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Automatic Library Book Picker

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Abstract - Automatic Library Book Picker is an ambitious project that aims at digitizing and automating libraries by incorporating the power of robotics, automation, and IoT technologies. This project also aims to promote a new age of technology to innovate the age-old invention of libraries.

A NodeMCU serves as the core control unit for this automated library book picker, utilizing its built-in WiFi connectivity and Arduino compatibility to provide smooth control and communication. It uses pulse width modulated (PWM) signals to send information to other components. The four wheels are controlled by L298N motor drivers, which allow the robot to move in the library. Furthermore, the system incorporates a 60 RPM side-shaft DC motor to enable arm lifting operations, and a servo motor governs the functioning of a robotic gripper mechanism necessary for book manipulation.

Thus, by converging these components, technologies, and advanced control algorithms, the automatic library book picker performs tasks such as retrieving books from the shelves with minimal human effort, providing security to the books in the library by reducing human contact, and also improving the user experience.

***Key Words*:** NodeMCU, L298N motor driver, Servo motor, Battery, DC Motor, Side Shaft DC Motor, PWM signals.

1.INTRODUCTION

For centuries, libraries have been the knowledge house for many individuals across the world. They not only provide knowledge but also protect and preserve the books for future generations. Some of the earlier works to digitize this field include using RFID technology to place the books in the shelves and thereby reduce the efforts of the librarians [2,3,4,5]. M .Z.A Rashid et. al. [6] proposed a Sorting and Retrieval Robotic System Controlled via Programmable Logic Controller for Library Usage. Ester Martinez-martin et. al. M. Elango et. al. [8] developed an Aerial Librarian Robot. Ramos-Garijo R et. al. [9] proposed a library assistant robot based on optical color recognition. These robots are instructed to get and place the books on the shelves by giving the input an app [1].

The automatic library book picker is designed to get the book from the required position based on the place number. Thus, it picks any book placed in the respective place number. It moves on the track arranged to pick up the book that is instructed. The system receives the instruction to pick up the book from the app with the help of a NodeMCU built-in wifi system. After receiving the instruction, the NodeMCU acts as the brain for the entire system by instructing, controlling, and sending information in the form of pulse width modulated (PWM) signals to complete the task initiated. The NodeMCU receives the command from the app and then instructs other components, such as the L298N motor drivers and the servo motor, to travel the distance and to pick up the book and bring it with the help of the complex code developed and installed in it. Thus, the automatic library book picker can digitalize the existing libraries, provide security to the books by reducing human contact, and improve the user experience by reducing their time in finding the book.

2. Design of Automatic Library Book Picker

The design of an automatic library book picker involves taking a wooden plank and fitting four DC motors with an operating voltage of 12 volts at its bottom, and wheels are attached to each of the DC motors. On the top of the wooden plank, the following components are fixed: firstly, a NodeMCU which uses ESP8266 microcontroller chip, which has an input voltage of 5 volts, a power consumption of 600 mA, an operating speed of 80 MHz clock speed, and a 4 MB flash memory. Secondly a side shaft DC motor of 60 rpm, an operating voltage of 12 volts, a torque of 5 kgf/cm, and can handle a load current of 300 mA. Thirdly, the two L298N motor drivers operate at a voltage varying from 5V to 35V, with a maximum power consumption of 20W, and can handle a peak current of up to 2A. To the side shaft DC motor, a worm gear is connected, and the arm is attached to the worm gear with the help of a worm wheel, and to this arm the gripper is fixed. To this gripper, a servo motor with a torque of 1.6 kgf-cm, an operating voltage of 4.8 volts, a current consumption of 550 mA, and a speed of 0.20 sec\60 degree is attached to control the gripper movement. Lastly, a 12-volt, 1.3-ampere-hour battery is installed as the power source for the entire system and a switch to turn on and off the system.

