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A Novel Smart Librarian Robot

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Abstract— **This paper presents a smart librarian robot with RFID technology. Our librarian robot that is kept in an experimental environment is able to say greeting properly based on estimation results of human behavior using a laser range finder, talk with a library user with a natural language, and search books depending on a user's request. When the robot explains where a requested book is in the library, it points out a target position using a laser spot while the body and head are also turned around to the direction of the target. This makes detailed oral explanation unnecessary. However, the robot cannot always point out a target position directly using the laser pointer. So we design three types of guidance using the laser pointer and the gestures depending on the library environment. Some experimental results reveal the validity and effectiveness of our proposed guidance method using the laser pointer and some gestures for our librarian robot. Hence our robot can help the library user to use the library effectively in less time.**

Index Terms— **RFID – Radio Frequency Identification, Laser Pointer.**

I. INTRODUCTION

A robot is an automatic mechanical device often resembling a human or animal. Modern robots are usually an electro-mechanical machine guided by a computer program or electronic circuitry. In recent years, the need for humanoids and service robots has increased in all working areas like research, design, and building new robots serve various practical purposes, whether domestically, commercially, or militarily. In this paper we present a Librarian Robot which is used to tell the library user that where the book he searching for. This is very much helpful for the physically challenged people also.

To the best of our knowledge, there are only few robotic systems that are designed to work in a library-like scenario. The system CAMP, presented in [1], was designed to work in an off-site shelving facility: the end-user requests a specific book through an internet Interface. The books locations are saved in the system database and the mobile system navigated to the target location. Using a bar code reader mounted on the robot gripper, the book is identified, grasped by a specially designed parallel gripper and delivered to the user. A similar system was presented in [2] where books are identified by special labels using an OCR system. The book segmentation operation is achieved by integrating visual and force sensing, where the vision system is responsible for detecting the book and identifying its approximate location and the force torque sensor on an industrial parallel plate gripper is responsible for detecting the exact position of the book borders. Both systems however, utilize a prior knowledge and/or marker detection process during the book segmentation operation. Another mobile system was presented in [3], it is being a system which does not use any pre-knowledge of the books, and in which distant users can browse books in a library through an internet interface. The user defines the category of the desired book and the robot then navigates to the corresponding shelf and positions itself perpendicular to it. The vision system of the robot uses a laser scanner mounted on the robot manipulator to segment the edges of the books on the shelf. The system then computes the thickness for each book, and identifies the book being targeted. This method requires, however, a special hardware configuration (specially designed laser scanner and robot manipulator) which limits the robot workplace to only that scenario.

Another Color Based Segmentation Robot is presented in [4], In this they are using the digital image processing method, where the books are searched with their color. This fails when two books are of same color. One more Bar code reader type Robot is presented in [10]. Here we present a Robot with RFID technology since the RFID has the following advantages then the Barcode reading. No "line of sight" requirements, more automated reading, improved read rates, Greater data capacity, "Write" capabilities. The paper is organized as follows. Next Session describes the methodology of RFID technique, followed by the proposed system based on the RFID technique and finally the Result and Discussion.

II. RFID TECHNOLOGY

Radio-frequency identification (RFID) is an automatic identification method, relying on storing and remotely retrieving data using devices called RFID tags or transponders. The technology requires some extent of cooperation of an RFID reader and an RFID tag. An RFID tag is an object that can be applied to or incorporated into a product, animal, or person for the purpose of identification and tracking using radio waves. Some tags can be read from several meters away and beyond the line of sight of the reader.

