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DEVELOPMENT OF VOICE CONTROLLED AUTOMATIC PAGE TURNING SYSTEM

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Abstract

Reading books, magazines, or any other printed material is an inevitable part of our day to day lives. It may form a part of one's hobby, work or leisure to flip through the pages of some material one has to read. Turning the pages of the book might be such a simple task for almost every one of us, that it is never given a thought. But still there are a few people among us who are devoid of such an obvious blessing, to be able to turn the pages on their own. So, for them this might seem to be a task very hard to come by. Therefore, in such a situation, an automatic page turning system could step into the scene and prove to be very beneficial. If a system is able to automatically turn the pages for such avid readers, simply as per their voice command and requirement, then it could be termed as a much needed revolution in this field. This system is based on simple and relatively cheap electronic components such as the Arduino board (UNO version), a Bluetooth module and mechanical components like the Servo motors. Hence, the desire for reading and learning, of such individuals can thereby remain unbounded and unconstrained with the support of this system. An issue that this system addresses is a need for a portable, inexpensive page-turning system that benefits people with limited motor movement and enables them to read bound material.

Keywords: - *Arduino board (UNO version), Bluetooth module and Servo motor.*

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1. INTRODUCTION

Having a closer look at the mechanism through which the operator reads the desired printed material and flips through the pages, gives us an idea of the essential forces involved in making the pages turn, which are:

1.The force of friction that acts when the reader slides one page over the next in order to give it a vertical elevation , so that it can be turned to the other side, as shown in figure 1. This force is represented by F1 here.

Fig 1: Frictional Force F1

2. The force that pushes the lifted page to the other side of the book, enabling the reader to view the next page, as shown in figure 2. This force is represented by F2 here.

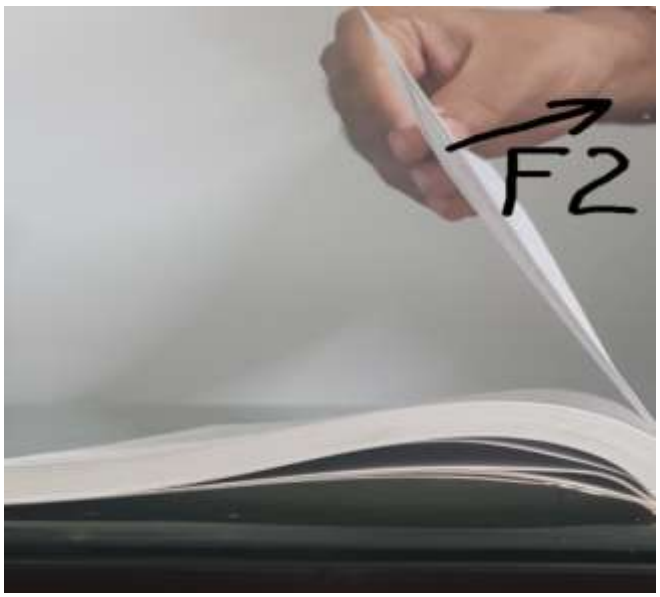

Fig 2: Pushing force F2

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Influenced by this principle, the design of the system is based. The mechanism of working stands upon the combined and well – timed effect of these forces enabling the user to turn the pages effectively.

A small wheel, rotated by an electric servo motor makes the current page slide over the next page.

