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Human Assistance Robot by Using Arduino

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ABSTRACT

One of fundamental issues for service robots is human–robot interaction. In order to perform such a task and provide the desired services, these robots need to detect and track people in the surroundings. In this paper we present a shopping assistant system to be used in supermarkets, primarily for helping handicapped or elderly people for carrying a big load in hand. The proposed system is based in three main components: a) mobile devices, like mobile phones, that users carry with them, b) a set of mobile robots to assist supermarket users, c) the robotic assistant. This system will allow users to keep control in robot by communication with the robot, the robot will help the customer by handling all the product. In this work is also shown the acceptability studies for this kind of robot. The problem of creating a person-tracking mobile robot has been studied by many researchers in literature. There are two main issues associated with this problem. The first issue is to equip a robot with proper sensory devices so that it is able to identify and locate the target person in a crowd in real time. The second issue is to control and navigate the robot so that it follows the target person within a certain distance.

Keywords : Human Following Robots , Arduino Micro Controller, Bluetooth, Ultrasonic Sensor, IR Sensor Control Unit

I. INTRODUCTION

Robotic technology has increased appreciably in past couple of years. Such innovations were only a dream for some people a couple of years back. But in this rapid moving world, now there is a need of robot such as “A Human Following Robot” that can interact and co-exist with them. The development of robot technology had increased significantly due to industrial and military applications. Most robots were used in industrial and military use but intelligent robots for general daily use is yet to be implemented. Human-Following Robot (HFR) is one of the applications that could be implemented under robot technology. Because of its human following capability, HFRs can work as assistants for humans in various situations and it can also acquire or monitor certain information associated with the human subject. Possible application scenarios include assistance for elderly people and general service robots for shopping centres or public areas. A key requirement for service robots is the ability to detect humans and to interact them in non-technical and natural fashion. The goal of our work is to move toward a more reliable and robust system, where human detection is viewed as a fundamental stepping stone.

II. SYSTEM MAIN PARTS & BLOCK DIAGRAM

2.1 System main parts Description’s

2.1.1The Mobile Devices: - In the figure 1, we can observe the general structure of the proposed system. The user uses his mobile device to store his shopping list, which is sent to the supermarket server. Then the supermarket server selects a robot and assigns it to the user. The use of mobile devices as mobile phones has become an essential part in the life of many people mainly in urban areas. However, the technology included on these devices change from one year to another, so it is difficult to design an application that could be used on all kind of mobile devices. Taking this into account we have decided to implement a small application for mobile devices.
Fig.

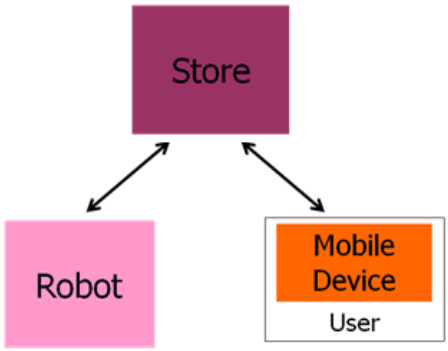

Figure 1. Structure and relationship between the system parts

2.1.2. The Supermarket Shopping Serve: - There will be an application running on the Supermarket Shopping Server, which will manage the connection requests coming from the users' mobile devices. When a new user is registered in the supermarket the server adds the Bluetooth address of the mobile device to the list of known devices and associating this address with the user's ID. Once this is done, the server receives the Bluetooth signal from the user and start following.

2.1.3. The Robotic Assistant: - At this stage of the project, the user can walk to their destination along with his load where this load can be shared by the robots. The robot can sense the human, obstacles, and distance of the human so that is can follow the human.

