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Design and Fabrication of Library Management Robot

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ABSTRACT
The main objective of this project is to design a robot that handles library services effectively, develop a smart system to maintain a library using controller based system, reduce the load and the time consumption of human services, and ease and simplify the job of monitoring the library services and saving expenses by reducing human dependency. The robot performs multipurpose services and assistance for library users. It brings and returns books for students and records database. The robot interacts between students and library system.
Keywords: *Monitoring, Multipurpose services, Reducing human effort, Database.*

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I. INTRODUCTION

1.1.1 1.1 Project Definition

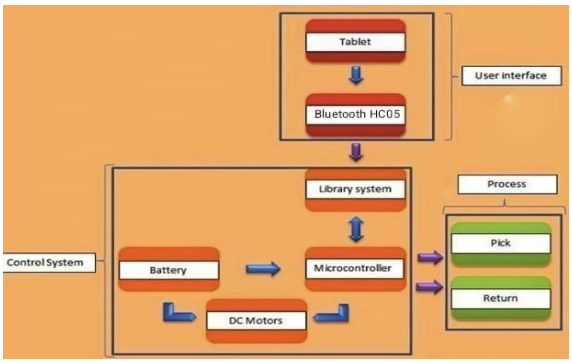
The goal of our project (An Autonomous Mobile Robotic Library System) is to design a smart human-robot interface, which will perform multipurpose services and assistance for library users; mainly bringing and returning books for students and other related services. The robot interacts between students and library systems.

1.1.2 LITERATURE REVIEW

Microcontroller based Robotic arm development for library management system .
Other people in different universities have done some previous similar projects. This definitely highlights the importance of having an autonomous robot within a workspace. For instance, the Department of Electrical Engineering Meghnad Saha Institute of Technology, Kolkata, India published an article concerning an autonomous robot, which could pick books and return books in different shelves within a library .

1.1.3 1.2 Project Objectives

- Design a robot that handles library services effectively.
- Develop a smart system to maintain a library using controller-based systems.
- Reduce the load and the time consumption of human services.
- Ease and simplify the job of monitoring the library services.
- Saving expenses by reducing human depend on the project architecture block diagraam



1.1.4 1.3 Project Specifications

- Controlling and monitoring book lending requests.
- Lifting capability of reaching 1.5 meters high shelves.
- Handling library books autonomously.
- Smart robotic detection of obstacles and shelves.

1.1.5 1.5 Applications

- This autonomous robot can be used in warehouse like what Amazon did.
- It can be used as a waiter for restaurant.

II. COMPONENTS OF ROBOT

To achieve the objectives set, LMR is designed to have 2 Degree of freedom. The arm consists of two degree of freedoms viz.
(i) For translating the X arm. (ii) For translating the Y arm.

CHASIS
The chassis for this robot is made up of mild steel sheet of 2 mm thickness. The sheet is bent into angles to provide strength.

A **caster** (or **castor**) is a free to rotate, single, double, or compound wheel that is designed to be mounted to the bottom of a larger object (the "vehicle") so as to enable that object to be easily moved. They are available in various sizes, and are commonly made of rubber, plastic, nylon, aluminum, or stainless steel. The caster wheels used in this robot are made aluminum with a total height of 15mm.

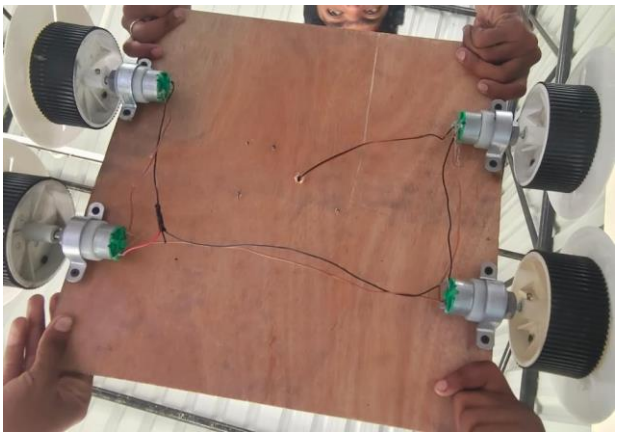


Fig .2

Fig 3. Pipe Dimensions

Fig 4. Square pipe

3) Vertical support square shaft
The vertical rod is made up of square section pipe of length 48''. Weight/ Linear foot: 0.27750781 Kg. This material meets the following specs: ASTM A554 [3].

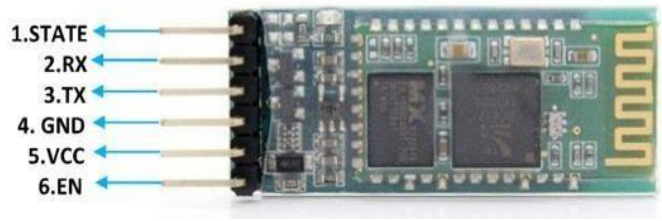
4) Battery
The battery is used here is a 12V & 7mah dry lead-acid battery. It find its applicationsin UPS system. 12V 7Ah batteries are very popular deep cycle and general-purpose batteries, commonly used for powering medical equipment, security systems, UPS and other emergency systems, toys, scooters, fish finders, etc. For a long time, 12V 7Ah batteries were built only as Sealed Lead Acid (SLA) batteries.

However, one type of motor has to be used. Thus, through our research, we decided that the DC motors are much suitable to our project compared to the others. The reason is that: DC motor has continuous displacement while stepper motor's motion has an angle incremental and servomotors are not continuous. Indeed, as our power supply is a battery then AC motor is not needed.