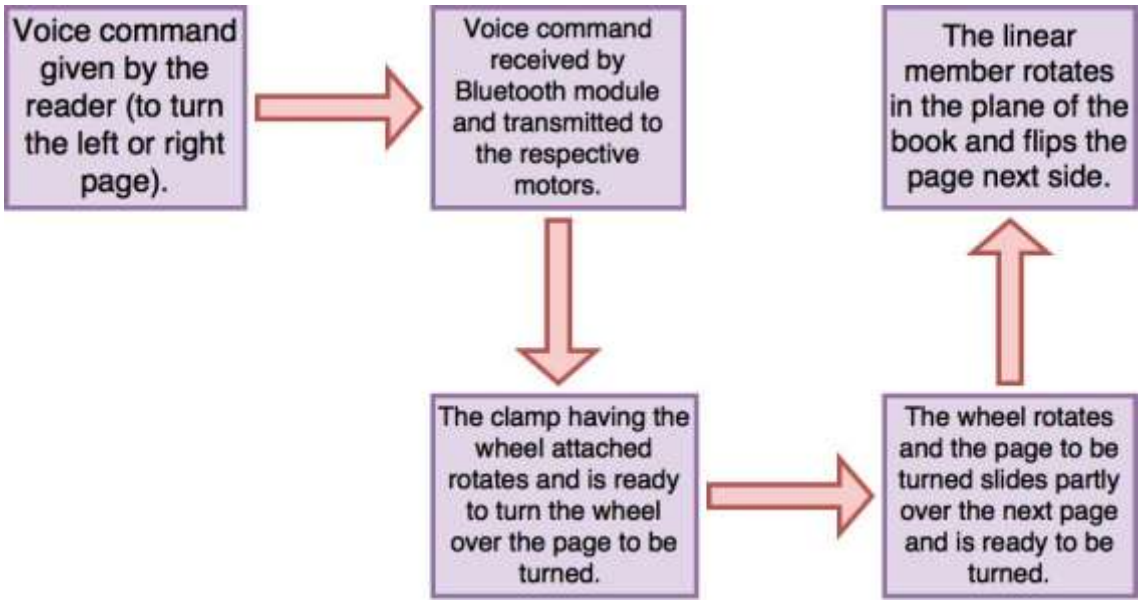

Fig 3: Block Diagram of the page turning system.

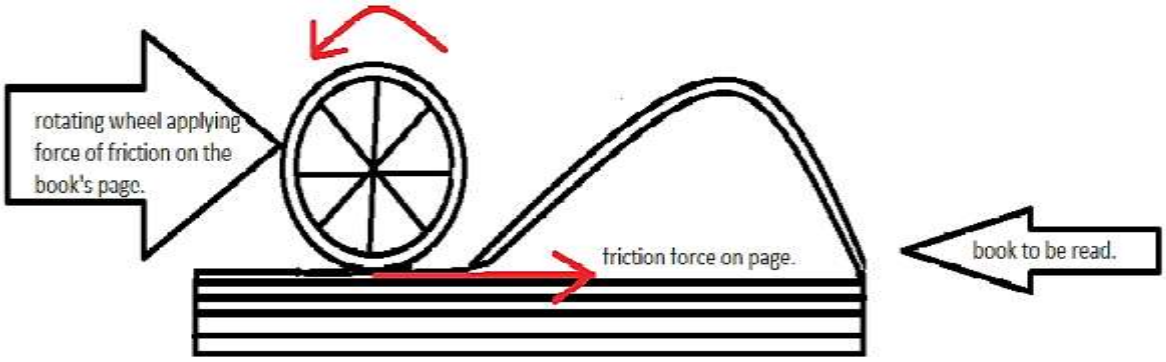

Fig 4: Actions taking place

The page once lifted by the rotating wheel can then be turned by a light linear part which rotates in the plane of the book by the help of another servo motor.

2. WORKING METHODOLOGY

The working sequence of the system can be explained by the following steps:

Step 1

The reader gives the voice command to turn the left or right page of the book by speaking the words 'left' or 'right' respectively to the microphone present in the reader's Smartphone which is in turn connected aerially with Bluetooth module. This message is received by a built in application present in the mobile phone.

Step 2

The mobile phone applications receives the voice input and sends the appropriate command to the mobile phone transmitter which is connection with the Bluetooth module which is further connected to the Arduino UNO board.

Step 3

The Bluetooth module receives the command from mobile phone and in turn transfers this information to the Arduino UNO board.

Step 4

The Microprocessor present in the Arduino UNO board processes the information received from the Bluetooth module and further generates signals and passes them on to the required servo motors.

