Implementation of Book Digitizer using Raspberry Pi

C.Jeevanatham Sharmila[1] V.Ashwin Venkatesh[2] T.Gohul[3] A.Govindhasamy[4] K.Kaviraj[5]
[1,2,3,4,5]Department of Electronics and Communication Engineering
[1,2,3,4,5]SNS College of Engineering, Coimbatore, Tamil Nadu, India.

Abstract— The primary idea of the project is to build a robotic structure which can scan the pages of the book and digitize it. Book Digitizer can turn the pages of the book and also read it aloud. The Book reader flips through the pages of a book, takes pictures of each page, and then turns each picture into a digital document. It has the ability to read pages from the tablets. The prime idea of this model is to convert a book into a digital document as well to read it aloud.
Key words: Book Digitizer, Tablets

I. INTRODUCTION

The structure consists of a Raspberry Pi board which is the brain of the system. It controls all the other peripherals which are a camera, motor drivers, memory devices and a speaker. Each page in the book is photo captured by the Pi-camera and is converted into digital copy. After capturing each page, the Pi turns the book to the next page with a separate mechanism. The quality of the image is given priority since any slighter flaw in the image can reduce the effectiveness of the bot. The page turning mechanism works as follows. Then the Raspberry Pi takes a picture and converts it to text and speaks it.

II. WORKING PRINCIPLE

The Book is placed in the platform such that the wheels that are connected to the motor, turns each page of the book. Each page is captured by the camera and digitized using an OCR. The digitized form of the text is converted into audio and the output is given through speakers. After reading each page, the page is turned automatically by the motors. Digital books can be easily distributed, reproduced, and read on-screen. Common file formats are PDF, and TIFF. To convert the raw images OCR is used to turn book pages into a digital text format like ASCII or other similar format, which reduces *the* file size and allows the text to be reformatted, searched, or processed by other applications. After scanning, software adjusts the document images by lining it up, cropping it, picture-editing it, and converting it to text and final e-book form. Human proofreaders usually check the output for errors. OCR is the mechanical or electronic conversion of images of typed, handwritten or printed text into machine-encoded text, whether from a scanned document, a photo of a document, a scene-photo or from subtitle text superimposed on an image.

III. MAIN BLOCK

A. Lighting:

Though some scanners rely on ambient room lighting, dedicated lighting is important to capture good scans. The lights must also be positioned to minimize glare and reflections.

B. Cameras:

Each camera must be mounted securely and aligned to point directly at the center of the page it is scanning. If possible, we can use two cameras so you can capture both pages at the same time.

C. Platen:

The easiest way to avoid page curl in your images is to flatten the pages by pressing them against glass or acrylic. While there are some computer algorithms that can help de-wrap the pages after capture, it is always more reliable to just capture flat pages in the first place.

D. Book

The book lies at the center of any scanning rig. It is alternately pressed against the platen for scanning and then pulled away so that the page can be flipped.

E. Cradle:

The cradle supports the back and spine of the book. While any contact with a book will cause wear and tear, a V-shaped cradle can minimize the wear that scanning can cause.

IV. HARDWARE

A. Raspberry Pi:

Raspberry Pi board is the brain of the system. It controls all the other peripherals which are a camera, motor drivers, memory devices and a speaker.

B. Pi Camera:

Camera is used to take the images of the pages. Each page is captured by the camera which will be converted to digital document by an OCR. The resolution and the pixel intensity of the image decides the quality of the image. The quality of the image is to be ensured to be maintained perfectly so that the conversion can be carried out efficiently.

C. Regulated Power supply:

A regulated power supply is an embedded circuit; it converts unregulated AC into a constant DC. With the help of a rectifier it converts AC supply into DC. Its function is to supply a stable voltage (or less often current), to a circuit or device that must be operated within certain power supply limits. The output from the regulated power supply may be alternating or unidirectional, but is nearly always DC. The figure 3.6 shows the block diagram of RPS. The type of stabilization used may be restricted to ensuring that the output remains within certain limits under various load conditions, or it may also include compensation for variations in its own supply source

D. Stepper Motor:

It is used to rotate the pages one by one and is driven by a motor driver. Book is placed in a position such that the wheels connected to the motor is sliding on the book. Motor is driven

in a calculated speed so that it turns each page of the book at specific intervals of time. Stepper motors are DC motors that move in discrete steps. They have multiple coils that are organized in groups called "phases". By energizing each phase in sequence, the motor will rotate, one step at a time. With a computer controlled stepping you can achieve very precise positioning and/or speed control. For this reason, stepper motors are the motor of choice for many precision motion control applications.

