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Collaborative Robot for Sightless Buyers in Supermarkets

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Abstract: *Grocery shopping is a routine activity that people all over the world perform on a regular basis. However, grocery stores and supermarkets remain largely inaccessible to people with visual impairments. The main barrier is the inadequacy of the principle navigation aids such as guide dogs and white canes. This work introduces a robotic assistance – COBOT (Collaborative Robot) for shopping and easy transactions in supermarket for the visually impaired as well as elderly people who need assistance. Here uses text to speech and speech to text converters for user interaction by introducing selenium, text to speech online and speech notes. A line follower technology is used for path recognition and robotic arm for product purchasing. The COBOT itself will purchase and collect the desired products into the cart. Then it automatically bills the products purchased and hand it over to the customer*

Keywords: Collaborative Robot; Line Follower; Selenium; Service Robot; Speech Notes

I. INTRODUCTION

Nowadays, robots are increasingly being integrated into working tasks to replace humans specially to perform the repetitive task. In general, robotics can be divided into two areas, industrial and service robotics. International Federation of Robotics (IFR) defines a service robot as a robot which operates semi- or fully autonomously to perform services useful to the well-being of humans and equipment, excluding manufacturing operations. These robots are currently used in many fields of applications including office, military tasks, hospital operations, dangerous environment and agriculture. Service robots are going to be the new attraction in super markets and big stores in a few years. The customer assistance robots will guide customers through the shop, recommend products and gives details and descriptions regarding each product. It can also act as a shopping companion to the elderly and even help in maintaining stocks up to date. Recently many works have been going on exploring the possibilities of using customer assistance robots in super markets.

Over last year's robots have evolved from manufacturing cells, to museum guides, passing successful commercial applications, such as vacuum cleaners, lawn movers and pool cleaners. As both, robots' hardware and software became more complex, new applications, particularly to serve humans in a closer way, are projected. Service robots should have the ability of move and interact with their environment, but mainly with their users, common people, in a friendly way. A robot can be replaced human to do work correctly. Here introduces a COBOT (collaborative robot), the robotic assistance for helping the visually impaired and elderly people. The COBOT will help them by easy transaction and purchasing.

II. RELATED WORKS

Independent grocery shopping is one of the most functionally challenging tasks for visually impaired and blind individuals. Many assistive shopping systems have been developed to address the problem of blind grocery shopping.

A) Robo Cart

RoboCart was the first accessible blind shopping project that started in early 2004. The purpose of RoboCart is to help visually impaired customers navigate a typical grocery store and carry purchased items. For localization,

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RoboCartrelies on RFID tags deployed at various locations in the store. For navigation, RoboCart relies on laser range finding. Experiences with deploying RoboCart in a real grocery store are described. As an accessible shopping accommodation system, RobotCart addresses neither utilization of existing devices nor minimal environmental adjustments [1].

B) Shop Talk

In early 2006, ShopTalk, a wearable system for independent blind supermarket shopping has done. The system partially meet product identification. However, it was observed during the experiments, the scanner was difficult to use on softer packages (e.g., potato chips). ShopTalk does not meet utilization of existing devices. The system partially meets minimal environmental adjustment. Although the supermarket is not required to install and maintain any new hardware, the system assumes access to the supermarket's inventory control system without which the BCM cannot be computed. Some supermarkets may not be willing to provide such access [10]

C) Robotic Arm

The use of industrial robots is increasing in areas such as food, consumer goods, wood, plastics and electronics, but is still mostly concentrated in the automotive industry. The aim of this project has been to develop a concept of a lightweight robot using lightweight materials such as aluminum and carbon fiber together with a newly developed stepper motor prototype [5]. Another paper discusses an approach for demonstration of a robot arm for physically disabled people who cannot walk. For those people who cannot easily lift simple things (e.g. lifting a glass of water). So, the development of a Robot Arm which is controlled by the wireless medium is the theme of the paper and to make this done haptic technology is going to play a crucial role as far as implementation is concerned. Basically, a robot arm is divided into two parts i.e. Haptic glove and robot arm. The area in which robot arm moves, depends upon the range of Zigbee module and robot arm is controlled by the haptic glove[4].