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Step 5

The servo motors after receiving the signals rotate as per the programming code and coherently work together to the page.

The final working setup with all the actual components in their place, as is seen by us is shown in figure 5.

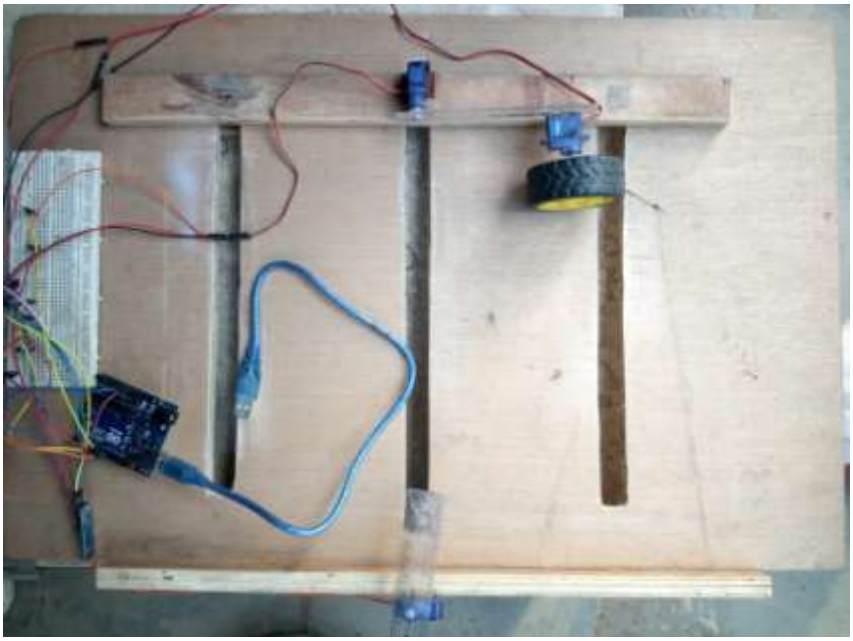

Fig 5: Final Assembled System

2.1 Working Code of the System

```
#include <SoftwareSerial.h>
#include <Servo.h> // servo library
Servo myservo; // servo name
Servo myservo1;
Servo myservo2;
#define zero 0;
int data;                //Variable for storing received data
int pos = 0;
int pos1 = 0;
int pos2 = 0;
void setup()
{
  myservo.attach(9); // attach servo signal wire to pin 9
  //Setup usb serial connection to computer
  myservo1.attach(8);
  Serial.begin(9600);
  myservo2.attach(10);
  //Serial.begin(9600);         //Sets the data rate in bits per second (baud) for serial data transmission

}
void loop()
{ myservo2.write(180);
  if(Serial.available() > 0)  // Send data only when you receive data:
  {
    data = Serial.read();      //Read the incoming data and store it into variable data
    Serial.print(data);        //Print Value inside data in Serial monitor
    if(data == 48){
       for (pos = 0; pos <= 180; pos += 1) {
          myservo.write(pos);}
```

Fig 6: Arduino Coding

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If you wish to have a detailed look of the full Arduino code, click on the Google drive link given below!
https://drive.google.com/file/d/1jlCvXCTcunFz_QJBIRM5F7xN5gtCAIhh/view?usp=sharing

