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Automated Library System using Robotic Arm

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Abstract

A library is a collection of information resources and provides invaluable services to its users for reference and borrowing of books and documents. As the library grows in size, the problem associated with the maintenance of the books also grows. Searching a book in the library manually is a tedious process and if there is any misplacement of the book either intentionally or unintentionally then it consumes more time and more effort to search the book. To overcome this problem an attempt is made to introduce automation of library for fast searching of books and to pick or place the book in a particular rack. A robot with an arm is developed which is able to find the book at particular position and then pick or place in a particular rack in the library.

Keywords: *Library, robot, robotic arm, Arduino, infrared sensor, WIFI module.*

INTRODUCTION

International Federation of Robotics (IFR) defines a service robot as a robot which operates semi or fully autonomous to perform services useful to the well-being of humans and equipment, excluding manufacturing operations. Robotic arm is a mechanical arm which is manually controlled through wired or wireless systems to perform the desired task in various fields of application such as military tasks, hospital operations, dangerous environment and agriculture.

The main aim here is to build a robotic arm that is capable of picking the

particular book and in case of any misplacement of the book the robotic arm should be capable of picking the particular book required by the user. The system that is built has two circuits namely Arduino circuit with Wi-Fi module for control operation and motor driver circuit to drive the DC motor. A robot with an arm is developed which is capable of searching the book at particular slot and then pick or place the book in a particular rack in the library. To create a systematic, faster and efficient operation, Arduino will be used which will process the input received from the WIFI module and perform the programmed action. This system proposes a database that provides a way of searching the required book to pick or place, to find the misplaced book and to get the information about the status of the book. A GUI is developed on visual basic platform. The GUI has icons such as add book, search book and reset. The hardware of the system consists of line follower robot that navigates in the library and detects the exact location of the required book. The visual basic platform is interfaced through WIFI module with the robot to pick or place the book in the designated position as per the instructions of the user.

EXISTING SYSTEM

In the library the books will be placed in the designated position of racks and if any user needs a particular book will first check the availability of the book and search the book in that designated position. But the problem is if someone by mistake or purposefully places the books in wrong positions then it is very difficult to locate the book. The user or the library staff has to search all the racks to locate the book which will be either time consuming or sometimes it may not be possible to locate the book at all.

PROPOSED SYSTEM

In the proposed system a robot with an arm is developed such that whenever a user wants to borrow a book will first search for the availability of the book. If the book is available then the user will press a button to inform the robot to bring that book. The position of the book will be sent to robot through WIFI module and the robot will move and bring the book. The advantage of this system is even if the book is misplaced the database will be updated to the new position of the book so that robot will search the book and pick it. Further in this proposed system whenever a book is returned back by the user, the robot will be intimated to place the book in

designated position and that position details will be updated in the database.

IMPLEMENTATION

A. Block diagram

The Block diagram of automated library system using robotic arm is shown in Fig. 1.

The automated library system consists of IR sensor, Arduino, robotic arm, WIFI module, DC motors and motor drivers and PC. It has two sections: a transmitter section and a receiver section. Transmitter section consists of PC for sending the commands to the robot through WIFI module. Receiver section consists of microcontroller to process the signals received through WIFI module.

The automated library system is concerned with the implementation of pick and place task using Arduino board. Instructions from user are sent from PC via WIFI module to the Arduino and the protocol used for communication between PC and controller is serial UART. The received data is processed and corresponding output is sent to the motor driver which enables the DC motors for the movement of robotic arm and line follower robot.