III. System Description

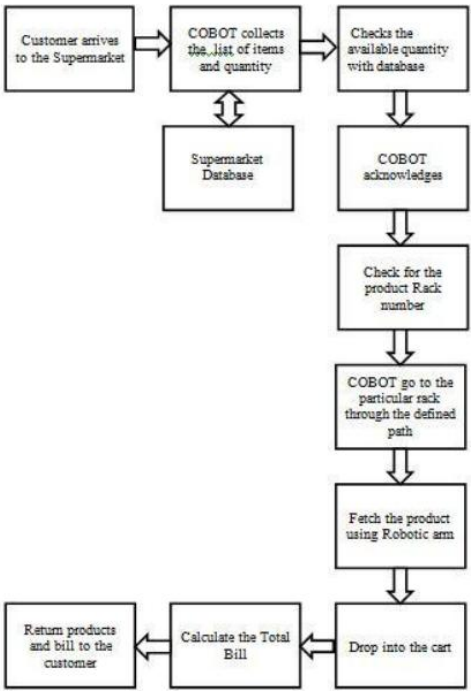

Figure 1: Process Flow Diagram

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This paper introduces the design of a complete shopping assistance system that permits people, possibly elderly of disabled, to have the support of a physical agent during all their shopping process with the added value of a complete connectivity with supermarket resources and a friendly user-interface. Although our proposal is addressed for any kind of public, elderly or disabled people may be considered a particularly important target, since this kind of developments might help them in accomplishing their shopping with a reduced effort. The name COBOT is derived from the "Collaborative Robot" which are robots intended for direct human-robot interaction within a shared space, or where humans and robots are in close proximity. It is a robot that is capable of learning multiple tasks so it can assist human beings. Here uses text to speech and speech to text converters for user interaction by introducing selenium which simultaneously switches speech notes and text to speech online. Line follower is the provided technology for path recognition and also robotic arm is used for product purchasing/fetching. The COBOT itself will purchase and collect items into the cart, thereby automatically billing the products in the cart using tkinter.

IV. IMPLEMENTATION PROCEDURE

Here introduces a robotic assistance for shopping in supermarket for the visually impaired as well as elderly people who need assistance, making transactions easy. The robotic assistance, COBOT, collaborative robot which interacts with the customer. COBOT is the one who provides complete assistance for shopping. COBOT will be collecting the list of items to be purchased, quantity, etc. from the customer. The figure 2 shown below is the block diagram of the proposed system.

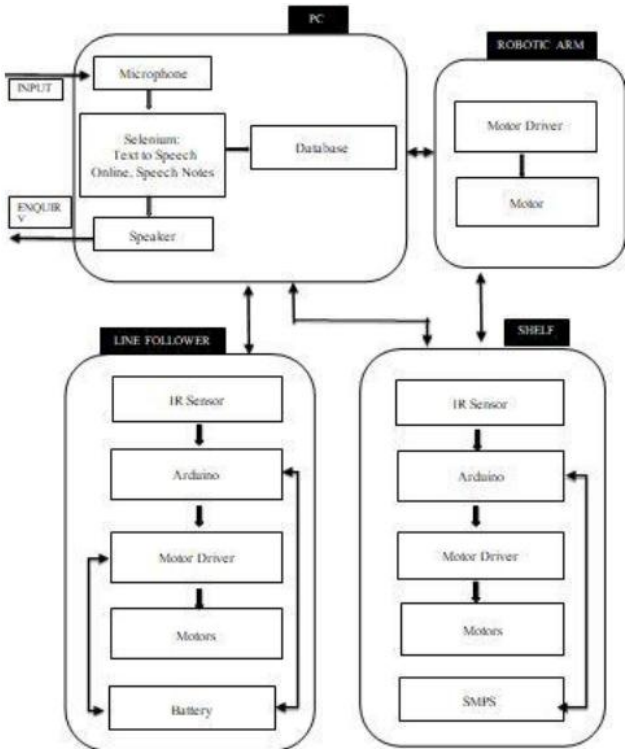

Figure 2: Block Diagram

When the customer arrives to the supermarket, the COBOT will initially interact with the customer. The interaction is by text to speech and speech to text conversions, for that two sites are used; text to speech online (convert text to speech) and speech notes (convert speech to text). These two sites are switched simultaneously by introducing a web automation tool called selenium, which is also a library of python. Google chrome is preferred for switching/ loading the two sites forming base platform for selenium. By this COBOT will collect the list of items to be purchased and its quantity. The quantity will be checked with the available quantity in the supermarket, which is already defined

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in the database of supermarket. If any of the product specified by customer is not available in quantity, COBOT will inform them immediately after matching the said quantity with available quantity in the database. After getting the list, COBOT ask the customer to wait there, and then will check for the product/item name and quantity. Then goes to the particular rack to pick up.