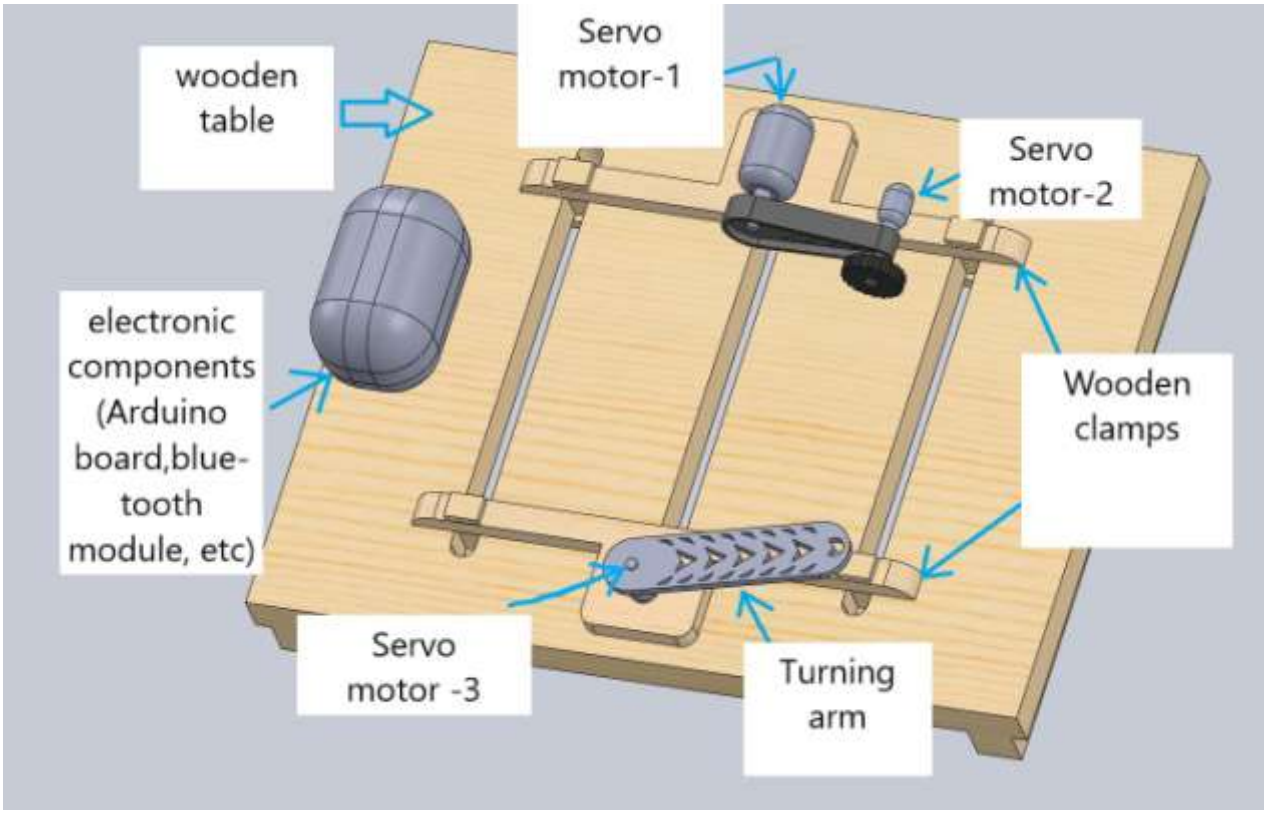

Fig 7: 3-DCADModelofthepresentwork

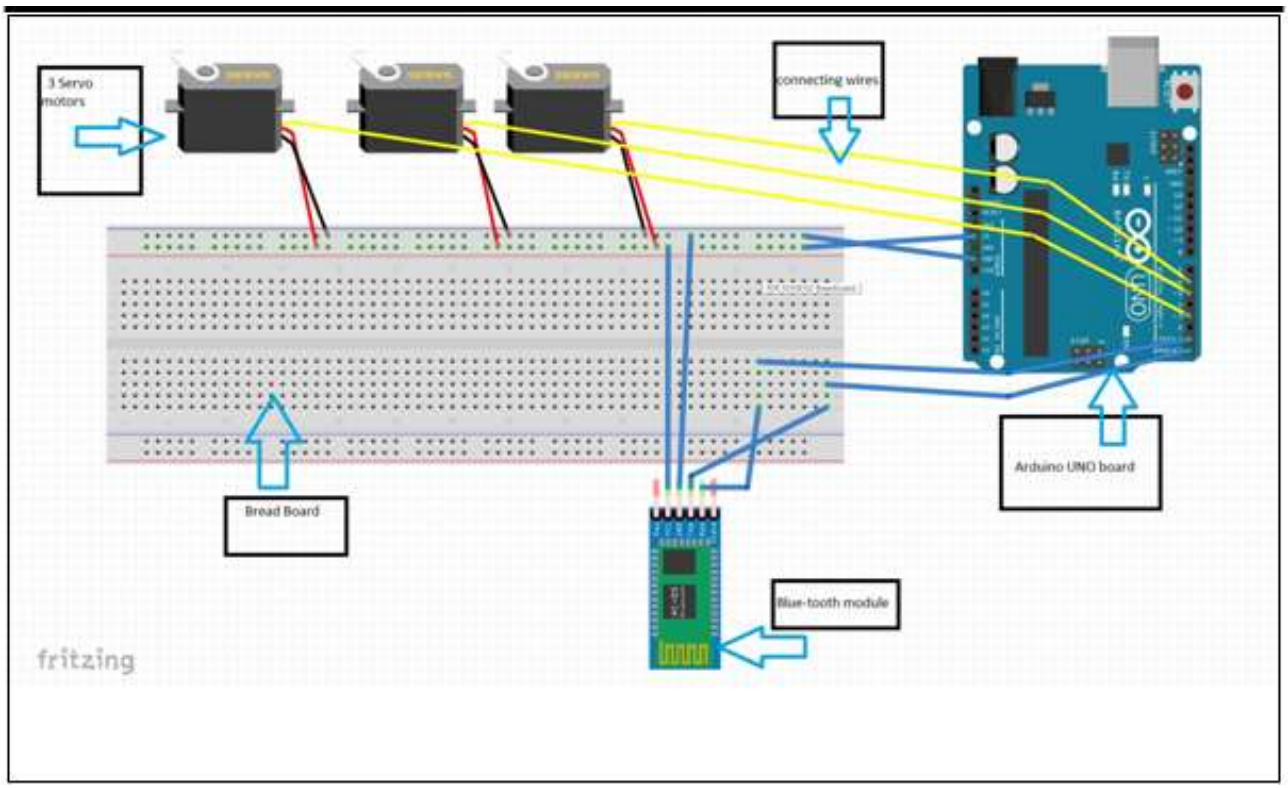

Fig 8: Electronic System of the Page turner.

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3. SIZING & DIMENSIONS

Determination of Minimum Torque required for the Servo Motor to Drive the Wheel

Suppose the rotating wheel assembly is pressed onto the page to be turned with a force of 'N' Newtons. And let the