An RFID tag is an object that can be applied to or incorporated into a product, animal, or person for the purpose of identification and tracking using radio waves. Some tags can be read from several meters away and beyond the line of sight of the reader. A basic RFID system consists of an antenna or coil, a transceiver (with decoder), a transponder (RF tag). There are many different types of RFID

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systems out in the market. They are categorized according to there frequency ranges. Some of the most commonly used RFID kits are as follows:

1) Low-frequency (30 KHz to 500 KHz)
2) Mid-Frequency (900KHz to 1500MHz)
3) High Frequency (2.4GHz to 2.5GHz)

These frequency ranges mostly tell the RF ranges of the tags from low frequency tag ranging from 3m to 5m, mid-frequency ranging from 5m to 17m and high frequency ranging from 5ft to 90ft. The cost of the system is based according to the ranges with low-frequency system ranging from a few hundred dollars to a high-frequency system ranging somewhere near 5000 dollars. The components of RFID are listed below.

A. Antenna

The antenna emits radio signals to activate the tag and read and write data to it. Antennas are the conduits between the tag and the transceiver, which controls the system's data acquisition and communication. Antennas are available in a variety of shapes and sizes; they can be built into a door frame to receive tag data from persons or things passing through the door, or mounted on an interstate tollbooth to monitor traffic passing by on a freeway. The electromagnetic field produced by an antenna can be constantly present when multiple tags are expected continually.

If constant interrogation is not required, a sensor device can activate the field. Often the antenna is packaged with the transceiver and decoder to become a reader (a.k.a. interrogator), which can be configured either as a handheld or a fixed-mount device. The reader emits radio waves in ranges of anywhere from one inch to 100 feet or more, depending upon its power output and the radio frequency used. When an RFID tag passes through the electromagnetic zone, it detects the reader's activation signal. The reader decodes the data encoded in the tag's integrated circuit (silicon chip) and the data is passed to the host computer for processing.

B. Tags (Transponder)

An RFID tag is comprised of a microchip containing identifying information and an antenna that transmits this data wirelessly to a reader. At its most basic, the chip will contain a serialized identifier, or license plate number, that uniquely identifies that item, similar to the way many bar codes are used today. A key difference, however is that RFID tags have a higher data capacity than their bar code counterparts. This increases the options for the type of information that can be encoded on the tag, including the manufacturer, batch or lot number, weight, ownership, destination and history (such as the temperature range to which an item has been exposed).

An unlimited list of other types of information can be stored on RFID tags, depending on application needs. An RFID tag can be placed on individual items, cases or pallets for identification purposes, as well as on fixed assets such as trailers, containers, totes, etc. Tags come in a variety of types, with a variety of capabilities. Key variables include: "Read-only" versus "read-write". There are three options in terms of how data can be encoded on tags:

(1) Read-only tags contain data such as a serialized tracking number, which is pre-written onto them by the tag manufacturer or distributor. These are generally the least expensive tags because they cannot have any additional information included as they move throughout the supply chain. Any updates to that information would have to be maintained in the application software that tracks SKU movement and activity.

(2) "Write once" tags enable a user to write data to the tag one time in production or distribution processes. Again, this may include a serial number, but perhaps other data such as a lot or batch number.

(3) Full "read-write" tags allow new data to be written to the tag as needed—and even written over the original data.

C. RF Transceiver

The RF transceiver is the source of the RF energy used to activate and power the passive RFID tags. The RF transceiver may be enclosed in the same cabinet as the reader or it may be a separate piece of equipment. When provided as a separate piece of equipment, the transceiver is commonly referred to as an RF module. The RF transceiver controls and modulates the radio frequencies that the antenna transmits and receives. The transceiver filters and amplifies the backscatter signal from a passive RFID tag.

III. PROPOSED METHOD

Our proposed Robot works as follows, all the books in the library are provided with a unique RF identification number. The RFID reader, Microcontroller, LCD display, Laser pointer and a Voice Module is placed in the Robot. First the reader is stored with the database (i.e, identification number of all books in library). Once the user is entered into the region of Laser, it tells greetings to the user through voice module. Once the Tag is shown to the reader, it reads the tag and finds the identification number and start searching the book in the shelves, as soon as it finds the book it point the book using laser pointer and also tells the position of the book in the rack.

