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Digitalised Scanner with Self-Assisted Flipping of Pages

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***Abstract:** In today's world, there is a main problem of storage for books and documents. Scanning the books manually has consumed time and resource. Many documents are disposed due to unavailability of proper storage facilities. In order to overcome this problem, automation and digitisation of scanning process is required. Hence a scanning system with high speed and high quality is to be designed. Similar type of design is proposed in our work for automated flipping of pages without any manual efforts. Our prototype is designed with minimum budget, to scan the Exam papers, Text books and private documents then converting the scanned pages to a portable document form. Many commercial scanning machines are available today but they have some or the other trade-offs like their working speed, quality and pricing. Considering all such issues we have designed a low cost and affordable scanner which consumers can buy for their homes and convert their documents to PDFs. The proposed work can be used in libraries to provide copies of books available to any person in exchange of money. Some scanned PDF documents may be personal/private and require protection to avoid it from being misused. Hence our prototype proposes a biometric security system in order to provide the document with utmost security.*

I. INTRODUCTION

The process of converting a physical document or a book into digital form such as images, text, or electronic books by using an image scanner is known as Book Scanning. A digital scanner is required for the purpose. Scanning large stacks of papers and books would obviously cost time and work load of a user. The main purpose of our scanner is to provide a reliable, efficient, economic and faster means of document conversion. It would also reduce human errors that may occur during the scanning process like page skip, page alignment problems, etc.

Digital images are similar to photographs produced using a digital camera. After scanning is performed, the images are thereby converted to PDFs and other formats and can be viewed on a computer screen or applied to a printer for producing hard copies of the file. Hence the designed scanner promotes digitization and portability of documents and large stacks of books without any damage to the original copies.

II. LITERATURE REVIEW

A. M.T. Nikham uses Finger flipping technique to turn pages, with the help of a roller and a slider. The mechanism of turning could rotate 45, 90, 135 and 180 degrees respectively. After the flipping or turning of each page, the image gets captured by a camera and converted into PDFs or other suitable formats and hard copies of the same can be obtained. The use of roller in the design resulted in skipping of some pages during the process.

B. An automatic page turner machine was proposed by Yoshihiro Watanbe that flips every page in a contactless manner by utilizing the elastic force of the page and an air blast. The experiment was performed for different paper qualities and the average success rate for thin-paper book was about 100% while for thick-paper book was about 98.4%.

C. A Google employee, Dany Qumisyeh designed a linear book scanning machine which used vacuum suction for flipping of pages, scanning the front and back part of a page in one shot. After a quick setup in 40 secs, 1000-pages of a book can be scanned in a short span of 90 minutes. The device was not able to provide security to personal documents and also couldn't protect few pages from damage.

III. PROPOSED METHOD

The process of scanning is initiated by placing the booklet/document on the wooden platforms. Once the document is placed, the stepper motors start to rotate, thereby, moving the platforms till they align themselves to the glass slab. The Raspberry pi camera is then initiated to take a snap of the document from a fixed position at which image of fine quality is obtained. The image so obtained is placed into a specified location on the Raspberry pi. The pi camera then goes to a sleep state until it is called for the next image capture.

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To continue with the process of scanning, i.e., to scan other pages of the document, first a process of turning the pages is required. For this process, the Vacuum pump is turned on with a constant pressure to suck a page, and platforms move down simultaneously to its normal position. At this point, the page is in a lifted position, which is flipped to the other side of the document with the help of wooden bar attached to a servo motor. Again, the platforms move above and get aligned to glass slab. By the time, pi camera wakes up, captures a fine image and saves it to the same location as above and goes off to sleep.
The similar process is repeated till end of the document is reached. Different codes for various processes are written in Python IDE. The speed, direction and number of rotations of Stepper and Servo motors, the amount of pressure from vacuum pump, the timer for pi camera to continuously capture the images at constant intervals, are all controlled and coordinated by the Raspberry Pi controller.
After all captured images are stored in a particular location, all at once are converted into PDF format and saved under a single filename in the order in which the images were captured and can be stored at a desired location. The file can additionally be provided a biometric security, if privacy of the document is required. Otherwise the files are saved normally and are open for access. This document can now be stored, viewed on a computer screen, printed as hard copies, and shared over a media.

