

Design and Development of Automatic Book Scanning Machine

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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 1.1. This force is represented by F_1 here.

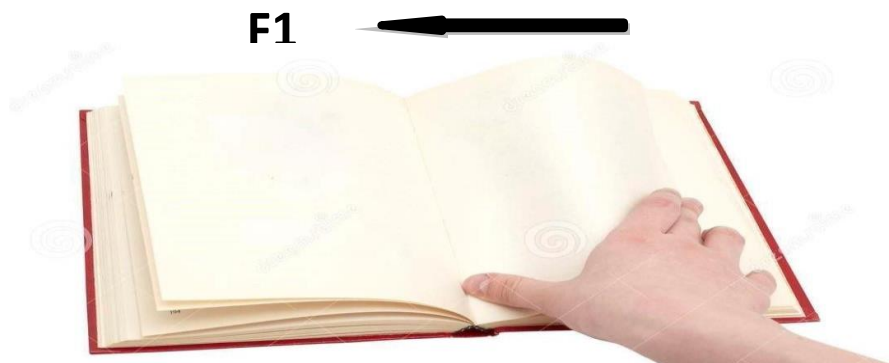


Fig 1.1: Frictional Force F_1

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 1.2. This force is represented by F_2 here.



Fig 1.2: Pushing force F2

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.

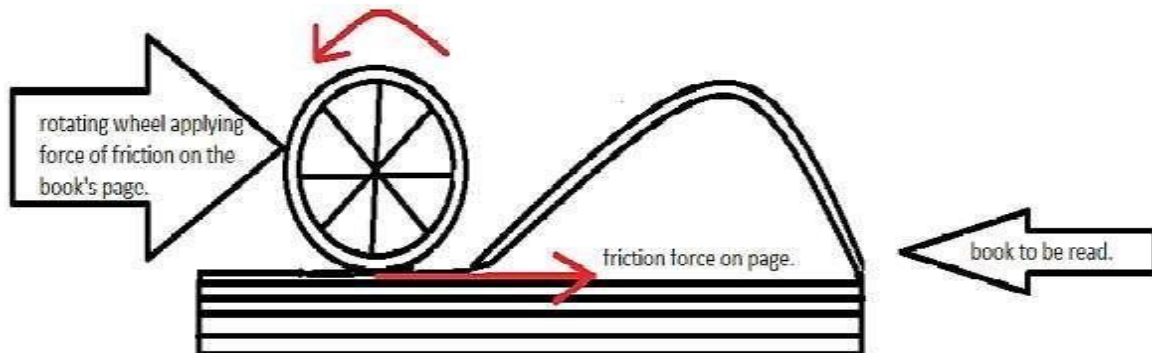


Fig 1.3: Actions taking place

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

A vital technology that made important growth under this situation, called Book Flipping Scanning, has been introduced. This is a new method of scanning books in which all pages of a book are captured while pages are continuously flipped automatically through the page turner without stopping at each page. Many systems introducing this concept are introduced and developed to reach the different requirements in different markets, a high-speed camera system and a portable system using a single camera. This project introduces a new book-page turner machine that provides three demands—high speed, accuracy, and automatic operation—so that an innovative high-speed book digitization technology based on Book Flipping Scanning. [1]

Project Objectives:

To design and develop an automatic scanning machine with the following features

- Automatic flipping of pages
- Automatic scanning of pages

Methodology:

Steps of 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 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

Step 5 : The servo motors after receiving the signals rotate as per the programming code and coherently work together to the page.