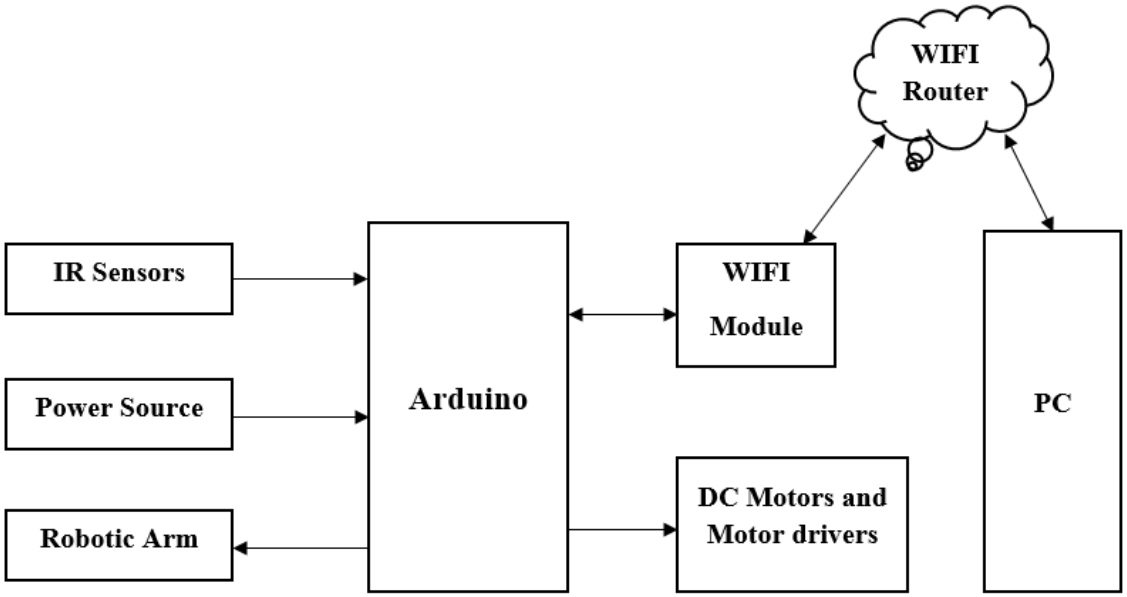

Fig. 1 Block Diagram of Automated Library System using Robotic Arm

DC Motor

The DC Motor is a class of rotary electrical machines that converts electrical energy into mechanical energy. The common type of motor work on the force produced by the magnetic fields the speed of the DC motor can be controlled using either a variable supply voltage or by changing the strength of the current in its field windings. DC motors are used for the movement of the robot and also for the movement of grippers.

Motor Driver (L293D)

The L293D motor driver is used to provide user with ease and user friendly interfacing for embedded application. The L293D is a dual H-bridge driver that can drive up to 1 Amp per bridge with supply voltage up to 24V. In automated library system using robotic arm two motor drivers is used to drive four DC motors.

Robotic arm with gripper

Robotic arm is an anthropomorphic structure which resembles human arm. In this project DC motors of 30RPM are used for the movement of the robotic arm and also for opening and closing of the gripper. Robotic arm with gripper is used to pick or place the book in to the rack.

IR Sensors

IR sensor uses the light sensor to detect specific light wavelength in the infrared (IR) spectrum by using an IR LED and it works on the principle of obstacle detection. The IR transmitter continuously emits the light, whenever the book is detected by the IR transmitter then the light gets bounces back to the IR receiver which indicates that the book is present in the rack and also used for line tracking of the robot.

Power Source

The battery is used to deliver required amount of power to all the components in the project. In this project line follower robot is energized using a 12V and 7.2A battery and all other components like IR sensors, Arduino, WIFI module and motor driver are energized using 12V and 1.2A battery.

Liquid Crystal Display (LCD)

A 16 X 2 LCD can display 16 characters per line and there are 2 such lines and each character is displayed in 5 X 7 pixel matrix. LCD is used to display the commands sent from the PC.

B. Algorithm and Flowchart

The algorithm used in the automated library system using robotic arm is:

- Configure WIFI module and Arduino.
- Set or define the input and output port.
- Set the baud rate as 9600 and enable the transmission pins for communication
- Initialize LCD
- Send the appropriate input from the PC to the Arduino through the WIFI module.
- Commands from PC are processed in the Arduino.
- The processed input from Arduino (i.e. book number) is sent to motor driver which runs the appropriate motors.
- If valid book number is entered, Robot moves towards the defined book position.
- If the book is found the robot pick the book and returns it to the destination.
- If the user wants to return the book, the robot picks the book from the user and moves towards the predefined position and places it.

