

Accessibility Book Scanner with Automatic Page Turner – A Review

Harshitha D K¹, Krathika², Libina Lal³, Ranjitha R⁴, Dr Veerapraphap V⁵ and Prof Sudhakar H M⁶

¹⁻⁶Electronics and Communication Engineering, Mangalore, India

Email: libinalal16@gmail.com, {harshithadk5, krathikakulal96, ranjitharao360}@gmail.com

Abstract— The use of high-speed, accessibility book scanner with automatic page turner aiming to improve the speed of digitizing books that is currently slowed down by manual page turning. The machine operates contactless, ten times faster than conventional methods and uses "book flipping scanning" to scan large stacks of paper while the user flips pages. The key point is how the system can decrease the user's workload when scanning document information on many pages. This low-cost device aims to provide assistive technology for individuals with disabilities, enabling them to turn and hold pages independently using a mechanical structure. The technical challenge is to realize an easy-to-use, simple, and high-speed scanning system.

Index Terms— High-speed book scanner, Accessibility technology, Automatic page turner, Book flipping scanning, Assistive technology for disabilities, Contactless scanning system

I. INTRODUCTION

The combination of an Accessibility Book Scanner with an Automatic Page Turner represents a powerful integration that enhances both accessibility and efficiency in digitizing books. This innovative technology employs features such as adaptive user interfaces facilitated by the Internet of Things (IoT). Real time data collection and analytics ensure optimal performance and provide insights for continuous improvement. The automatic page turner streamlines the digitization process, making it faster and more user-friendly. This synergy of accessibility-focused design and automation not only caters to diverse user needs but also transforms traditional book digitization into a seamless, inclusive, and efficient experience. While existing book scanning devices often fall short in handling page-turning intricacies and the diverse shapes of books, our initiative introduces an innovative mechanical module. This component seamlessly integrates the functions of an automatic scanner and a page turner, addressing the challenges encountered by traditional book scanning devices. In essence, our project serves as a conduit between state-of-the-art technology and the pragmatic needs of individuals, presenting a seamless and user-friendly reading experience in diverse settings. Our primary focus extends to libraries and institutions, recognizing them as crucial spaces where books play a pivotal role. The project aims to optimize the scanning and accessibility of books, creating an efficient and straightforward process in these environments. While our vision encompasses universal access, our priority is enhancing the experience for individuals and ensuring that libraries and institutions, serving diverse needs, benefit from our innovative solution. Envisaging a world where technology facilitates universal access to knowledge, our project seeks to make reading and learning an effortless endeavor, especially in spaces where books are central to education and information dissemination.

II. LITERATURE SURVEY

Sushma et al. [1] This study evaluated the creation of an innovative automatic book scanning machine that employs friction and pushing forces to flip and scan pages. This is achieved through a mechanism involving a wheel, driven by an electric servo motor, and a light linear part within the book plane. User control is facilitated by voice commands and switches, utilizing a Bluetooth module for communication between a smartphone and an Arduino UNO board. Key hardware components include the Bluetooth module, servo motor-driven flip mechanism, Arduino UNO board, mobile camera, and wheels. The machine's primary function is the conversion of physical documents into digital format through automated page flipping and scanning.

Watanabe et al. [2] Presents an Automatic Page Turner Machine designed for high-speed book digitization, addressing the limitations of manual page turning. The machine achieves nearly 100% success in contactless page turning at a rate of around 300 pages per minute, promising to significantly improve the efficiency of book digitization. System evaluations demonstrate a 100% success rate with the proposed configuration, emphasizing its effectiveness. The machine performs consistently well with various paper qualities, exceeding 98% success in all tested cases. Future improvements include a sensor feedback mechanism for stable page turning and addressing friction issues with thin-papered books. Overall, the machine holds great promise for advancing high-speed and high-precision book digitization processes.