Step 6 : Apart the voice command through bluetooth module, the pages of book can even be flipped through left and right switches

Block Diagram:

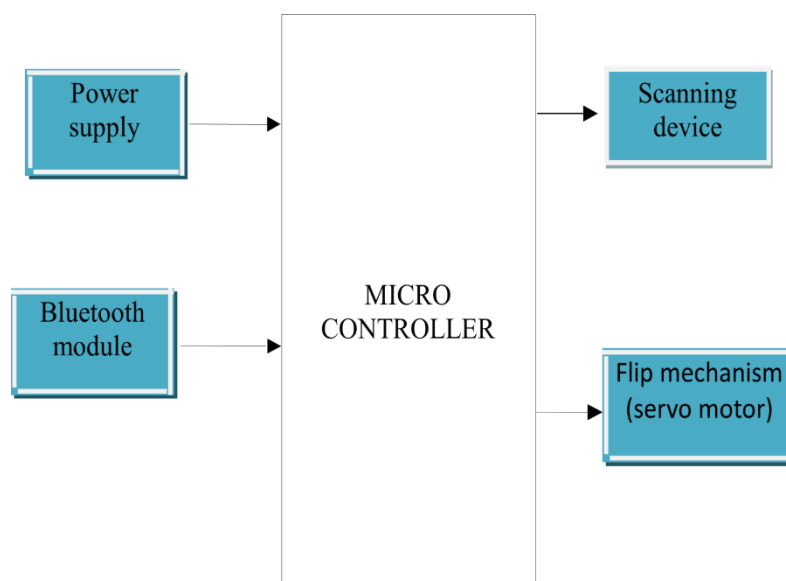


Fig 3.1: Block Diagram

- Bluetooth Module: It helps to flip pages automatically through voice command.
- Flip Mechanism: It help to flip the pages which consist of servo motors.
- Arduino UNO: Is a low-cost, flexible, and easy-to-use programmable open-source microcontroller board that can be integrated into a variety of electronic projects.
- Servo Motor: A servo motor is a rotary actuator that allows for precise control of angular position.

Hardware Components:

- Bluetooth Module
- Flip Mechanism
- Servomotor
- Arduino Uno
- Mobile Camera
- Wheels