2.2 BLOCK DIAGRAM

2.2.1 BASIC BLOCK DIAGRAM OF HFR & DISCRIPTION:-

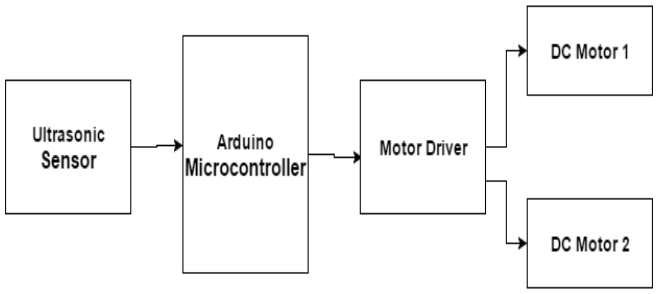

Figure 2. Block diagram of human following robots

2.2.2 Descriptions of the components used in block diagram:-

1. Ultrasonic sensor: - It is used to sense the obstacle and the distance between them and it is also used to sense the distance between the cart and the human whom he should need to follow.

2. Arduino Microcontroller**:** - It is the brain of our project. It can give all the command to their sub ordinate components which should by operated by the human behaviour. And it also give feedback to the other components and human. So that it can be the used as a medium of communication between human and robots & vice versa.

Motor Driver: - Here Motor Driver Board is designed to Work with L293D IC. This can control 2 DC Motors, their direction using control lines and their speed using PWM.

4. DC Motor: - Here 4 DC motor are used to drive the cart. Where two are normally in working mode and other two are used in standby mode. The purpose of providing a standby is used as back also. And is it used when the carts is overloaded.

III. COMMUNICATION

The communication proposed in this project is divided in two parts depending on the scenario in which they operate. The communication between the mobile device and the server is performed via Bluetooth due the wide range of mobile devices that support this type of communication, on the other hand, the communication between the server and the robot assistant.

Two main communications are established and used to make all the actors of our system to properly interact. The first one concerns the identification of the user and his mobile device when arriving to the store. This communication is achieved by using Bluetooth©, between the user's mobile device.

IV. SYSTEM DESIGN & WORKING

The system design consists of separate processing and control unit. The processing unit only makes use of a sensors and is linked with the control unit. The control unit is serially linked with the processor and it makes use of several sensors and modules i.e. ultrasonic sensor and infrared sensors. The above sensors works in unison with each other and helps the robot in its operation and to navigate its path by avoiding the obstacles and maintaining a specific distance from the object. The decision is made on the basis of information obtained from all above sensors.

We used ultrasonic sensor for obstacle avoidance and to maintain a specific distance for the object. The

ultrasonic sensor works accurately works accurately with in a range of 4 meters

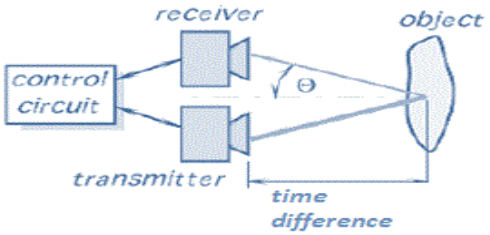

Figure 3. Ultrasonic Sensor Principle

This ultrasonic sensor is placed at the top of robot to maintain accuracy in measuring distance between the robot and target object.

The flow chart to maintain specific distance from target is shown below.

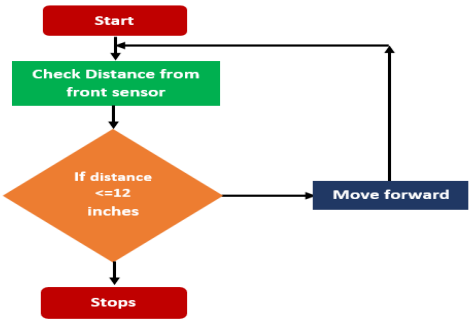

Figure 3. Flow Chart of Maintaining Specific Distance

After interfacing of above sensors, the next most important part of this system design is to interface the encoders to wheel calculate the distance travelled by the robot to eliminate any further error in the robotic movement due to displacement. For this purpose we attached two slot sensors on top of the encoder's right beside the wheels. The slot sensor has IR transmitter and a photodiode mounted on it and facing each other. The light emitted by the IR LED is blocked because of alternating slots of the encoder disc. This causes the logic level of the photo diode to change and is detected by the controller.