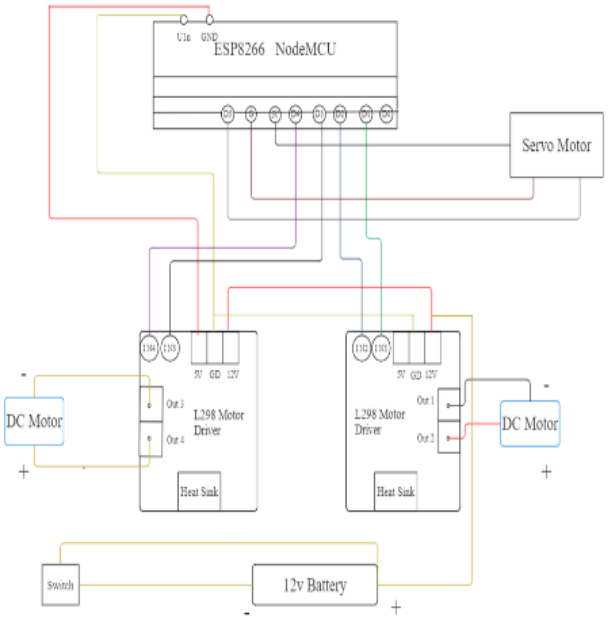

Fig -1: Circuit Diagram

2.1 Methodology

The automatic library book picker begins by switching on the power source, and then this power is transmitted to the entire system. When the place number is entered in the app, it sends this information to the NodeMCU through its inbuilt wifi connectivity. The NodeMCU does the decision-making tasks by sending instructions in the form of pulse width modulated signals to various components, like the two L298N motor drivers and the servo motor. After receiving the specific instructions from NodeMCU, the right-side-placed L298N motor driver controls the speed and direction of the wheels by controlling the DC motors attached to them. The left-side placed L298N motor driver controls the worm gear and thereby the arm movement by controlling the 5 kg, 60 RPM side-shaft DC motor to which the worm gear is attached. After getting the instructions from the NodeMCU the servo motor controls the gripper to grip and lose the book. In this way, the required book is picked.

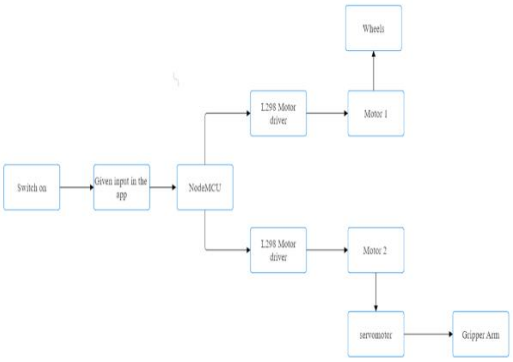

Fig -2: Automatic Library Book Picker Block Diagram

2.2 Experimentation Result and Discussion

The experimentation begins by switching on the system. Then the place number is entered in the app, and the NodeMCU receives the command and sends the instructions to the respective components. The system started moving to pick up the book; it reached the required position and stopped. Then the arm begins to move downward, and the gripper picks up the book. After grabbing the book, the arm raises to its original position. The system moves backwards to the starting position, and now the gripper releases the book. Thus, the book is acquired by using the automated library book picker. The above process is repeated again to get the other book placed at another place number.

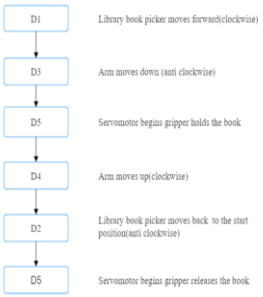

Fig -3: Flow Process of Automatic Library Book Picker

2.2.1 Calculation

To calculate the weight lifting capacity:
Firstly use the Torque (T) = Force (F) *distance from axis of rotation to force applied (r).
From the above equation the force is obtained. Now to calculate the mass (m)
Force (F) = Mass (m) * Acceleration (a) where [a = 9.81m/sec^2]

3. CONCLUSIONS

In this paper, an automatic library book picker is developed whose purpose is to pick the book placed on a certain place number. NodeMCU after taking commands from the app with the help of built-in wifi connectivity, instructs the tasks with the help of pulse width modulated signals to different components, such as the L298N motor driver to control the DC motor and the servo motor to control the gripper action to pick and release the book. Though the developed model is a prototype , it can be extended to develop a final product by adjusting the component's capacity to handle much more weight and speed. The limitation could be its performance decreases with the decrease in voltage. Thus, the developed automatic library book picker that automates the libraries, provides security to the books, and also improves the user experience by reducing the time spent in searching for the book.

3.1 FUTURE SCOPE

The future scope of this project could be extended to developing another code to handle placing the book at the place we want by just placing that place number. To achieve this, one more NodeMCU is to be placed. Also to improve the movement of the system by not only moving forward or backward but also to turn another motor driver is to be fixed to handle the turning of the wheels. A camera can be incorporated for visualizing purposes in longer alleys.

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