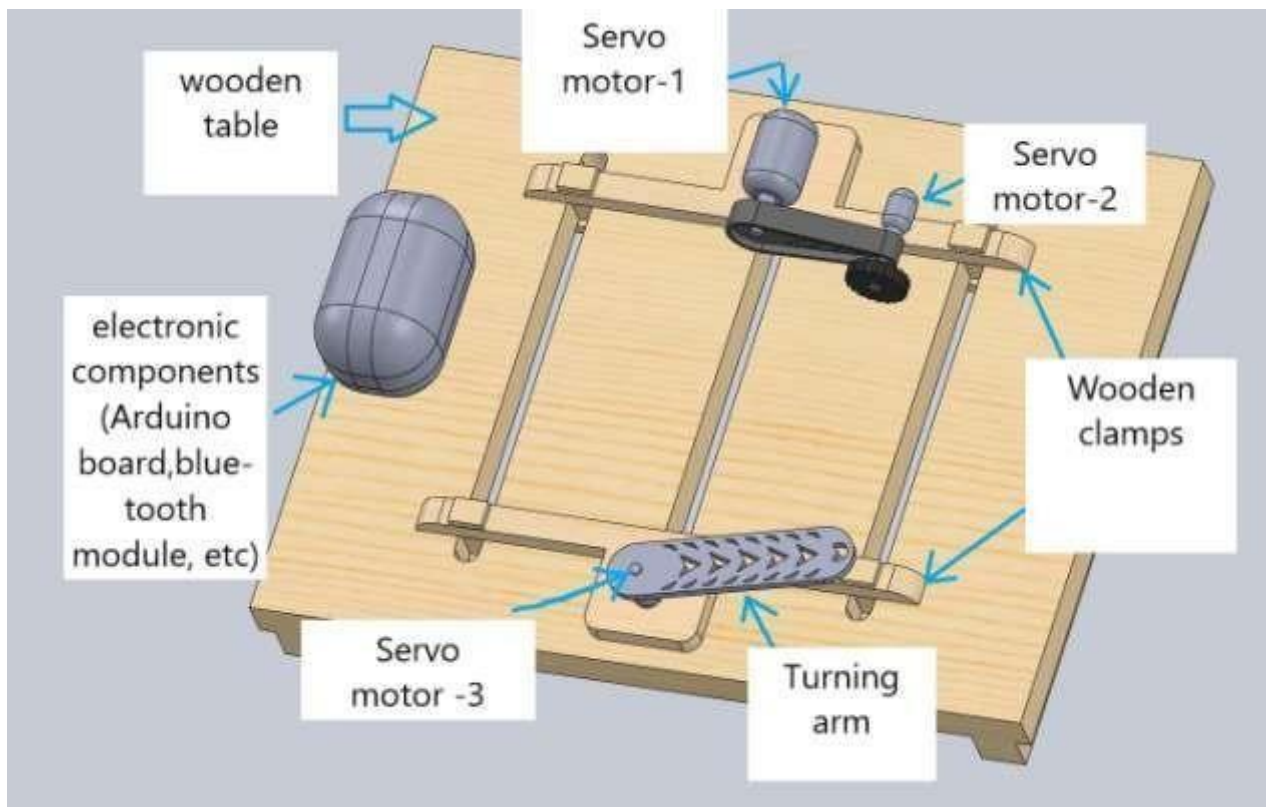


Fig 3.2: 3-D CAD Model of the present work

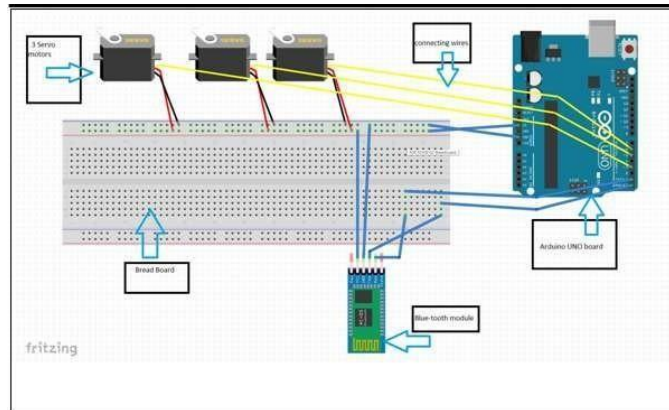


Fig 3.3: Electronic System of the Page turn

Protius simulation:

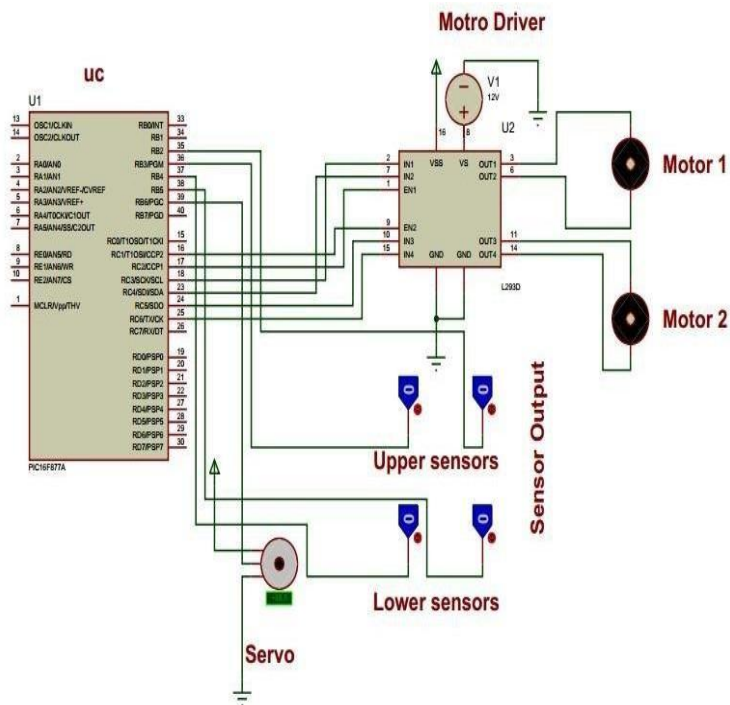
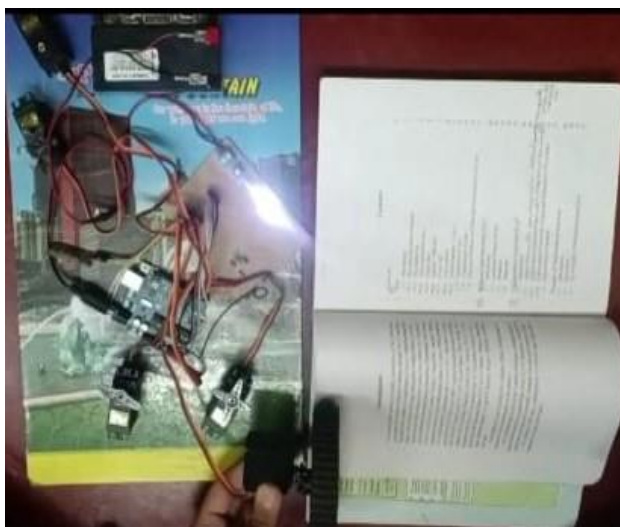
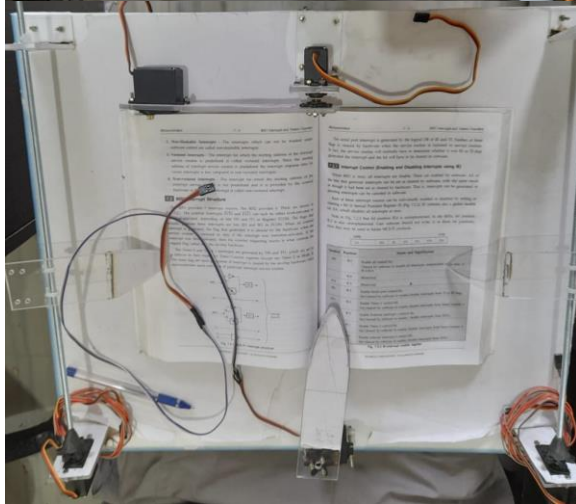
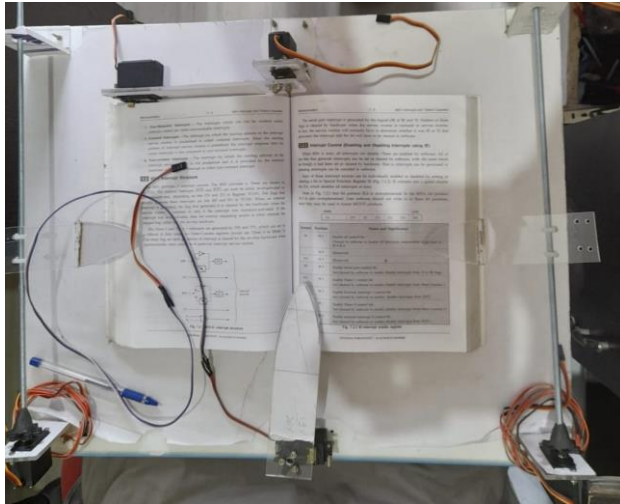


Fig.3.4 Simulation Model of Protius

Results and Conclusion:





Simulated Results:

- We expect to control through combined voice and switches commands.
- Capturing of images at a given time period.
- To be used for book scanning and page turning.

Conclusion:

Due to the orientation of the book lying flat, pages turn best for larger books with sturdy bindings. The camera successfully captures consistently illuminated pages, due to the camera limitations, the resolution could not be improved to the desired DPI. By using two cameras (one for each page) or obtaining a better camera would remedy this issue. During the scanning the natural error of skipping and tiring is negligible and through this auto-flipping technique all the physical documents or book can easily be converted into digital form.

The whole process is automated and the initial setup is needed. The working procedure of the book scanner is simplistic, and the hardware part can effortlessly be built from easily available elements. Given a paper book, the pages are sequentially scanned (pictures are taken and then are processed). Though our presented project has many places to improve on, it can serve its purpose as an book scanner in its current state. It is affordable and is specially designed for the use of people in low-income countries where book scanning technologies are still out of reach for the general people.

Scope for Future work

In future, the scanner would have additional features like

- The range of scanning, the number of pages that could be scan (as assigned by user),
- May have a built-in touch screen, by which the user can give the instructions.
- The image processing for the PDF conversion is done manually now, we plan on using the OpenCV library on python to make it automatic. Include improvements on the scanning speed and quality of the scanned images.