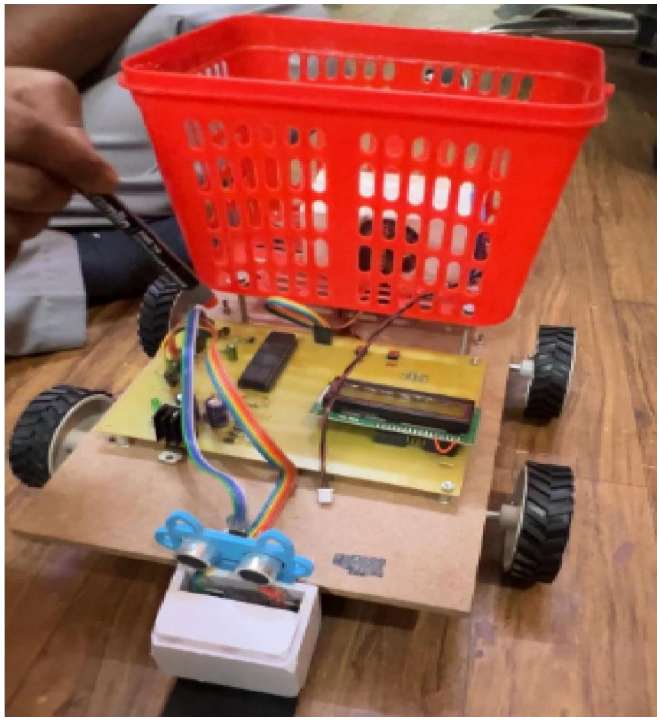

Fig. 7.Photograph of Project Model

Human Computer Interaction technology is very well developed in the current era. Follow Me robot was developed to follow the customer automatically while the customer performs shopping activities in the supermarket. When customer gets the trolley it follows the customer automatically with the help of Sharp IR sensors which is fixed to the PIC microcontroller. Through the ultrasonic sensor the distance will be identified within the customer and the trolley. Moreover, to identify the obstacles again the ultrasonic sensors were used.

V. CONCLUSION

In conclusion, the development of the "Smart Shopping Cart" represents a significant stride towards revolutionizing the conventional shopping experience by seamlessly integrating advanced technologies. The amalgamation of key hardware modules, such as the PIC microcontroller, ultrasonic and IR sensors, DC motor, and LCD display, forms a sophisticated system that enhances user interaction, automates processes, and elevates overall shopping efficiency. The PIC controller serves as the central processing unit, orchestrating the functions of each component to ensure seamless navigation, autonomous movement, and real-time information display. The collaborative efforts of these modules provide users with a novel and engaging shopping adventure. The system's ability to detect and follow customers automatically identifies products, monitor weight, and offer alerts contribute to a more efficient and enjoyable retail experience. The "Smart Shopping Cart" not only showcases the capabilities of modern technology but also underscores the potential for innovation in optimizing everyday activities. As we advance further into the era of smart solutions, this project stands as a testament to the transformative power of integrating cutting-edge hardware components for the betterment of daily experiences.

VI. FUTURE SCOPE

The "Smart Shopping Cart" project lays the groundwork for an innovative shopping experience, and its future scope holds promising avenues for further enhancement. One potential direction for expansion involves integrating machine learning algorithms to analyse customer preferences based on their shopping history. This could enable the cart to

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provide personalized recommendations or even assist in optimizing store layouts for better customer engagement. Additionally, incorporating environmental sensors could allow the cart to adapt to its surroundings, ensuring seamless navigation and improved obstacle avoidance. The project could further explore partnerships with retail analytics platforms, enabling retailers to gather valuable insights into customer behaviour and preferences. As technology evolves, exploring the integration of augmented reality (AR) features could provide users with interactive and immersive shopping experiences. Furthermore, collaboration with smart payment systems could lead to a fully integrated, cashless checkout process. The future scope of the "Smart Shopping Cart" project extends beyond automation to create a dynamic, personalized, and technologically advanced shopping ecosystem.

Recommendations to those who are willing to develop this system further are as follows:

a. Setting up a navigation map to the application to identify the where the products are been stored.

b. Promoting the application to customer own mobile device.

c. Sending SMS or E-Mail after the purchasing is finished.

d. Add a payment method which is fixed to the trolley to pay using customers debit or credit card.

e. Developing a tag which uniquely identifies only the specific customer.

As the research was limited to a specific time period the group was able to focus only a limited amount of components. In the future the group is willing to do more researches and develop more methods that will be included to the hardware device as well as to the android application.

VII. APPLICATION

Autonomous Shopping Assistance: The "Smart Shopping Cart" application provides real-time autonomous assistance to shoppers by actively following them throughout the store. The cart utilizes sensors such as IR and ultrasonic sensors for human detection and tracking, ensuring a seamless and convenient shopping experience.

Automated Pricing and Product Recognition: In real-time, the RFID reader integrated into the cart instantly recognizes products as they are added or removed. This enables automated pricing, allowing shoppers to view the total cost of their items on the cart's LCD display in real-time, facilitating budget management and decision-making.

Weight Monitoring and Overload Alerts: The load cell incorporated into the cart provides real-time monitoring of the weight of items placed inside. Should the weight approach or exceed a predefined limit, the system triggers overload alerts, prompting shoppers to manage their load or seek assistance, ensuring a safe and efficient shopping experience.

Dynamic Navigation and Obstacle Avoidance: The ESP32 microcontroller, coupled with sensors, facilitates real-time dynamic navigation. The cart can adapt to its surroundings, navigate through aisles, and intelligently avoid obstacles. This ensures efficient movement and prevents disruptions in the shopping flow.

User-Friendly Interface: The application includes a user-friendly display module on the cart, offering real-time feedback on the cart's status, pricing details, and potential alerts. This interface enhances the overall shopping experience, providing shoppers with instant information and control over their purchases.

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