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Library Assisting Robot

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***Abstract*—With the development of technology amount of books, kind of newspapers and magazines holding in modern library increase sharply. The following management works become terrible day by day and if it depends only on traditional manual operations, it will not only be consuming more and more manpower, material resource and financial resource but also reduces the dependability of the management. So it is inevitable trend to bring intelligence into libraries which replace the manual work with machine. In our proposed model, the book returned is placed in the conveyor unit of robot called 'LIBRARIAN' which sense the book. The RFID scanner placed in the module reads the RFID tag and details of the book is obtained along with corresponding stop pit address. PIC 16F887 is the control unit. The robot is designed to be a line follower. Using the concept of "line tracer", tracks are provided which facilitates the robot to navigate along the book shelf, using the IR sensors, and place the book at corresponding shelf. This robot can be designed and build to function as a shelf reader in a library, replacing hundreds of man-hours typically required in library today using standard manual shelf reading process.**

Keywords—PIC microcontroller, IR sensors, line tracer, RFID tag, RFID scanner

I. INTRODUCTION

A library is collection of information, resources and services, organised for use, and maintained by a public body, institution or private individual. In the more traditional sense, it mean a collection of books. Typically, we need a librarian to pick the books and hand it over to the person, to whom the books are being issued. This might be an easy task in case the library floor area is small. Also, to search for the books by humans takes a lot of time as many a times the books get overlooked by the human eye. To automate the process of book sorting, we suggest a robot, which will place the books in the respective locations. Here we will be placing the books in a rack, and all the books will be tagged by RFID tags and an RFID reader will be placed on the arm of the robot. The RFID reader sends the data to PIC which in turn pass the corresponding location details to the wheels. This ensures that the books are placed in their actual locations. In this case, the proposed robot will make the life of librarian a lot simpler and the books can be tagged easily.

The library assisting robot improves the dependability on management of books in library. It also provides high precision work by a librarian. Misplacement of books are completely avoided with the implementation of this robot. The robot also facilitates proper sorting and active time management. It save library employees from their time consuming task of book sorting and arranging and the major task of library employees can be performed at greater accuracy and reliability. It reduces labour requirements, time consumption and cost of library management

WORKING

The basic working of the 'Library assisting robot' deals with the returning of the book to the correct predestined location in the library. The working of the robot can be divided to different layers:

1) Reading of RFID tags using an RFID sensor
2) Working of line tracer sensors for the movement of robot to the destination
3) Movement of the conveyor unit for placing the book in its destination. The book which has to be returned is kept on the conveyor belt after bringing the book near the RFID sensor. The RFID sensor obtains the number stored in the RFID tag which is attached to the book. Each book has a unique RFID tag. Hence by reading the RFID tag, the sensor obtains the destination of the book and stores the destination number in a destination register. As the book is placed on the conveyor unit after showing it to the RFID sensor the book cutting sensor gives input to the microcontroller showing the presence of the book. Now the robot starts moving in straight direction.

Each shelf locations in the library are marked by a stop pit of the line tracer. As the robot cuts these stop pits every time the temporary register is incremented. Program is done in such a way that the robot is commanded to stop when the temporary register becomes same as the destination register. The movement of the robot is based on the line tracer program. If the robot tends to move towards right direction and if the left sensor cuts the line, program is done to rotate the right motor alone, so that the robot falls back on track. Similarly if the robot tends to move towards the other direction the right motor rotates alone to bring the robot back on track.

Once the robot reaches the destination, the conveyor program is started so that the book is shifted to its location by the conveyor. As the book is placed in its destined location, the book cutting sensor is turned off, giving signal to the microcontroller that the book is placed. Hence the microcontroller starts the returning procedure for the robot. The robot moves back along the line and reaches the starting location and waits for the next book to be returned.

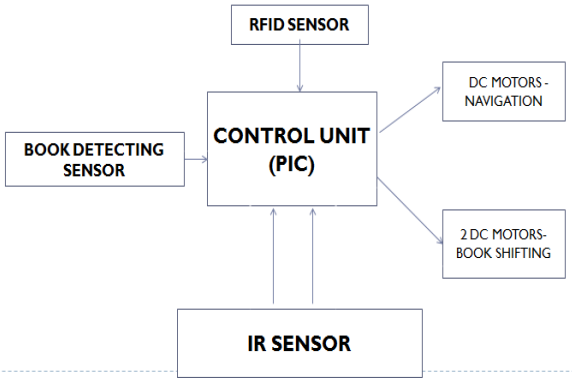

Figure 1: block diagram

Figure 1 shows the block diagram of the proposed model. PIC 16F887 in the main control unit. Book detecting sensor, RFID sensor and IR sensors are the input to control unit. Two dc motors for navigation and two dc motors for book shifting forms the output of the control unit. The presence of book is detected by the book cutting sensor. The RFID reader reads the details of the book from the RFID tag attached to the book. The stop pit address corresponding to the book is transferred to the control unit which gives the command to the dc motors for navigation, using line tracer mechanism. On reaching the correct stop pit, PIC gives command to the dc motors of the conveyor unit to shift the book. As the book is placed, control unit gives command to return to the starting pit.