coefficient of friction between the surfaces of the current and the next page be 'μ'. Therefore the friction force,'f', acting between these two pages will be given as:

$$f= \mu*N;$$

The length of the page be 'L' centimeters.

Suppose the page to be lifted must rise vertically such that it is slid by the rotating tire over the next page by a length of 'x' centimeter.

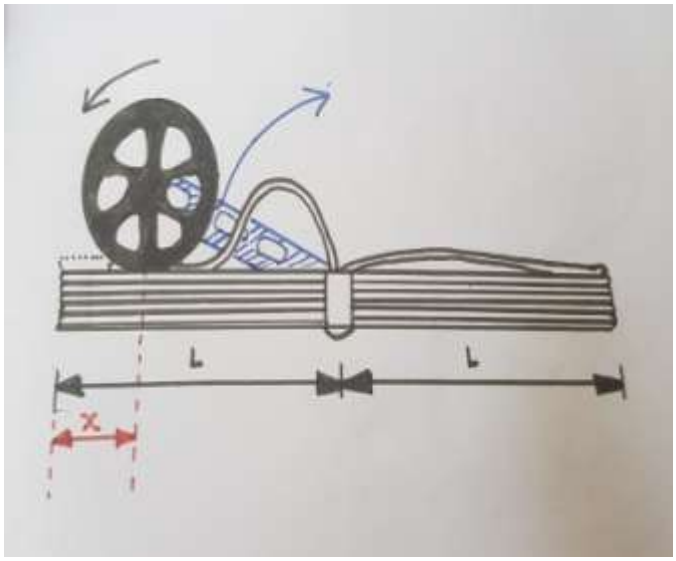

Fig 9: Diagram of the Page Turner.