Deshmukh et al. [3] The importance of book scanning and digitization for better document accessibility, especially for valuable older materials. It introduces the Book Flipping Scanning method and a new high-speed, accurate book-page turner machine. Technologies like the Kirtas APT BookScan 1200 and a polydimethylsiloxane-based method for manipulating bound book pages are detailed. The document concludes by proposing the low manipulation machine as a cost-effective solution, highlighting the automatic page turner machine's capabilities, anticipating future cost-efficient digitization, and suggesting a more affordable prototype compared to existing machines in the market.

Nakashima et al. [4] Main objective of the Book Flipping Scanning method is an innovative approach for efficiently scanning large paper stacks through continuous page flipping. The system, utilizing a unique camera system for sensing 3D paper deformation and printed information, aims to reduce user workload and enable swift scanning. The prototype, incorporating a laser line projector and high-speed camera, effectively captures 3D page structure, correcting distortions and reconstructing original flat page images. Despite promising noise robustness and generality, future challenges include simplifying the mobile platform configuration and improving image quality by integrating multiple datasets. The authors underscore the method's efficiency and outline plans for further development.

Bano et al. [5] An automatic book scanner prototype designed for digitizing and preserving documents. Controlled by a Raspberry Pi, the scanner utilizes a robotic arm with suction power and a slider for page-turning, complemented by a mounted camera for image capture. The construction, methodology, and operation details, including a pneumatic cradle actuator, are succinctly presented. Notable features include the scanner's speed of 12 pages per minute and the ability to scan a 900-page book in approximately 60 minutes, with considerations regarding image resolution. The document concludes by highlighting limitations, proposing potential enhancements, and underscoring the scanner's efficacy in converting physical materials into digital formats.

Sharbati et al. [6] This study evaluates a Book Reader and Page Turner Robot powered by Raspberry Pi, targeting individuals with reading difficulties. The robot captures and converts book pages into speech, featuring an autonomous page-turning mechanism. Using Raspberry Pi as an interface, the system controls components like the camera, speaker, and motors. Hardware includes Raspberry Pi 4 model B, camera module, servo motors, DC motor, and H-bridge module. The proposal outlines system design, implementation, and testing, addressing identified issues and suggesting future enhancements, such as broader book compatibility and integration of artificial intelligence for an improved reading experience.

Nawshin et al. [7] Describes how an affordable automated book scanner and translator using Raspberry Pi, converting paper books into digital formats with features like language translation and audio book creation. The process involves an external webcam, Tesseract OCR, Google Translator API, and eSpeak TTS engine, automated with a page-turning mechanism. Emphasizing cost-effectiveness, the proposal addresses the need for accessible digitization in Bangladesh. The hardware includes a camera, page-turning mechanism, and Raspberry Pi. Comparative analysis underscores the proposed scanner's affordability and additional capabilities, suitable for low-income countries and benefiting the visually impaired. Future plans focus on improving scanning speed, audio quality, and PDF conversion.

Luthra et al. [8] The implantation of a low-cost automatic document scanning machine powered by Raspberry Pi and Tesseract OCR designed for converting printed content into a digital format, the machine offers affordability and flexibility, accommodating various page lengths and paper types through mechatronics principles. The literature review covers OCR techniques, while the proposed mechanical and image processing modules detail the Raspberry Pi-controlled pageturning mechanism and Tesseract OCR integration. Results highlight enhanced precision with an IR sensor, making the machine versatile for different applications. The document concludes that the machine successfully meets its objectives, with future improvements aimed at enhancing precision, recognition rates, and text positioning. In summary, it provides a comprehensive overview of an economical solution for digitizing printed material.

A et al. [9] This study investigates the design and creation of a low-cost page turner device for quadriplegic individuals, aiming to assist in turning book and magazine pages. The device, activated by a switch controlled by the user's head, hand, or other body parts, utilizes a microcontroller and motors. The working principle involves disengaging clamps, rolling the page, and transferring it to the other side. The prototype's testing showed an 8-second page-turning time, with potential for improvement with a faster processor. The device offers ease of use, reliability, and portability but requires initial setup assistance and may have accuracy issues with different page thicknesses. The document concludes by proposing future enhancements, including wireless switches, automatic power control, and improved accuracy.