The flowchart of Automated Library System using Robotic Arm is shown in **Fig. 2**.

RESULTS AND CONCLUSION

A. Results

The working model of the Automated Library System is shown in **Fig. 3**.

The hardware of the automated library system using robotic arm consists of gripper and triangular bars to hold the book firmly. The system uses four DC motors each of 30 RPM and two Johnson motor each of 30 RPM with 6 to 7 kg torque is used. Motor drivers converts lower currents into higher currents that are used to drive the motors. Motor driver can drive two DC motors simultaneously. The system uses RF transmitter and receiver to communicate between Arduino and obstacle detectors. IR sensors are used to detect the book i.e. whether the book is present in the slot or not and they are also used for line follower robotic vehicle and make the robotic vehicle to stop at particular slot to pick as shown in the Fig. 4 or to place the book as shown in the Fig. 5

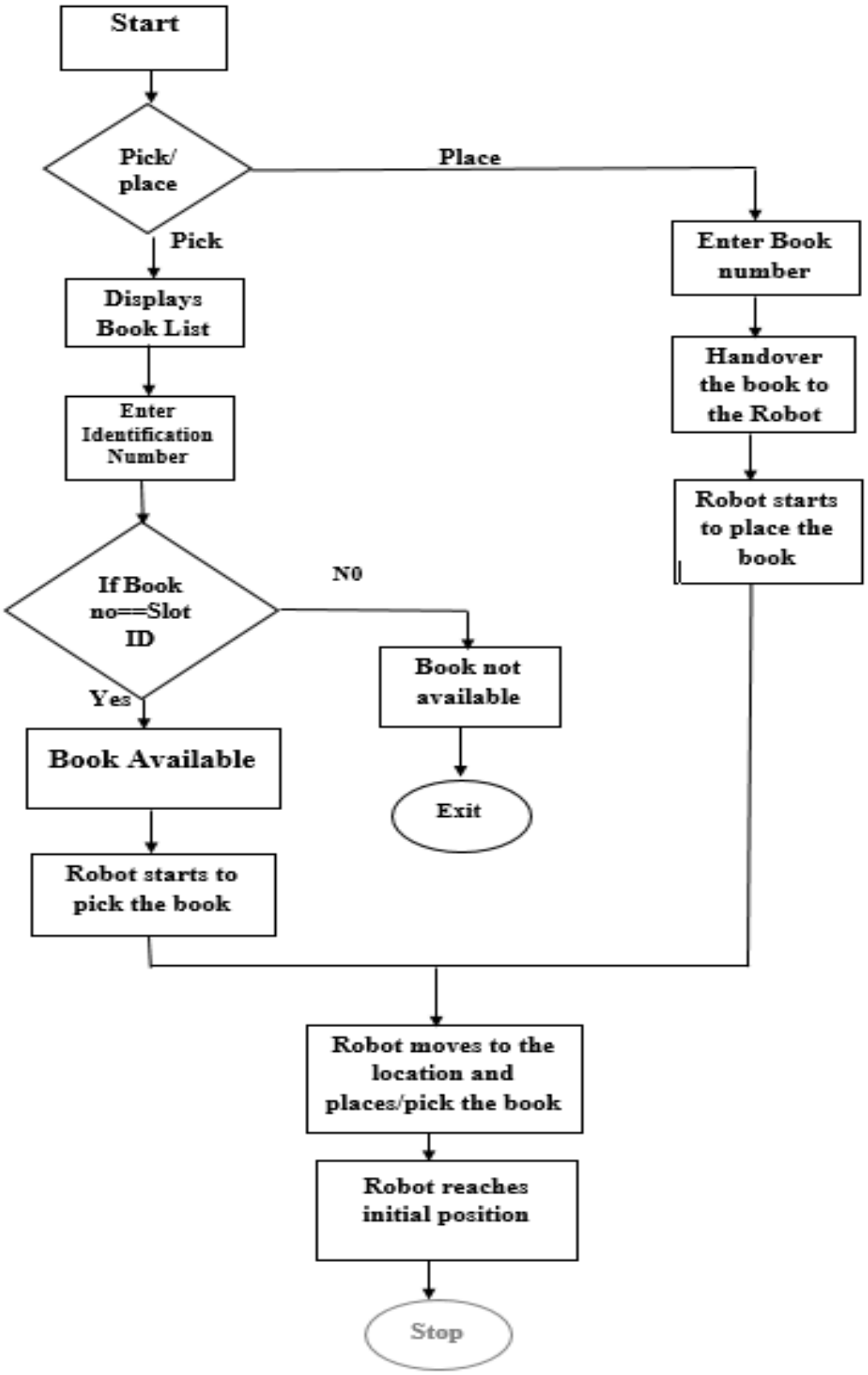

Fig. 2 Flowchart of Automated Library System

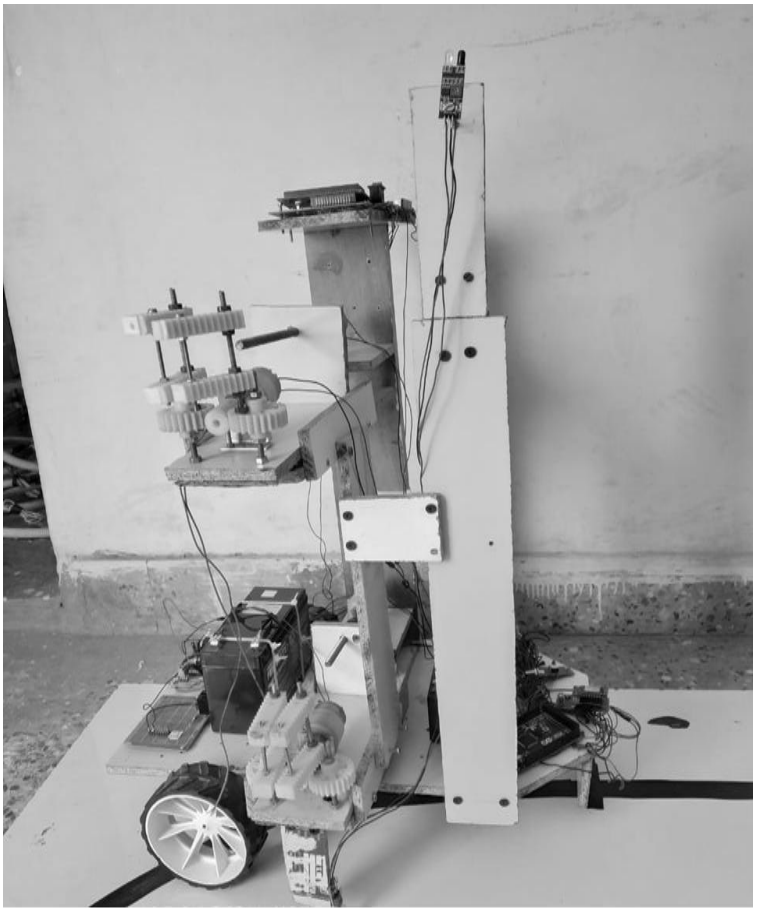

Fig. 3 working model of smart energy meter

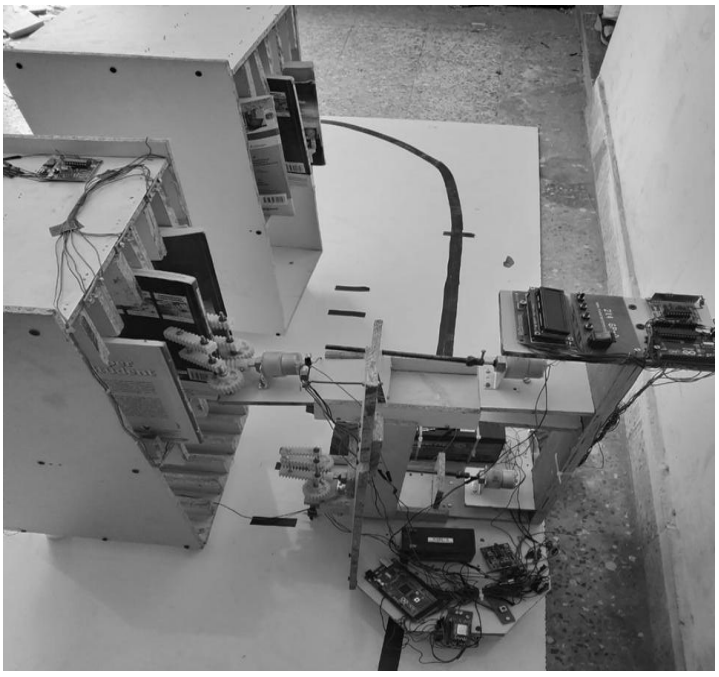

Fig. 4 Robot picking the book at a particular slot

Figure:-5 Robot placing the book at a particular slot

The visual basic window of the automated library system using robotic arm uses VBA (Visual Basic for Application) language. The interface of the visual basic window is provided with different type of icons such as add book, search book, reset and close icons. The visual basic window of the automated library system using robotic arm is shown in Fig. 6.

The search icon is used to search a particular book in the library. The result of searching the particular book in the library is shown in Figure. In this visual basic platform search option is used to search a book. In this comport the details such as book name is entered. This comport shows whether the book is available or not in the slot of the rack in the library. If the book is available then the robot moves to the predefined position to pick the required book and returns it to the destination as shown in Fig. 7. If the book is not available in the library the PC shows the comment in the comport as Book not available as shown in Fig. 8. The add book icon is used to add new book to the XL Macro database used in automated library system using robotic arm. Whenever we want to add new book to the database as shown in Fig. 9, the name of the book that is adding should be written in the comport and then press the add icon as shown in Figure. The reset icon is used to reset the visual basic window.