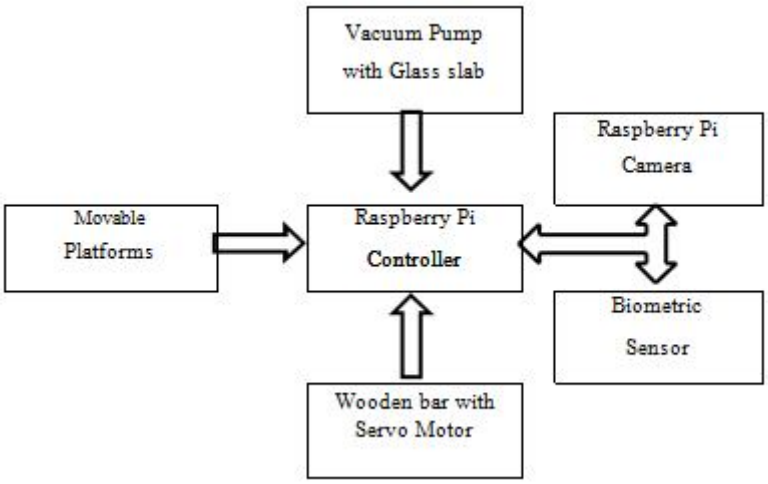


Fig 1 :- Block Diagram showing interfaces of various processes with Raspberry Pi controller

The above block diagram shows the different blocks used in our prototype and their interfaces. Two separate platforms are used in the system for document placement. These movable platforms consists of Stepper motors to control up and down movements. Vacuum pump is attached to a fixed glass slab and is used for lifting of pages. Flipping of page is done using a wooden bar with Servo motor. Raspberry Pi camera is used for capturing images of documents. An additional Finger print module is used for securing private documents. Raspberry Pi is the main controller and coordinator for all the activities in the system.

IV. APPLICATIONS

A. Digital Examination Scanners

During evaluation of Examination booklets, booklets need to be cut in order to be scanned. Our prototype automatically scans the entire booklet without any damage to it.

B. Xerox Centers

In order to scan textbooks, covered books and other documents, this prototype will reduce man-power and reduces the possible errors in manual scanning.

C. General Public use

People in companies, government offices, banks and common people require documentation of the files or hard copies which may be lost or dispensed due to storage problems. Here this scanner can be used as an alternative to get soft copies of these documents.

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V. ADVANTAGES AND DISADVANTAGES

A. *Advantages*

1) Reduces human intervention and thus saves time and effort required for manual scanning operation which can be utilised for other purposes.

2) Minimises human errors such as page skip, page ordering, page alignments, etc. that are likely to occur in manual scanning process.

3) Portability of large physical documents by converting them to soft copies that can be transferred or shared over any media easily.

4) Economical in design since minimal components and parts are used in the unit.

5) More secure in comparison to other technologies due to extra security provision for private documents.

B. *Disadvantages*

1) Since the process is entirely automated, there is a partial increase in power consumption compared to manual scanning.

2) Regular maintenance of mechanical parts is to be done for smooth functioning of the device.

VI. RESULT ANALYSIS

A. *A Main user Interface*

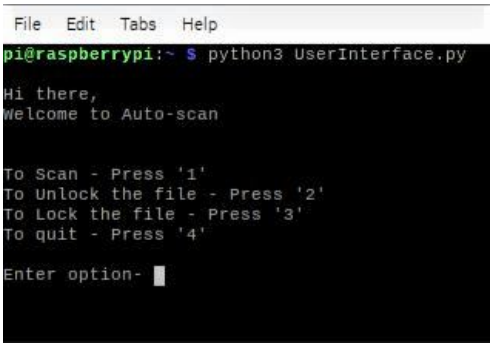


Fig 2 ;- A main screen for User-Interface

As seen in the above picture, the user at first is displayed with a screen with options for Scan, Unlock, Lock and Quit respectively.