Here the COBOT uses line follower technology for path finding, for which the rack number is already specified in the database. After reaching the position, the robotic arm fetches the product and drops into the cart, which is within the COBOT. Similarly, COBOT collects all the items in the list, drops it to the cart; and finally return it to the customer along with the bill. The bill is produced by tkinter; when the list is completed, there will be a new database created in which the item name, purchased quantity and price is listed. Finally, the total amount is calculated and produced to the customer. Here a PC is used for running the python program and Arduino for line follower circuit. The shelf for the proposed system is an automated one. The overall setup consists of a PC, a line follower part, Robotic Arm, Automated Shelf and a Cart. The Line Follower Robot designed is based on Arduino. It detects the black line on the surface and move along that line. So that sensors are to be needed to detect the line. Arduino UNO detects this change in sensor input and sends signal to motor driver accordingly. In order to turn right, the motor on the right side of the robot is slowed down, while the motor on the left side is run at normal speed.

Similarly, when the other IR Sensor detects the black line first, it means that there is a left curve ahead and the robot has to turn left. For the robot to turn left, the motor on the left side of the robot is slowed down (or can be stopped completely or can be rotated in opposite direction) and the motor on the right side is run at normal speed. Arduino

UNO continuously monitors the data from both the sensors and turns the robot as per the line detected by them. After collecting the list from the customer, it will send to the data to Arduino using a USB cable then to the serial monitor. Then it read, decode and identify the number of items needed. Using these, the movement of lift and shelf is occurred. If any item in the upper shelf is needed, the motor at the upper shelf will rotate forward. Then the lift will come up. If any in the lower shelf is needed, the lower motor rotates forward and the lift will come down by lowering the motor. Then it will stop. Here a Robotic Arm is used to fetch the item from the lift and drop it to the cart.

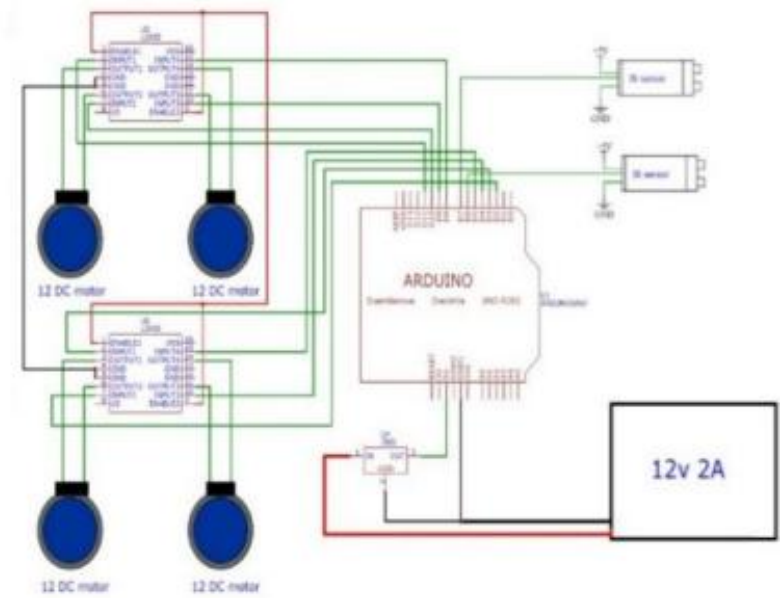

Figure 3: Circuit Diagram for Automated Shelf

The shelf used here is fully automated. It is a two-layer shelf – upper and lower layer. Two motors are used in rotating or rolling the shelf. The items in the shelf rolls down along with the rolling action of shelf. A lift has been designed for collecting the items from the shelf which is rolled down. A motor is being used for the movement of lift. Speed of the lift can be controlled by using relay. If any item in the upper shelf is needed, the motor at the upper shelf

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will rotate forward. Then the lift will come up. If any in the lower shelf is needed, the lower motor rotates forward and the lift will come down by lowering the motor. Then it will stop. Here a Robotic Arm is used to fetch the item from the lift and drop it to the cart. The movement of arm is based on the motor. The supply required in shelf is completely produced by the SMPS.