V. SOFTWARE

A. Raspbian:

Raspbian is a Debian-based computer operating system for Raspberry Pi, developed by a small team of developers. It is not affiliated with the Raspberry Pi Foundation, but the foundation provides a Raspbian image which is listed as an officially supported operating system. Raspbian is maintained by Mike Thompson and Peter Green et al. which completed the initial build in June 2012. The operating system is still under active development.

B. Python:

Python is a programming language and it is a widely used high-level, general-purpose, interpreted, dynamic programming language. Its design philosophy emphasizes code readability, and its syntax allows programmers to express concepts in fewer lines of code than possible in languages such as C++ or Java. The language provides constructs intended to enable writing clear programs on both a small and large scale.

Python supports multiple programming programming paradigms, including objectoriented, imperative and functional programming or procedural styles. It features a dynamic type system and automatic memory management and has a large and comprehensive standard library. Python interpreters are available for many operating systems, allowing Python code to run on a wide variety of systems. Using third-party tools, such as Py2exe or Pyinstaller, Python code can be packaged into stand-alone executable programs for some of the most popular operating systems, so Python-based software can be distributed to, and used on, those environments with no need to install a Python interpreter.

C. Tesseract Ocr:

Tesseract is an optical character recognition engine for various operating systems. It is free software, released under the Apache License, Version 2.0, and development has been sponsored by Google since 2006. Tesseract is considered one of the most accurate open source OCR engines currently available. It is available for Linux, Windows and Mac OS X, however, due to limited resources only Windows and Ubuntu are rigorously tested by developers. Tesseract supports various output formats: plain-text, PDF. This project does not include a GUI application

VI. HARDWARE OUTPUT

Fig. 1:

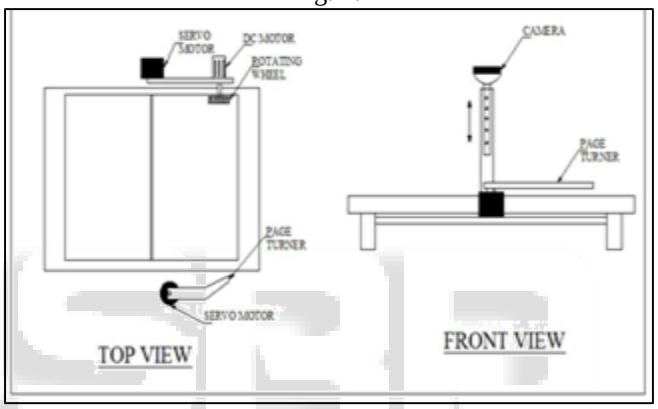

Fig. 2: Automatic page Turner

Using the configuration that showed the highest performance in the experiments described above, we performed an experiment with different books. The target books were two books originally made by ourselves and two purchased books

VII. CONCLUSION

We designed and developed a high-speed, high-precision, automatic page turner machine for high-speed book digitization. The proposed machine is based on a configuration for turning pages in a contactless manner at high-speed by using the elastic force of the paper itself to recover its shape, assisted by an air blast. Experimental results show that our machine achieved 100 % success rate in page flipping at a speed of 300 pages/min in the case of a book consisting of paper of average thickness. Also, we achieved a 100 % success rate with a book having thinner paper and over 98 % success rate with a book having thicker paper. We confirmed that our proposed machine is a promising technology for realizing both high-speed and high-precision performance for various books. Future tasks include introducing a sensor feedback mechanism in the manipulation system for more stable page turning operation, so as to enable page-flipping that can be flexibly adapted according to the physical state of the edge face of the book. In particular, we plan to measure the shape of the edge face in real-time and obtain the distances between pages. The movement of the

head can be controlled based on the obtained distances. This new configuration will allow us to avoid the problem where multiple pages are flipped at the same time, even when the pages are not uniformly aligned in the edge face, for instance, in books having a round-back binding. Also it is important to consider an automatic book installation mechanism in order to simplify and standardize tasks performed by a human operator. In addition, we need to consider friction problems for books having thin paper, the detection of abnormal flipping, and problems related to environmental variations, including temperature and humidity.

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