

Apr 6, 2021
Dr. Craig Scratchley
School of Engineering Science
Simon Fraser University
BC, V5A 1S6



RE: ENSC 405W/440 project proposal for FlipScan

Dear Dr. Scratchley,

Please find enclosed our project proposal for the FlipScan, a completely automated scanner that will digitize physical books.

This document provides a breakdown of the business proposal for our project, the FlipScan. This includes a description of the project's scope, the benefits and risks for the customer that come with using FlipScan, an analysis of the market for automated book scanning, including an analysis of the competition, as well as a budget and a schedule for the project.

The FlipScan team is composed of five passionate members each with different backgrounds: computer engineers Trevor Chow and Kai Sackville-Hii, electronics engineers Abbas Raza and Tom Doherty, and system engineer Aaran Shan.

Thank you in advance for your time spent reviewing our project proposal. If you have any questions or concerns please contact our chief communications officer Kai Sackville-Hii by email at ksackvil@sfu.ca or by phone at +1-778-986-2009.

Sincerely,

A handwritten signature in black ink that reads "Kai Sackville-Hii". The signature is written in a cursive, flowing style.

Kai Sackville-Hii
Chief Communications Officer
FlipScan



FlipScan Proposal Document

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Executive Summary

The FlipScan is a system that automatically scans books. This is to help librarians with the scanning of books so that they can be converted into a digital format for people who may not be able to comfortably read books.

At libraries, people who have problems reading books in the traditional way can ask for the librarians to scan their books to convert them into an ebook, then extract the text for conversion to an audio book. Current solutions involve manually scanning the book page by page, which is a time consuming and laborious task.

FlipScan solves this problem by providing a platform that automates the scanning process. FlipScan uses a wheel to roll back one of the pages so that a kicker arm can come forward and push the page forward. A camera mounted on a tower then takes a picture of the pages to scan the document. This greatly reduces the amount of labour needed to perform the task.

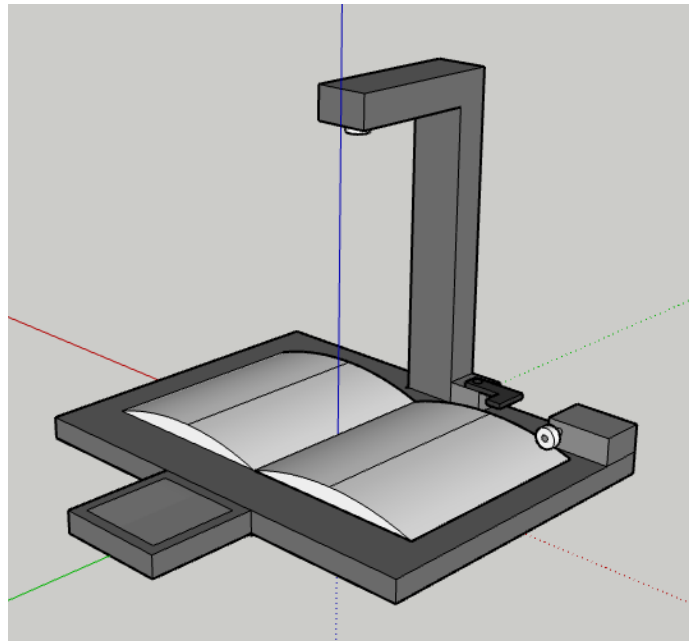


Figure E.1: FlipScan appearance diagram

Our business plan is to directly market and sell the FlipScan to libraries, with the pitch that the device can streamline one of their most time-consuming tasks. Our project needs funding so that we can finish engineering the device to make it as reliable as possible. Our goal is to have a working prototype by the end of August, so that we can start selling units to libraries.

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Glossary

SBC: Single Board Computer
PDF: Portable Document Format
RPI: Raspberry PI
ROI: Region of Interest
UI: User Interface

1. Introduction

Many people are unable to read physical books due to ailments such as poor eyesight or lack of motor skills. While audio and digital books are possible solutions, not all physical books are available in digital or audio formats. Thus, to convert physical books into accessible copies librarians go through the tedious task of scanning each page on typical office scanners. This task is both time consuming and laborious.

Therefore, our solution to this obstacle is FlipScan. FlipScan is an automated book scanner that successively flips and then scans pages. The result of the scanned pages is a PDF of a text that will be transferred to the user's computer. Overall, FlipScan's process requires minimal human interference in comparison to standard office scanners.

This document outlines our project to make the FlipScan into a commercial product. It includes an overview of the scope of the project, explaining how the FlipScan is able to automate the task of scanning a book. The proposal also includes an analysis of the benefits and risks to the user of the FlipScan, and an analysis of the market for scanning books and the competition. This will show that there is an unfilled need for book scanning solutions by libraries.