B. *Scan Process*

If option 1 is entered, i.e., Scan option is entered, two types of scanning are provided namely Manual scan and Self scan. When subsequent option for Scan is entered as below, the corresponding type of scan is executed.

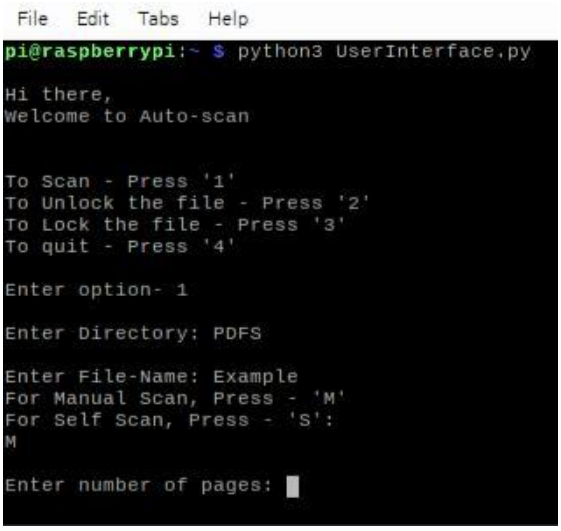


Fig 3 :- Manual Scan

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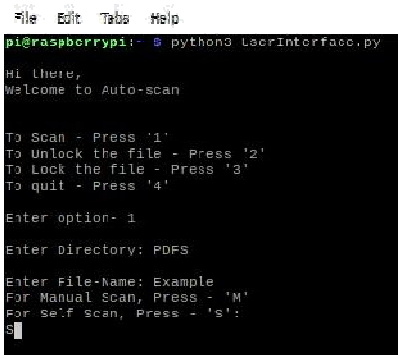


Fig 4 :- Self scan

In case of Manual scan, the user has to enter number of pages to be scanned in order to initiate the scanning process as shown above. This type of scan is preferred for small documents.
In case of Self scan, the process gets initiated automatically till a reference image matches with one of the subsequent images in the scanning. This type of scan is preferred for large documents.

C. Unlock Process

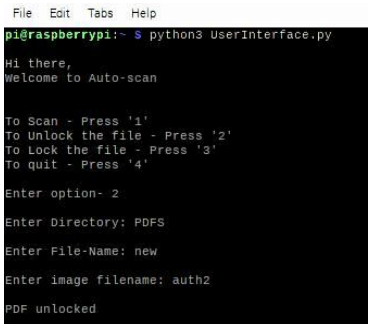


Fig 5 :- Authentication process

For an option 2 entered by the user, i.e., Unlock option is selected, a process of unlock based on histogram comparison of images is initiated. The user in order to validate his identity is asked for authentication.
If user authentication is found to be successful, the pdf or document gets unlocked. Otherwise the file remains in locked state and user needs to provide authentication again if he is a authorized user.

D. Lock Process

If a user enters an option 3, i.e., the Lock option wishing to lock a file, he needs to enter a valid path of the file, which if exists in turn is locked and protected from any other users. After any locked document is unlocked, before the user ends the session, can again lock his document using this option if required. Also this option can be used to protect any new or unprotected documents.