Tabone et al.[10] An automated page turning system for musicians employing eye-gaze tracking. Musicians often face challenges with small screens on tablets while reading music sheets. The system utilizes a Kalman filter model to predict the musician's gaze location, facilitating automated page turns. Evaluation with 15 piano songs resulted in a 98.3% success rate for page turns. The document also explores related work on page-turning systems and digital music display. In summary, it outlines an efficient solution for musicians, enhancing their experience with digital music sheets.

Sanjiwani et al. [11] The creation of a Raspberry Pi-based blind reader to aid visually impaired individuals in accessing printed text. Utilizing Optical Character Recognition (OCR) technology, the system converts printed characters into machine-encoded text and further into audio output using Textto-Speech synthesis. The hardware involves Raspberry Pi 3 Model B, detailed in technical specifications. System software design encompasses image capturing, OCR processing, and Python-based text-to-speech conversion. The compact and user-friendly prototype stands as a promising alternative for both blind and illiterate individuals seeking improved accessibility to printed materials.

III. WORKING PRINCIPLE

A. Flow chart

Creating a flow chart for an automatic book scanner with accessibility features involves breaking down the process into sequential steps. Begin the flow chart with start. The system automatically detects the presence of pages. If yes, it takes a picture and checks for additional pages in the book. If yes, it proceeds to capture the next page. If no, move on to the next step. Afterward, compile the captured images and recognized text into a PDF document.

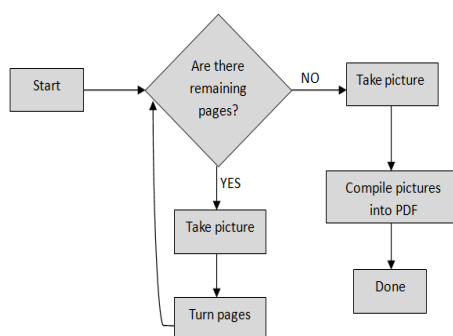


Figure 1. Flow chart of accessibility book scanner with automatic page turner

B. Block diagram

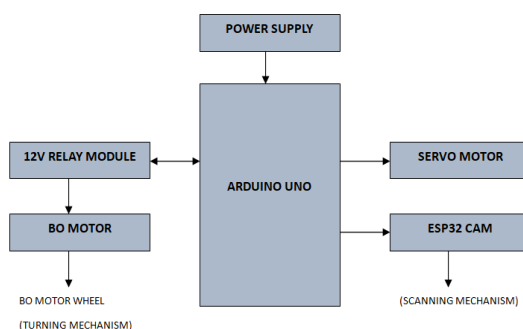


Figure 2. Block diagram of Accessibility Book Scanner with Automatic Page Turner

The page-turning and scanning mechanism involves a seamless vertical elevation and propulsion of book pages, achieved through an electric servo motor and a small wheel in our system. Specifically designed for inclusivity, our Accessibility Book Scanner and Page Turner offer a transformative reading experience for individuals and in library institutions facing challenges in manual page turning and scanning. With a focus on high speed, accuracy, and automatic operation, this innovation represents a significant advancement in accessibility technology, promising an efficient and inclusive approach to accessing printed material.

The ESP32 CAM captures images of each book page, which are then processed by the Arduino Uno to determine if a page turn is needed. The Arduino controls the page-turning mechanism, comprised of DC motors and a servo motor, to turn pages as required. Power distribution is managed by a 12V relay module, ensuring all components receive adequate power. Connecting wires facilitate communication between the ESP32 CAM, Arduino Uno, and motors, creating an automated system for scanning books efficiently.

IV. COMPARATIVE ANALYSIS

Book flipping scanning is the process of digitizing physical books by flipping through their pages and capturing images with a camera or scanner. It is often used for archival, accessibility, or distribution purposes. There are two common approaches: manual scanning and automated scanning. Manual scanning is cost-effective and flexible, but time-consuming and labor-intensive. Automated scanning offers speed, precision, and efficiency, but can be expensive and have limited flexibility. Common challenges include image quality and postprocessing. The choice between manual and automated scanning depends on project scale, budget, and book characteristics. Manual scanning is more cost-effective and flexible, while automated scanning offers speed and efficiency for large-scale projects.