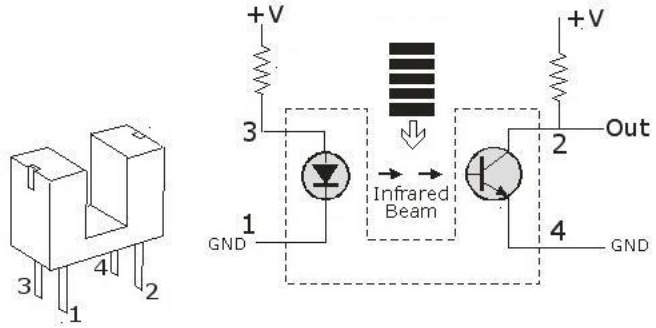

Figure 4. IR Slot Sensor

Final phase is consisted of fusing all the information obtained by the sensors and modules in the control unit. Hence, control unit makes an intelligent decision to change the direction of robot and to get back on its track again and to follow the target having tag on basis of information obtained for all sensors and modules i.e. serially received coordinates from processor, distance information from ultrasonic sensor, heading direction from magnetometer, and distance calculation from the IR sensor.

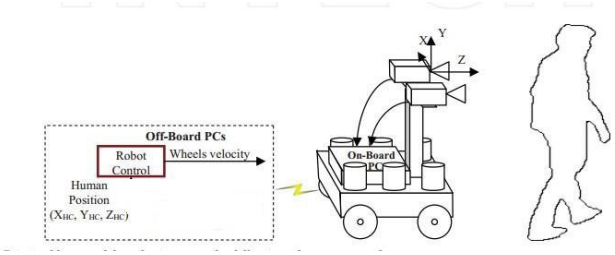

Figure 5. Human Following Robotic System.

The system is designed in such a way that it intelligently makes use of the information obtained from different sensors and modules. Different sensors are incorporated in the system.

Mechanism of Mobile Shopping Trolley

Mechanism design for mobile shopping trolley was based on the portability concept. The mechanism can be attached under the bottom of shopping trolley and it can be taken out easily. Shopping trolley was implemented with differential wheeled drive. The two driven wheels are placed as middle wheels of the trolley. Therefore, it can move in every direction. Besides, suspension mechanism was designed by using springs so that the robot is able to touch with the uneven ground surface. This helps to increase the stability of the shopping trolley. Figure 3.1 and Figure 3.2 show the robot mechanism and shopping trolley with attached robot respectively

Figure 6. Side angle view and top view of robot mechanism with hardware and components attached

Figure 7. Mechanical structure of portable robot is attached to shopping trolley.

V. APPLICATIONS

Looking deeply into environment or our surroundings, we will be able interpret that "YES" there is a need of such robot that can assist humans and can serve them. Such a robot can be used for many purposes. With a few changings, the robot can act as a human companion as well.

Some other applications of this robot are

- Can assist in carrying loads for people working in hospitals, libraries, airports, etc.
- Can service people at shopping centers or public areas.
- Can assist elderly people, special children and babies.
- Can follow a particular Vehicle.

VI. FUTURE WORK

There are many interesting applications of this research in different fields whether military or medical. A wireless communication functionality can be added in the robot to make it more versatile and control it from a large distance. This capability of a robot could also be used for military purposes. By mounting a real time video recorder and camera on top of the sensor, we can monitor the surroundings by just sitting in our rooms. We can also add some modifications in the algorithm and the structure as well to fit it for any other purpose. E-g a vehicle follower. Similarly it can assist the public in shopping malls, hospitals, airports. So there it can act as a luggage carrier, hence no need to carry up the weights or to pull that. Using this algorithm the robot will automatically follow that person.

VII. CONCLUSION

A successful implementation of a human follower robot is illustrated in this paper. This robot does not only have the detection capability but also the tracking and following ability as well. The tracking is basically performed on the tag and the human is followed on the basis of that detection. It was also kept in mind that the "following" capability of the robot should be as efficient as possible. The tests were performed on the different conditions to pin point the mistakes in the algorithm and correct them. The different sensors that were integrated with the robot added an additional advantage.

VIII. REFERENCES

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