On an average, a books width which is 'L' can be taken as 20 cm. And suppose 'x' and 'L' be related by:

$$x=L/3;$$

Therefore the work done, 'W', to slide the current page over the next page to slide it through 'x' cm will be given as-

$$W= \mu*N*x;$$

On the other hand, the work done by the servo motor, 'w', to rotate the tire through an angle of 180 degrees or π radians is given as:

$$w=\tau*\pi;$$

Where 'τ' is the torque of the motor.

By conservation of energy these two works will be equal. So on equating the two work done, we get,

$$\mu*N*x = \tau*\pi;$$

Therefore the minimum required torque of the motor is given by:

$$\tau= \mu*N*x/ \pi;$$

On substituting the values: μ=0.1745

N= 0.3g x=20/3=66.7mm.

We get the value of minimum required torque of the

Servo motor = 10.903 N-mm.

Minimum torque required for the Servo Motor rotating the entire motor Assembly.

Let W1 be the weight of the combined motor and tire assembly. And W2 be the weight of the supporting arm. The perpendicular distances between the line of action of W1 and W2 are L1 and L2 respectively. Therefore the maximum torque that must be provided by the servo motor to rotate the assembly is given by:

On substituting the values as - W1=0.1g, W2=0.05g; L1=10 cm, L2=5 cm;

The value of torque comes out to be, τ= 122.625 N-mm.

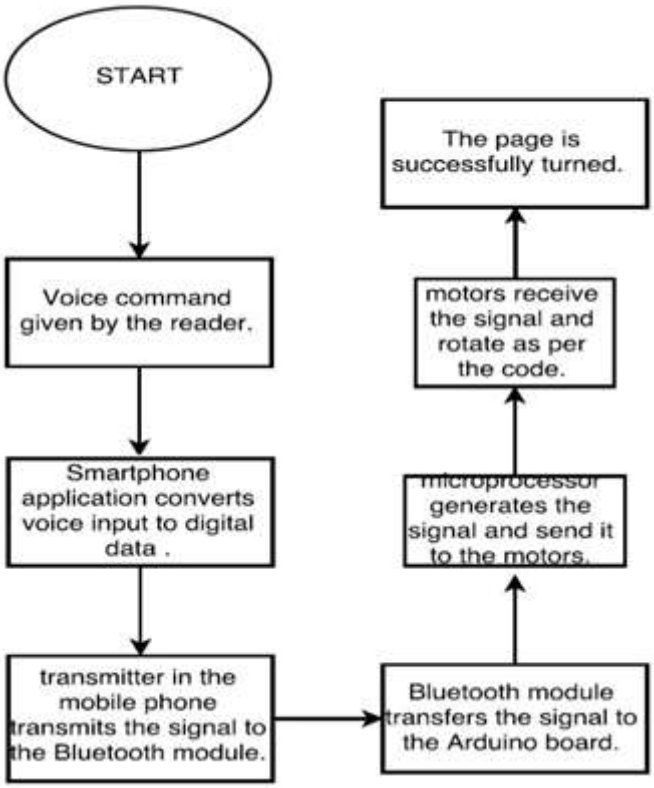

Fig 10: Stepwise Operation of the system

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4. CONCLUSION

The present setup was tested for the job intended, and was found to be working satisfactorily. The work on this project is expected to serve a purpose for the society. A lot of people, with impaired motor activity, have to give up education just because it becomes difficult for them to cope up with the struggles they have to face due to their discomfort.

Developing a system which enables them to regain access to reading and eliminates the hurdles in their education and career because of these physical constraints, it can be some pay off to the huge debt of the society.

Application of technology for overcoming and eradicating the social issues faced by our society, is the best possible utilization.

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