V. CONCLUSIONS

Low manipulation machines present a budget-friendly and efficient solution for appropriately positioning book leaves, minimizing overhead costs. Automated scanning machines further enhance this by ensuring 100% error-free digitization. With ongoing advancements, future development has the potential to yield prototypes that are more affordable than existing photocopy and scanning machines. The scanner employs an auto-flipping technique, effectively minimizing skips and fatigue-induced errors during the conversion of physical documents into digital format. This straightforward and cost-effective process renders the technology particularly suitable for deployment in low-income countries where conventional book scanning technologies may be out of reach.

REFERENCES

- [1] Maria Sushma, Misbah Afsheen, Syed Danish and Salman Ahmed, "Design and Development of Automatic Book Scanning Machine", Project Reference No.: 45S_BE_4433.
- [2] Yoshihiro Watanabe, Miho Tamei, Masahiro Yamada and Masatoshi Ishikawa, "Automatic Page Turner Machine for High-speed Book Digitization", in 2013 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) November 3-7, 2013. Tokyo, Japan 978-1-4673-6357-0/13/\$31.00 ©2013 IEEE.

- [3] Priyanka Bhanudas Deshmukh, Me E&Tc(VLSI & Embedded System), G. H. Raisoni Coem and Ahmednagar India, "Book Flipping And Scanning Machine Review", in 2016 International Journal of Latest Trends in Engineering and Technology (IJLTET), ISSN: 2278-621X, Vol 7 issue 2 July 2016, Doi 10.21172/1.72.538.
- [4] Takashi Nakashima, Yoshihiro Watanabe, Takashi Komuro, "BOOK FLIPPING SCANNING" in 2014 University of Tokyo Hongo 7-3-1, Bunkyo-ku, Tokyo 113-8656, JAPAN.
- [5] N Bano, M Aziz, U Ghani, M Taha and H Ahmed, "Automatic Book Scanner", 5th International Conference on Mechanics and Mechatronics Research (ICMMR 2018), Doi:10.1088/1757-899X/417/1/012032.
- [6] Lana Sharbati, Manar Iqefan, Omar Taradeh and Mousa Farajallah, "Book Reader and Page Turner Robot using Raspberry", Available at: <https://socialcompare.com/en/comparison/raspberrypimodels-comparison>. [Accessed 11 May 2020].
- [7] Sabila Nawshin, Samir Kumar Das, Najia Hossain, Joyita Das Mela, Abu Shafin Mohammad Mahdee Jameel and Salekul Islam, "Development of an Automated Low-cost Book Scanner and Translator", in 2019 1st International Conference on Advances in Science, Engineering and Robotics Technology (ICASERT)IEEE, DOI: 10.1109/ICASERT.2019.8934635.
- [8] Prateek Luthra, Praveen Chauhan and Irshad Ahmad Ansari, "Low cost automatic document scan machine using Raspberry pi and Tesseract OCR", in 2019 International Conference on Advances in Electronics, Electrical & Computational Intelligence (ICAEEC).
- [9] Anand A, Ibrahim ShariffMD, Mohammed Zahid Abbas Khuraishi, Syed AnisurRehaman, Vinayak Ashok Pavate, "Design and Fabrication of Page Turner for Quadriplegic", in 2016 Anand A Allah Int. Journal of Engineering Research and Application, ISSN : 2248-9622, Vol. 6, Issue 6, (Part -2) pp.64-69.
- [10] André Tabone, Alexandra Bonnici and Stefania Cristina, "Automated Page Turner for Musicians", in 2019 Frontiers in Artificial Intelligence, Doi: 10.3389/frai.2020.00057.
- [11] Patil Sanjiwani A, Narute Kavita C, Jadhav Mahesh R, Chougule Ashok L, Prof. Durga S Patil, Prof. Ashwini B Babar, "BLIND READER USING RASPBERRY PI", in 2019 International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056, p-ISSN: 2395-007