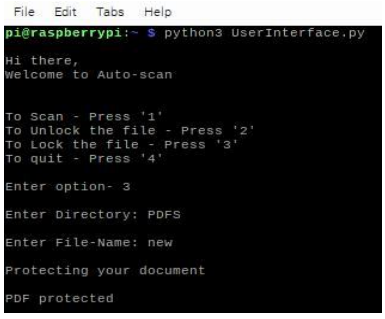


Fig 6 :- Locking a file

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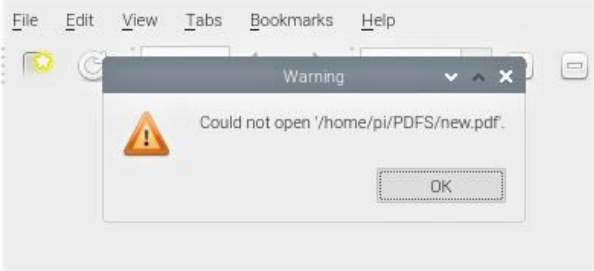


Fig 7 :- A Locked file

E. Quit

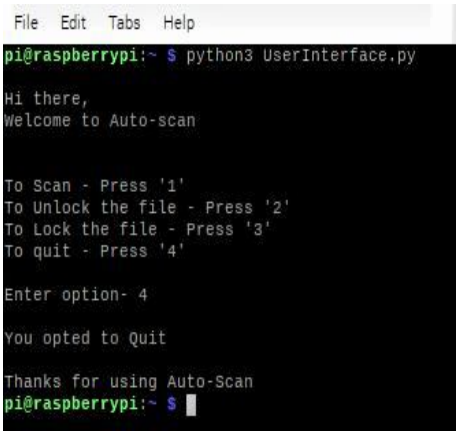


Fig 8 :- Termination of program

After user completes the Scanning process, he can quit the program by entering an option 4, i.e., the Quit option which terminates the Scan.

F. Sample image of a Scanned PDF

Above figure is a sample image in a scanned pdf file. The images are captured using a Pi-Camera with a pixel quality of 5MP and conversion is done using a Python Imaging Library which may be in-built or installed, which in turn are converted to PDF.

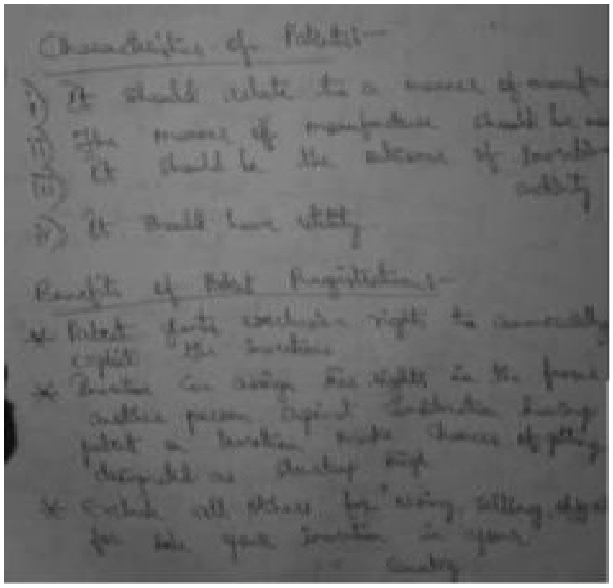


Fig 9 :- A sample pdf converted image

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VII. CONCLUSIONS AND FUTURE WORK

A. *Conclusions*

At the completion of this work, we have created a device that can automatically scan books and compile them into a PDF file, without any user intervention once the process has been started.

The device is capable of scanning hard and soft cover books without damaging them. The final device consists of a means of turning the book's pages, a means of photographing each page, and a system that compiles the photographs into a PDF. The device is accompanied with any design references and software needed to replicate it.

The final device is provided by a special finger-print security feature to lock and secure important private documents if desired by the user. Also the device provides self-scan option by which start and end points of scan is detected automatically by the system.