IV. HARDWARE UNITS

Our ROBOT contains the following hardware components as shown in fig.1

1. The RFID reader
2. PIC Microcontroller
3. LCD display
4. Laser pointer
5. Voice Module
6. Power supply unit

A. PIC16F877-Microcontroller

It is an electronic device. It consists of 40 pins for passing controls to the external devices. 5v power is supplied to pic through the VSS, VDD pins. It has four ports for communication. Microchip Corporation develops this pic micro controller.

B. Single-Chip Voice Recording &Playback Device

The APR9600 device offers true single-chip voice recording, non-volatile storage, and playback capability for 40 to 60 seconds. The device supports both random and sequential access of multiple messages. Sample rates are user-selectable, allowing designers to customize their design for unique quality and storage time needs. Integrated output amplifier, microphone amplifier, and AGC circuits greatly simplify system design. The device is ideal for use in portable voice recorders, toys, and many other consumer and industrial applications.

APLUS integrated achieves these high levels of storage capability by using its proprietary analog/multilevel storage technology implemented in an advanced Flash non-volatile memory process, where each memory cell can store 256 voltage levels. This technology enables the APR9600 device to reproduce voice signals in their natural form. It eliminates the need for encoding and compression, which often introduce distortion.

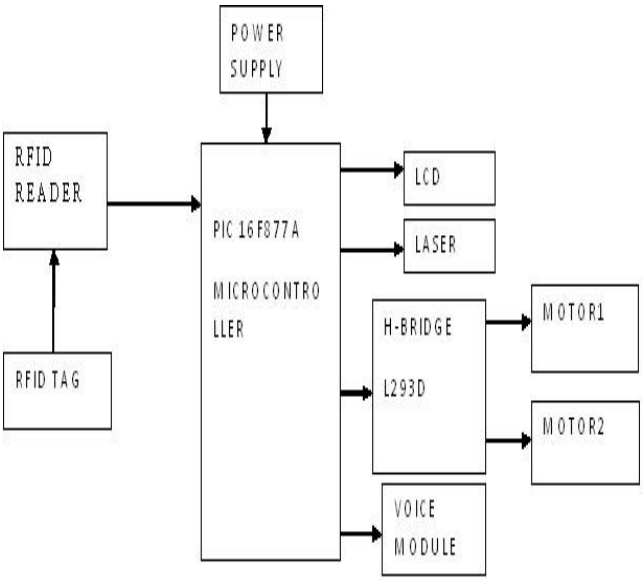

Fig.1 Block Diagram of Proposed System

C. Single-Chip Voice Recording &Playback Device

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D. Liquid Crystal Displays (LCD)

Liquid crystal displays (LCDs) have materials which combine the properties of both liquids and crystals. Rather than having a melting point, they have a temperature range within which the molecules are almost as mobile as they would be in a liquid, but are grouped together in an ordered form similar to a crystal.

An LCD consists of two glass panels, with the liquid crystal material sand witched in between them. The inner surface of the glass plates are coated with transparent electrodes which define the character, symbols or patterns to be displayed polymeric layers are present in between the electrodes and the liquid crystal, which makes the liquid crystal molecules to maintain a defined orientation angle. One each polarisers are pasted outside the two glass panels. These polarisers would rotate the light rays passing through them to a definite angle, in a particular direction. When the LCD is in the off state, light rays are rotated by the two polarisers and the liquid crystal, such that the light rays come out of the LCD without any orientation, and hence the LCD appears transparent.

When sufficient voltage is applied to the electrodes, the liquid crystal molecules would be aligned in a specific direction. The light rays passing through the LCD would be rotated by the polarisers, which would result in activating / highlighting the desired characters.

The LCD's are lightweight with only a few millimetres thickness. Since the LCD's consume less power, they are compatible with low power electronic circuits, and can be powered for long durations. The LCD's don't generate light and so light is needed to read the display. By using backlighting, reading is possible in the dark. The LCD's have long life and a wide operating temperature range. Changing the display size or the layout size is relatively simple which makes the LCD's more customer friendly.