The next parts of the document outline the preliminary budget for the project, and a schedule of how we intend to move forward so as to have a working prototype by the end of summer 2021. The document also contains a list of the team members working on the project and our roles therein.

2. Scope of the project

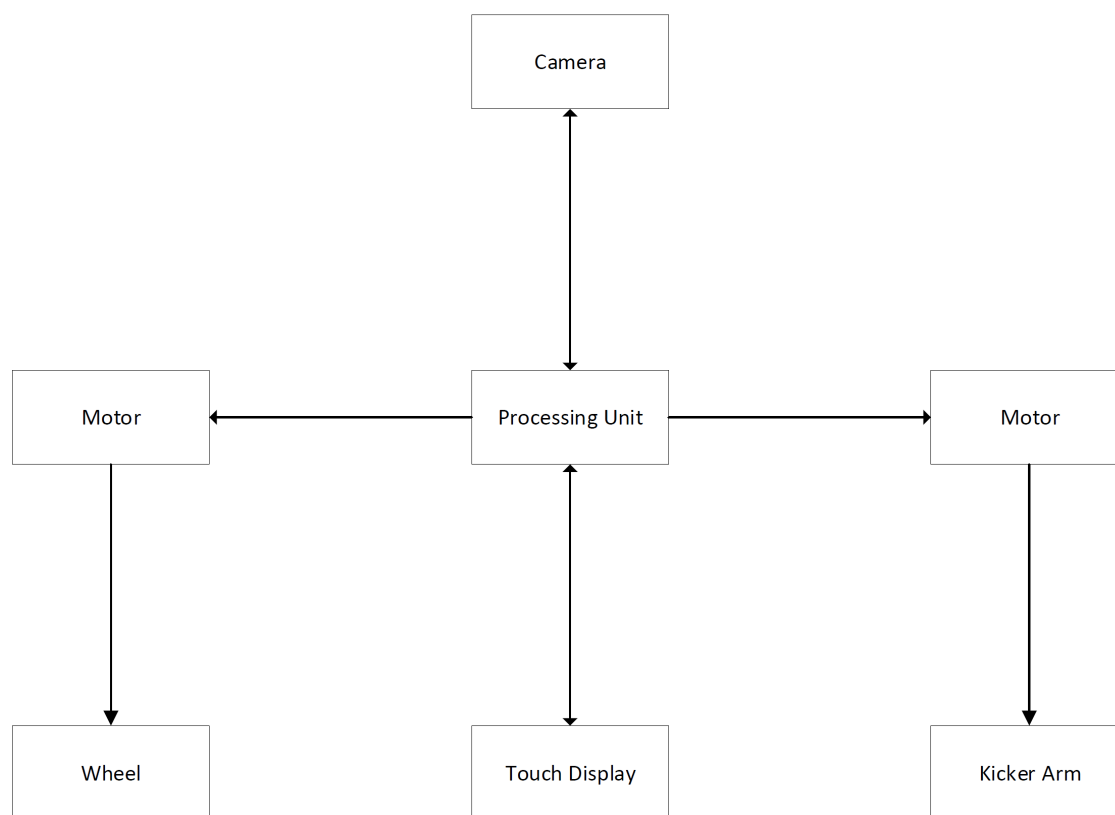


Figure 2.1: System diagram

The FlipScan system consists of:

- A wheel and arm for turning the pages of the book.
- A camera to take pictures of the book.
- A touch screen to serve as the interface.
- A single board computer (SBC) to control the other components as well as processing the camera's pictures into scanned documents.

The wheel is situated on the right page of the open book, and when the processor wants to turn the page, it rotates clockwise and rolls the page up. The second part of the page turner, the arm, then rotates under the rolled up page and kicks the page over. The camera then takes a picture of the two new pages and sends that picture to the SBC. The software then identifies the outlines of the two pages, and performs the perspective transforms to turn the picture into a scan of the two pages. The software

also tries to find page numbers on the open pages, and will track page numbers to record if a page has been skipped over. The user controls the device through the touch screen, and the FlipScan gives feedback messages through the same screen.

3. Benefits

The first benefit of the product is the cost and accessibility. For a consumer, an automatic robotic book scanner is hard to find in the market, with most companies only willing to sell them to large corporations. In addition, the cost of these book scanners are expensive and are priced well into the thousands. With FlipScan, consumers are able to find a high quality automatic book scanner at an affordable cost.

The second benefit is the user friendly and responsive system. FlipScan's UI will be constructed with a built-in touch screen to control the product. This allows the user to easily set up their scan as well as be informed of any errors such as missing pages.