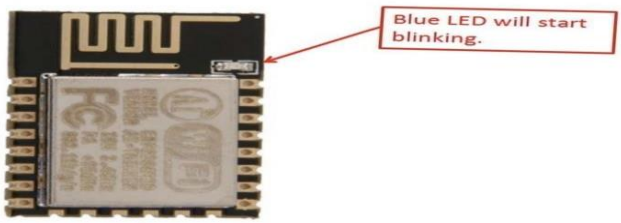
Fig 5. Battery used

Specifications:
Capacity :1.2Ah
Nominal voltage:12V
Terminal Type :T1
Cells per unit :6V
Voltage per unit:12V
Max.Discharge current:18A(5sec)
Max. Charging current Limit : 0.36A
Float charge voltage : 13.5DC to 15.0VDC/unit
Internal resistance : 125mOhm

5) Bluetooth HC05



The HCO5 Bluetooth module can be used in a master or slave configuration, make it a greate solution for wireless communication. you can used it simply for a seriel port replacement to established connection between mcu and gps, pc to your embedded project . The HCO5 BLUETOOTH MODULE AS 6 pins vcc, gnd , tx,rx,key and led. It comes pre-programmed as a slave, so there is no need to connect the key pin, unless you need it change it to master mode.



Whenever our device is connected to this Bluetooth then the blinking of LED light will stop. That's the main signal is our device is connected or not to the LMR

PLASTIC RACK
The plastic rack used in this robot is of dimensions 22.86 cm X 1cm X 1cm (L X B X H). The module of the rack being 0.8.

Fig 7. Plastic Rack

(b)

Fig 8. (a) Bevel Gear Dimensions. (b) Bevel Gears Used.

CARTESIAN BOX A) MECHANICAL COMPONENTS

1. X-Rod

It is used to provide a linear motion to the gripper. It provides a travel of 6cm which will enable the gripper to carry and place two books in one cycle.

2. Y-Rod

It is used to provide a linear travel of 15cm to the gripper. It will allow the gripper to go inside the shelf and come back.

3. Gripper

It consists of two moving members which come in contact with the book to pick it. It consists of a worm and two pinions to tighten and loosen the grip. When the motor turns clockwise, the gripper opens and vise-versa.

Fig 9. Worm and Worm gripper

4. Servo Motors

The servo circuitry is built right inside the motor unit and has a position able shaft, which usually is fitted with a gear (as shown below). The motor is controlled with an electric signal which determines the amount of movement of the shaft.

Fig 10. MG946R Servo Motor

5. wheels

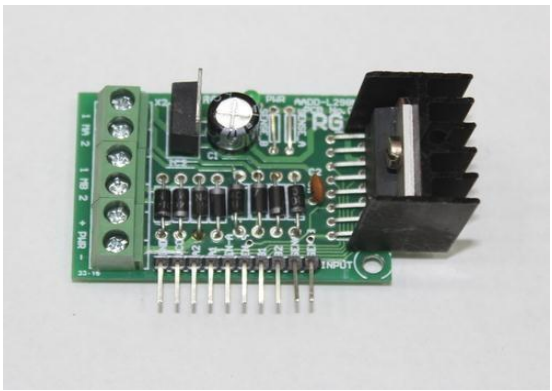
Plastic wheels with metal base are used to support various links and arms which move from one place to another.

Fig 11. Plastic wheels

DC MOTORS

Two high torque DC motors of 150 rpm has been used in this robot. DC motors include two key components: a stator and an armature. The stator is the stationary part of a motor, while the armature rotates. In a DC motor, the stator provides a rotating magnetic field that drives the armature to rotate.

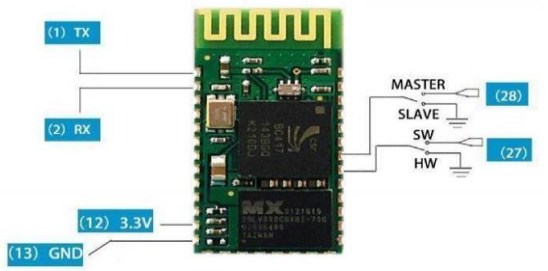
Fig 12. DC Motor (High Torque)



1.2 MOTOR DRIVER L298N

The control box is the heart and brain of an actuator solution. It translates the signals from the control unit into perfectly controlled movement and adjustment of the actuators and the motors. The control box also links the various accessories connected to the system. It controls all the electrical components fitted in the robot. It encapsulates microcontroller as well as all the connections to each component.

Motor channels: 5
Maximum operating voltage: 46 V
Peak output current per channel: 2 A
Minimum logic voltage: 4.5 V Maximum logic voltagae
:
This module comes with a built in USB connector and a rich assortment of pin-outs. With a micro USB cable, you can connect NodeMCU devkit to your laptop and flash it without any trouble, just like Arduino. It is also immediately breadboard friendly



B. Performance Evaluation:

The robot is capable of picking two books from the counter and placing them to the required shelves. The gripper can lift one book precisely to it's position. Also the robot could navigate itself towards the destination shelf and thus automatically places the book by reading it's radio frequency identity. It can carry two books at a time and can place one book at a time. Such robots in sufficient numbers can alleviate the work of placing books in robots.

CONCLUSION

In this project the proposed system give the result of find thebook, Misplacing of the books can be identified easily. It reduces the manual work. With the proposed architecture, if constructed with at most accuracy, the robot will pick the book. It will act as a basic platform for the generation of more such devices for the book picking. This helps and simplifies the job of monitoring the arrangement of books and also reduces the manual routine. As development in Robotics is growing fast, we can make robot more autonomous and sophisticated .Also we can develop this system with real time camera implementation.

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