The LCDs used exclusively in watches, calculators and measuring instruments are the simple seven-segment displays, having a limited amount of numeric data. The recent advances in technology have resulted in better legibility, more information displaying capability and a wider temperature range. These have resulted in the LCDs being extensively used in telecommunications and entertainment electronics. The LCDs have even started replacing the cathode ray tubes (CRTs) used for the display of text and graphics, and also in small TV applications.

E. *Power Supply*

The power supply should be of +5V, with maximum allowable transients of 10mv. To achieve a better / suitable contrast for the display, the voltage (VL) at pin 3 should be adjusted properly.

A module should not be inserted or removed from a live circuit. The ground terminal of the power supply must be isolated properly so that no voltage is induced in it. The module should be isolated from the other circuits, so that stray voltages are not induced, which could cause a flickering display.

V. SOFTWARE UNITS

Microcontroller has to read the RFID tag, for that the program is embedded in the microcontroller using Embedded C.

VI. RESULT AND DISCUSSION

The experiments were conducted to evaluate the performance of the proposed method. The results presented in this paper mark the beginning of our efforts to build a robot for detecting the books. This circuit is designed for book detection. The IR sensor is used to sense and detect the book. When the librarian types the book name, the robot will be ready to search the book. As soon as it identifies the book, and shows the book using laser pointer and also tells the position of the book and display the position in LCD display. If the book is not available in the library it will display it on the LCD display.

VII. CONCLUSION

In this paper the proposed system give the result of finding the books in the library. Misplacing of the books can be identified easily in this method. It reduces the manual work. With the proposed architecture, if such a system is developed, it will act as a basic platform for the generation of more such devices for the book picking in an efficient way in most of the libraries. We can also make the robot to go near the place and make the robot to pick the book for physically challenged users.

REFERENCES

[1] **J. Suthakorn, S. Lee, Y. Zhou, R. Thomas, S. Choudhury and G. S.** Chirikjian, "A robotic library system for an off-site shelving facility," in *IEEE Int. Conference on Robotics and Automation*. *2002*

[2] R. Ramos-Garijo,, M. Prats, P. J. Sanz, A. Del-Pobil and P.,"An autonomous assistant robot for book manipulation in a library," in *IEEE International Conference on Systems, Man and Cybernetics*, 2003

[3] A. Gräser, O. Kuzmicheva, D. Ristic-Durrant, S. K. Natarajan and C. Fragkopoulos,"Vision-based control of assistive robot FRIEND: practical experiences and design conclusions," *Automatisierungstechnik* , 60, 297-308. 2012

[4] A. Gräser et al.,"A supportive FRIEND at work: robotic workplace assistance for the Disabled," *IEEE Robotics and Automation Magazine*,. 20, 148-159. 2013.

[5] T. Tomizawa, A. Ohya and S. Yuta, "Remote book browsing system using a mobile manipulator,"in *IEEE International conference on robotics and automation*. *2003.*

[6] M. Wallenberg, M. Felsberg, P. Forssen and B. Dellen,"Channel coding for joint color and depth segmentation," *Pattern Recognition*, 6835, pp 306-315.2011

[7] A. Beliweiss and M. Werman,"Fusing Time-of-Flight depth and color for real-time segmentation and tracking," *Proceeding Dynamic 3D Imaging*, 5742, pp. 58-69. *2009.*

[8] M. Johnson-Roberson, J. Bohg, M. Bjorkman and D. Kragic,"Attention-based active 3D point cloud segmentation," in *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*. *2010.*

[9] B. Enjarini and A. Gräser,"Planar segmentation from depth images using Gradient of Depth feature," in *EEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*. *2010.*

[10] P. F. Felzenszwalb and D. P. Huttenlocher,"Efficient graph-based image segmentation," *International Journal of Computer Vision*, 59. 2009.

[11] Arumugaraja.M, GugaPriya B, Soundarya.M(2014) " The Library Management Robot" , International Journal Of Engineering And Computer Science.3 PP 5008-5012. 2014.