The third benefit is portability. Most automatic robotic book scanners are quite large and nonportable. FlipScan in comparison is much smaller in size and structure enabling the product to be transported easily.



Figure 3.1: DL Mini[1]



Figure 3.2: SMA-ROBO Scan V2 [2]

4. Risks

The first risk with the system is that it might skip over a page or fail to turn a page. This risk will be mitigated by the software being able to detect the page numbers, and track if a page number has been skipped over, however it still represents a loss of automation in the

system. The second risk is that FlipScan could damage the books that are put in it. This will require careful monitoring of the torque from the motors. The third risk with the system is the possibility of bugs showing up in our software. Validation testing of the software will be needed to manage the risk of bugs.

5. Need, Market, and competition

After researching local libraries in the lower mainland, our team found out that there is a clear gap between the demand from people who want scanned versions of books and the current technology that is afforded to librarians to do so. Once implemented in the libraries FlipScan will be able to meet the needs of two distinct groups: Those in the academic field who want to succinctly scan years of research work, and those who benefit from text to speech technology due to poor eyesight and lack of motor skills.

In the last four years, the scanning technology market is growing at a CAGR (Compound annual growth rate) of 14%. Monetarily, there is an increase of \$5.6 Billion from 2019 to 2022 [3] indicating that there is a rapidly growing demand for products such as FlipScan. The reason for such rapid progression is that the market is currently dominated by a few major companies such as Canon and Epson.

In the consumer market, a product that is comparable to FlipScan in functionality on the high-end technology side is the DL mini book scanner. DL mini book scanner automatically flips and scans the document and provides the finished document to your required destination. However, the cost for one DL mini book scanner is approximately \$80,000 while FlipScan is committed to keeping the pricing affordable at \$700 while providing the same services.

In contrast, there are products such as CZUR ET18 Pro that are lower cost of 1000\$ and rivals FlipScan's own pricing, but lack in functionality point of view. CZUR ET18 Pro efficiently scans the documents but does not provide automatic flipping feature and requires human assistance while FlipScan and scan as well as flip the pages automatically giving it an edge over CZUR ET19 Pro.

6. Project Budget

To properly illustrate the general budget of FlipScan there are 4 major parts that will be working synchronously to provide the required output. First and foremost is the initial \$15 SBC (Single- board computer) cost which is a Raspberry Pi Zero W that we are using for processing the scans of the book as well as communicating with the UI.[4] The second

primary cost is the \$50 touchscreen UI that will provide user interaction while being connected to SBC [5].

Thirdly, the largest cost for FlipScan will be the use of a Lego mindstorm Kit that will be between 450\$ - 500\$ and will act as the mechanical mechanism for flipping the pages of a book. Lastly, the final part of the budget will go towards a camera that will be attached to the post from the Lego mindstorm to take pictures of the book. we will be using “IMX 298 - 16-0 MP Raspberry Pi Compatible Camera Module”. It will cost us 70\$ to buy.[6]

In summary, the total expenses of building FlipScan will amount to 635\$ - 700\$. However, there is flexibility in our budget when it comes to Lego mindstorm Kit preference. If we decide that our preferred mechanical choice of “Lego mindstorm Kit” is not economically feasible we will look for cheaper alternative options such as building the mechanical arm by using motors and 3D printed hardware kit to keep the overall cost of FlipScan low.

7. Time Schedule

Figures 7.1 and 7.2 shows the projects schedule for the duration of ENSC 405 (January 11th to April 16th) in the form of a gantt chart. There are three sections of tasks: “Research & Planning”, “Documentation & Presentations”, and “Implementation”; each with multiple tasks. Tasks are shown as teal rectangles, and milestones shown as grey diamonds. Figure 7.3 and shows the project schedule for the duration of ENSC 440 (May 11th to August 9th) in the form of a gantt chart. Note that this schedule is an approximation, and will be updated at a later date.