II.CIRCUIT DIAGRAM

The model has mainly four parts:1)conveyor unit which carries the book to the required position, 2)RFID scanner that reads the RFID tag, 3)line tracers through which the robot navigates, 4)PIC which is the control unit. The sample simulation is done in Proteus. A circuit diagram is drawn with two IR sensors, a book cutting sensor and an RFID tag as the input and the dc motors for navigation and book shifting forms the output.

The basic circuit diagram of the proposed model is shown in Figure: 2.

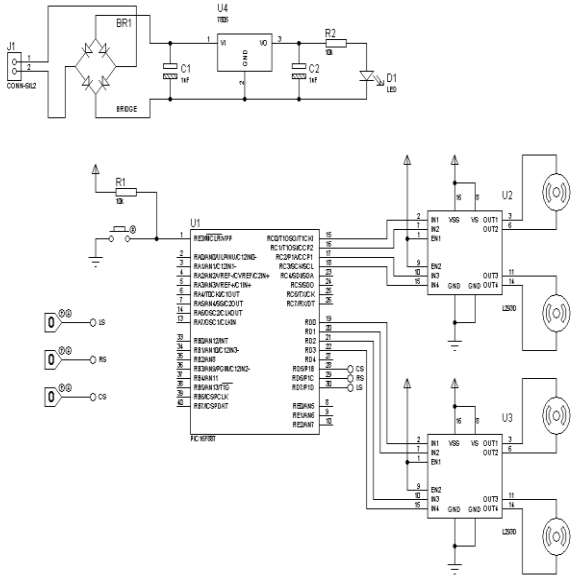

Figure 2: Circuit Diagram

III. HARDWARE

a) Microcontroller PIC 16 F887A

It is a controller is a mid- range family having a built-in SPI master. 16F877A have enough I/O lines for current need. It is capable of initiating all intersystem communications. The master controller controls each functions of the system with a supporting device. Also responsible for reception of commands from the host and taking necessary actions. This powerful (200 nanosecond instruction execution) yet easy-to-program (only 35
single word instructions) CMOS FLASH-based 8-bit microcontroller packs Microchip's powerful PIC architecture into an 40- or 44-pin package and is upwards compatible with the PIC16C5X, PIC12CXXX and PIC16C7X devices. The PIC16F877A features 256 bytes of EEPROM data memory, self- programming, an ICD, 2 Comparators, 8 channels of 10-bit Analog-to-Digital (A/D) converter, 2 capture/com- pare/PWM functions, the synchronous serial port can be configured as either 3-wire Serial Peripheral Interface (SPI) or the 2-wire Inter-Integrated Circuit (IC) bus and a Universal Asynchronous Receiver Transmitter (USART). All of these features make it ideal for more advanced level A/D applications in automotive, industrial, appliances and consumer applications. PIC16F877A is an 8-bit, fully static, EPROM/EPROM/ROM-based CMOS microcontroller. It employs RISC architecture with only 35 word/single cycle instructions. All these instructions are single cycle (1ms) expect for program branches which takes two cycles. The PIC16f877A products are supported by a full featured macro assembler, a software simulator, C compiler etc.

b) Line tracer

Line follower is an autonomous robot which follows either black line in white are or white line in black area. Robot must be able to detect particular line and keep following it. This can be implemented using two IR LEDs and IR sensors which facilitates motion through the specific path.

Working Principle: IR LED must be forward biased (+5V) and Photodiode reverse biased (-5V). The sensors must be arranged such that the radiations from IR LED must reach within the proximity of the photodiode in case of reflections from a white surface. Ideally, the reflectivity of white surface is 1 and that for black surfaces is 0. The Line tracer works on the above principle for distinguishing white and black surfaces. The difference in analog between the two surfaces must be made digital. The comparator IC LM324 is used for this purpose. The comparator will give out- puts either high or low which can be adjusted for black /white respectively or in the reverse order by adjusting the input of the comparator IC(inverting/non-inverting in-puts).Suppose that white gives HIGH and Black LOW. The output from comparator must be coupled to the motor driver IC L293D accordingly.

Sensor Arrangement: There must be two sensors. The sensors must be arranged such that the line to be followed lies between them. i.e., the two sensors senses the outside of the required line. This is to facilitate the differentiation of turns.

c) DC motor

A DC motor has a two wire connection. All drive power is supplied over these two wires think of a light bulb. When you turn on a DC motor, it just starts spinning round and round DC motor, its speed or more accurately, its power level is controlled using a technique named pulse width modulation.

d) IR LED

An IR LED, also known as IR transmitter, is a special purpose LED that transmits infrared rays in the range of 760 nm wavelength. These LEDs are usually made of gallium arsenide or aluminium gallium arsenide. They, along with IR receivers, are commonly used as sensors.