B. *Future Scope*

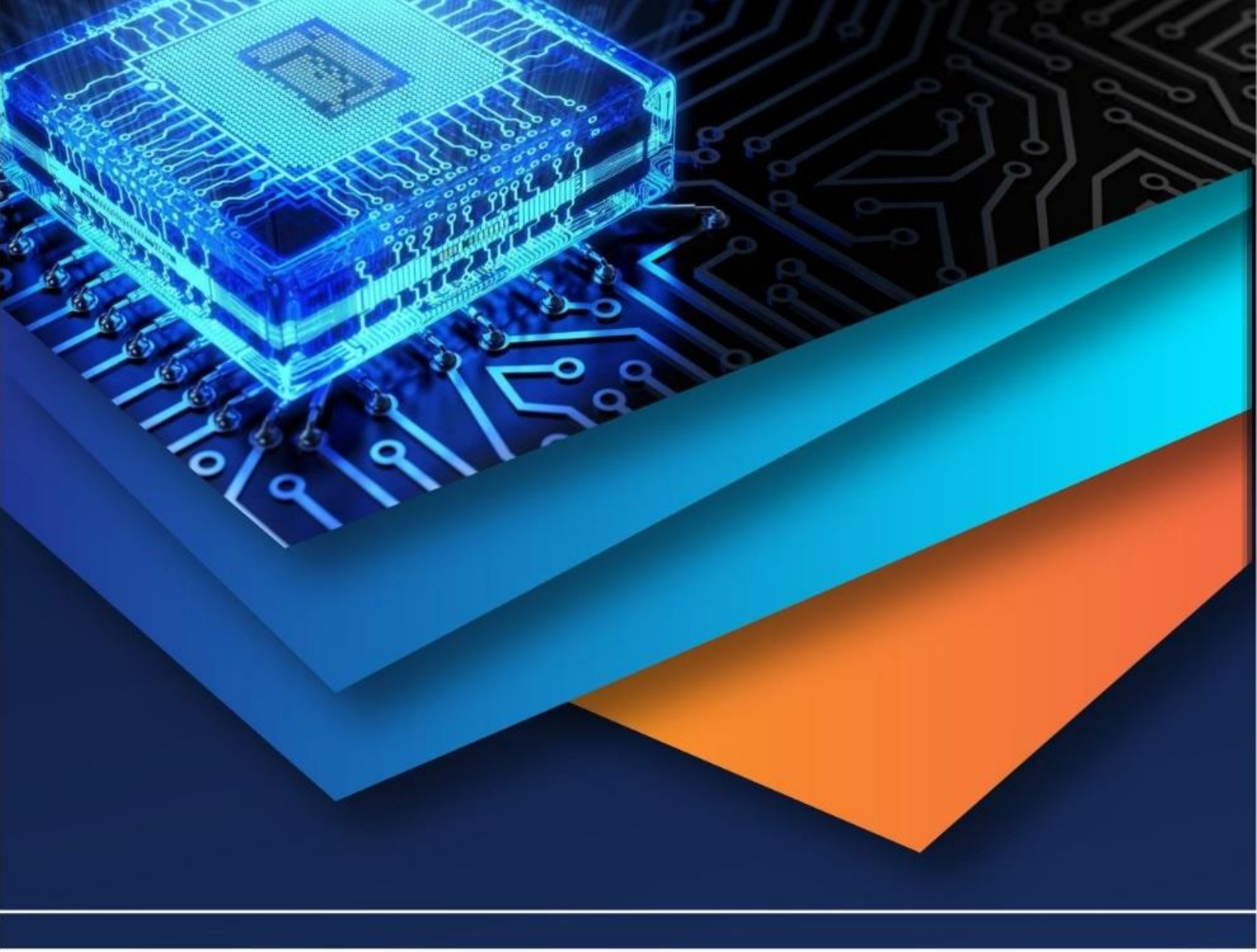
In the future, the scanner can be improved to have additional features like

1) Can have a in-built touch screen to take input instructions from the user.
2) Use of high resolution cameras for better quality pictures.
3) Can implement Optical Character Recognition to convert scanned documents

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