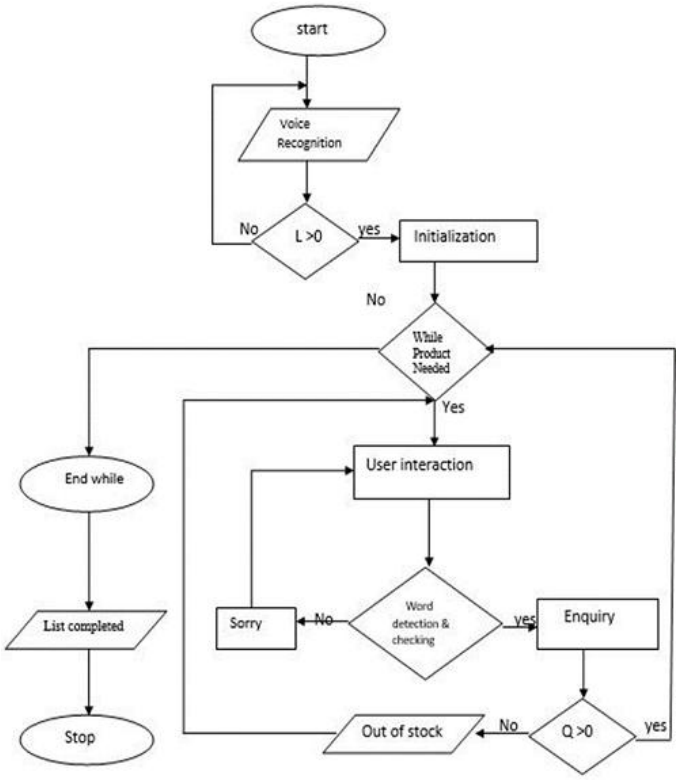

Figure 4: Proposed System Flowchart

V. RESULT

To improve the quality of the services provide to users in the supermarkets many development have been proposed. But most of the system does not meet all the requirements of the customer. Some may provide only the navigation assistance, some will help to read/identifies the product name, and some systems will help to carry the bags, groceries during shopping, etc. Even if these much systems are available, the customers especially the old age and blind peoples have to suffer several difficulties while shopping. In almost many existing system, the customers need to go along with the robot, and they have to wait for their bill.

When the proposed system is introduced, the difficulties of the blind people can be eliminated. The COBOT itself will purchase and collect the desired products into the cart. Then it automatically bills the products purchased and hand over it to the customer. It can have further future expansions to all the fields in order to provide assistance for blind as well as people who seek assistance.

VI. FUTURE WORKS

In our proposed system the connection is wired, but in future it can be enhanced with wireless system. In order to reach out the cart to the right customer, an RFID technology will be added; where it will provide RFID tags to customer and the RFID receiver with in the robot. The customer's face id is stored with the help of facial recognition system. Thus, when the customer arrives to supermarket, the COBOT approaches them. It enquires about the products to be purchased and fetches the commodity. Then by checking the previously fetched face id COBOT automatically returns

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to the customer along with the cart and bill. A unique identification number can be assigned along with the customer name, which is randomly generated say e.g. ABC – 12062020010.

In near future, we can include a system where the robot itself can directly inform the seller whenever the minimum required quantity of product is unavailable through inventory scanning. COBOT can be upgraded in such a way that, it can make customers notify about offers in the store as well as suggest them alternative products they are looking for. It can also have a feature which notify the respective person about product stocking and also whether the products are on the right shelf which it is supposed to be or not. We can also add features to it which scans the floor to look for any type if slips or any hazards, clearing it if found; there by creating safer environment to the customer.

VII. CONCLUSION

This paper mainly focusing on providing assistance for the blind and elderly people in supermarket for easy access of products. However, grocery stores and supermarkets remain mostly difficult for purchasing to people with visual impairments. This proposed system introduces a new framework for the supermarket shopping. The COBOT will make the transactions and purchasing easy. COBOT is a collaborative robot that is capable of learning multiple tasks so it can assist human beings. Here the COBOT will be collecting the list of items that is to be purchased by interacting with the customer. Then the it asks the customer to wait and it moves to the particular rack to fetch the product, after completing the list, COBOT returns the products to the customer along with the calculated bill. This product will be very helpful in the supermarkets as well as blind people. And also this included many future advancements that can be implemented to this adding societal benefits.

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