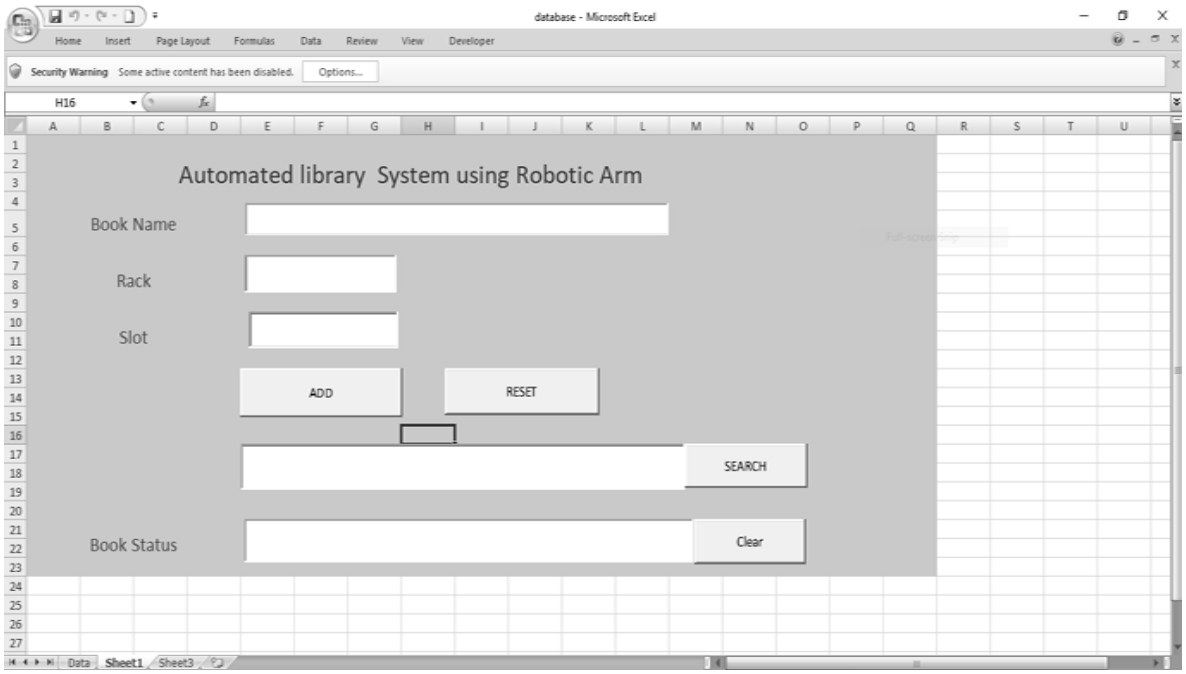

Fig. 6 Visual basic window of the automated library system using robotic arm

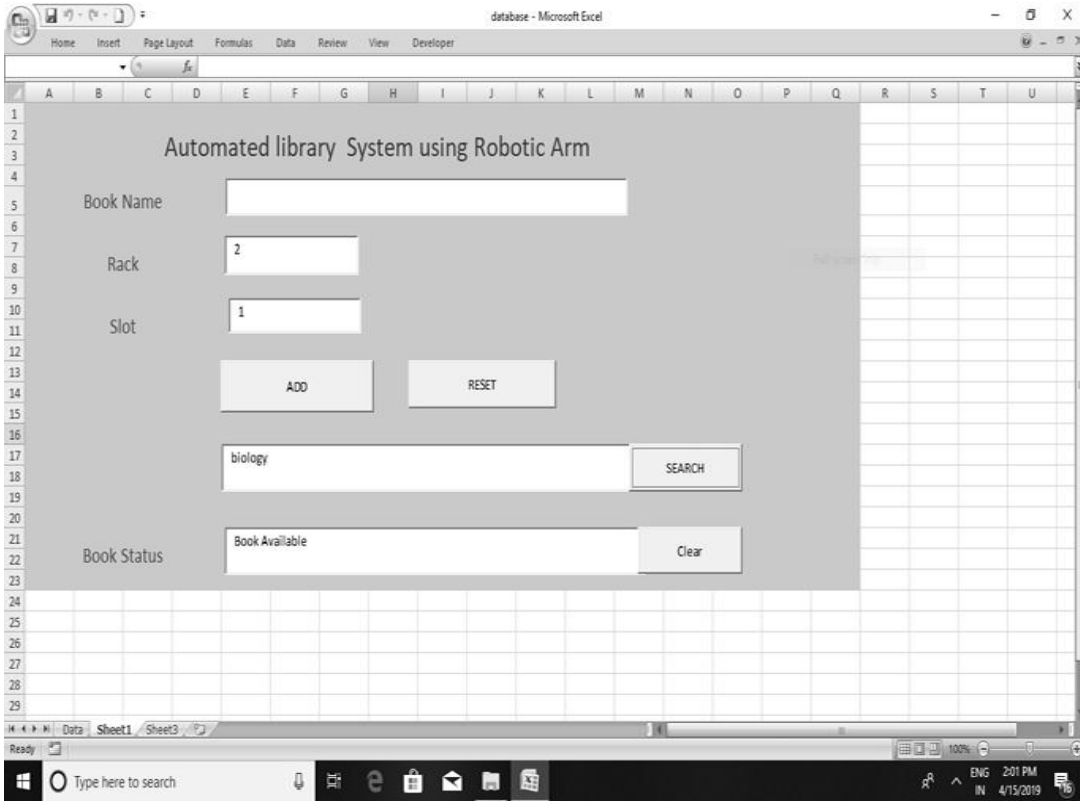

Figure: - 7. The book selected is available in the rack

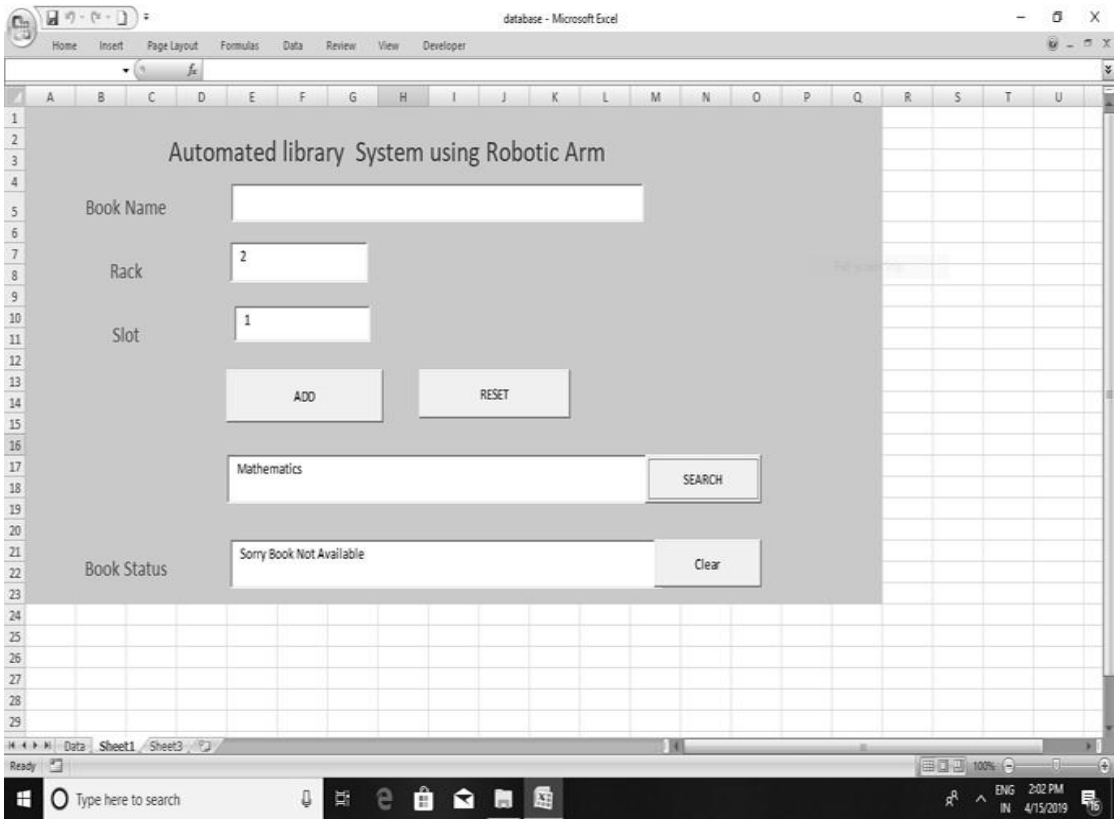

Figure: - 8 The book selected is not available in the rack

	A	B	C	D
1	Serial No.	Book Name	Rack No.	Slot No.
2	1	Microelectronics	1	1
3	2	Network Analysis	1	2
4	3	Signals and Systems	1	3
5	4	Power Electronics	1	4
6	5	Antenna and propagation	2	1
7	6	Wireless Communication	2	2
8	7	Embedded System	2	3
9	8	Digital Signal Processing	2	4

Figure:-9. Database to display the book numbers

CONCLUSION

The main objective was to overcome the problem of searching the books in the library and provide automation in a user friendly manner. The robot with an arm is designed which can search the required book, pick the book from the rack and deliver the book to the issue counter. It can also place the book in its designated slot once the book is returned by the borrower. The hardware and software required for automated library system using robotic arm has been designed and tested successfully.

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