The appearance is same as a common LED. Since the human eye cannot see the infrared radiations, it is not possible for a person to identify whether the IR LED is working or not, unlike a common LED.

e) RFID Reader

Radio-frequency identification (RFID) is the wireless use of electromagnetic fields to transfer data, for the purposes of automatically identifying and tracking tags attached to objects. The tags contain electronically stored information. Unlike a bar- code, the tag does not necessarily need to be within line of sight of the reader, and may be embedded in the tracked object.

f) RFID Tags

A radio-frequency identification system uses tags, or labels attached to the objects to be identified. Two-way radio transmitter-receivers called interrogators or readers send a signal to the tag and read its response. RFID tags can be either passive, active or battery-assisted passive. RFID tags contain at least two parts: an integrated circuit for storing and processing information, modulating and demodulating a radio-frequency (RF) signal, collecting DC power from the incident reader signal, and other specialized functions; and an antenna for receiving and transmitting the signal. The tag information is stored in a non-volatile memory. The RFID tag includes either a chip-wired logic or a programmed or programmable data processor for processing the transmission and sensor data, respectively.

IV. SOFTWARE

a) Flowcode V5

The programming is done using flowcode software. Flowcode is a development environment commercially produced by Matrix Multimedia for programming embedded devices such as PIC, AVR (including Arduino) and ARM using flowcharts instead of a textual programming language. It is currently in its sixth revision. Flowcode is a high level programming language dedicated to simplifying complex functionality such as Bluetooth, Mobile Phones Communications, and USB etc. by using dedicated component libraries of functions. Flowcode is therefore ideal for speeding up software development times and allowing those with little programming experience to get started and help with projects. Flowcode is flowchart based and components are simply dragged onto a chart before the program is compiled. Flow code software is used to program PIC micro-controller. It resembles to a flowchart and is similar to logic of flowchart.

b) Eagle

EAGLE (for: Easily Applicable Graphical Layout Editor), by CadSoft Computer is a flexible, expandable and scriptable EDA application with schematic capture editor, PCB layout editor, auto-router and CAM and BOM tools developed by CadSoft Computer GmbH, Germany, since 1988. EAGLE contains a schematic editor, for designing circuit diagrams. Parts can be placed on many sheets and connected together through ports.

c) Proteus

The Proteus Design Suite is wholly unique in offering the ability to co-simulate both high and low-level micro-controller code in the context of a mixed-mode SPICE circuit simulation. With this Virtual System Modeling facility, you can transform your product design cycle, reaping huge rewards in terms of reduced time to market and lower costs of development. Proteus Virtual System Modeling (VSM) combines mixed mode SPICE circuit simulation, animated components and microprocessor

models to facilitate co-simulation of complete micro-controller based designs. For the first time ever, it is possible to develop and test such designs before a physical prototype is constructed. This is possible because you can interact with the design using on screen indicators such as LED and LCD displays and actuators such as switches and buttons. Here instead of HT12E transmitter we were connected a LED to the corresponding pin. If the LED is ON, it indicates that the micro-controller is transmitting a signal.

V. CONCLUSIONS

In this paper, we proposed a Library Assisting Robot which will save the library employees from their time consuming task of book sorting and arranging. The major task of library employee can be performed at a greater accuracy and reliability. It also help in reducing labor requirement, time consumption and cost of library management. To automate the process of book sorting, we use this robot, which will place the books in the respective locations. Here we will be placing the books in a rack, and all the books will be tagged by RFID tags and an RFID reader will be placed on the robot. The RFID reader sends the data to PIC which in turn pass the corresponding location details to the wheels. This ensures that the books are placed in their actual locations. In this case, the proposed robot will make the life of librarian a lot simpler.

As a future scope, the project can be extended so as to pick the books too, along with the placing of books. With more improvisation using a robotic arm, that is instead of a conveyor unit by incorporating an arm unit, the system can be made to place the books precisely at the correct location, irrespective of weight of the book and height of the shelf. Also, the system can be modified to carry more than one book at a time. With proper design of the path, efficiency of operation can be increased considerably.

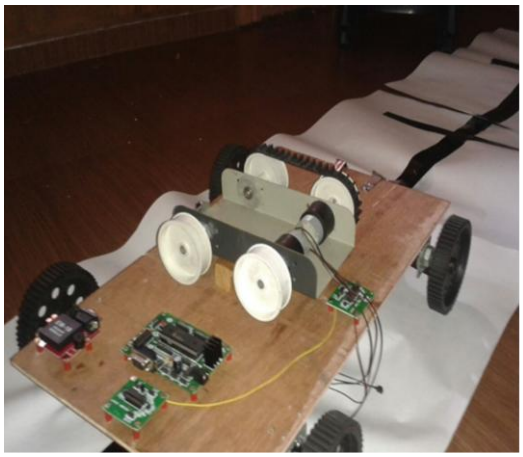

Figure 3: Hardware Implementation

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