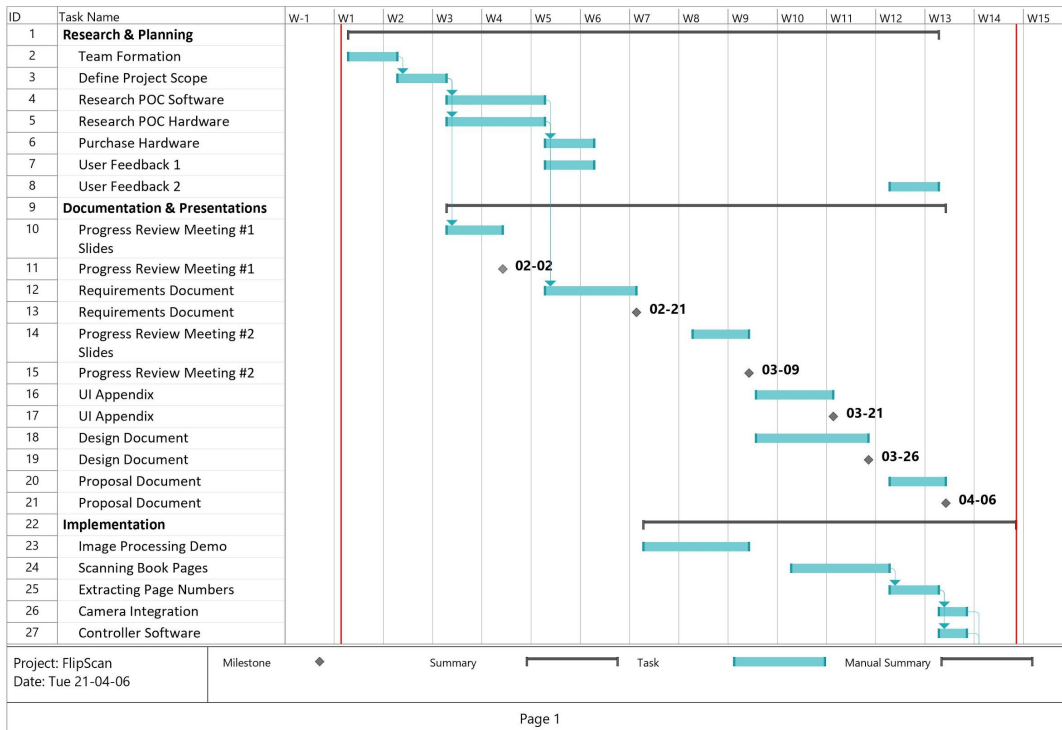


Figure 7.1: FlipScan Gantt Chart for ENSC 405 - Page 1

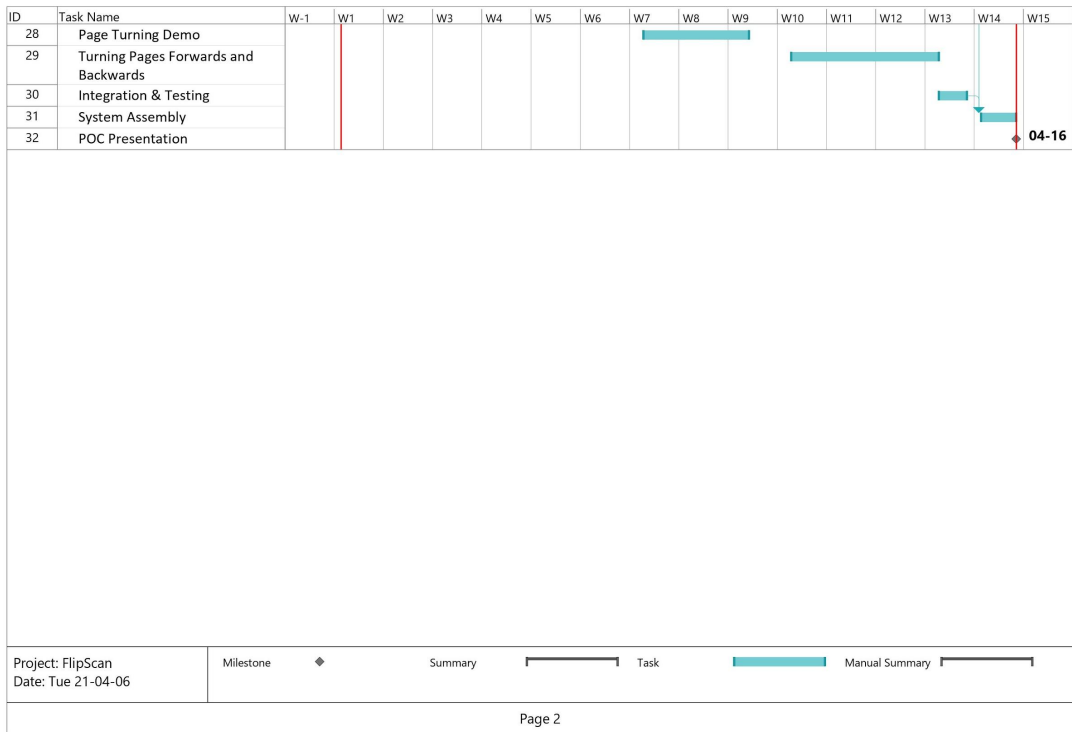


Figure 7.2: FlipScan Gantt Chart for ENSC 405 - Page 2

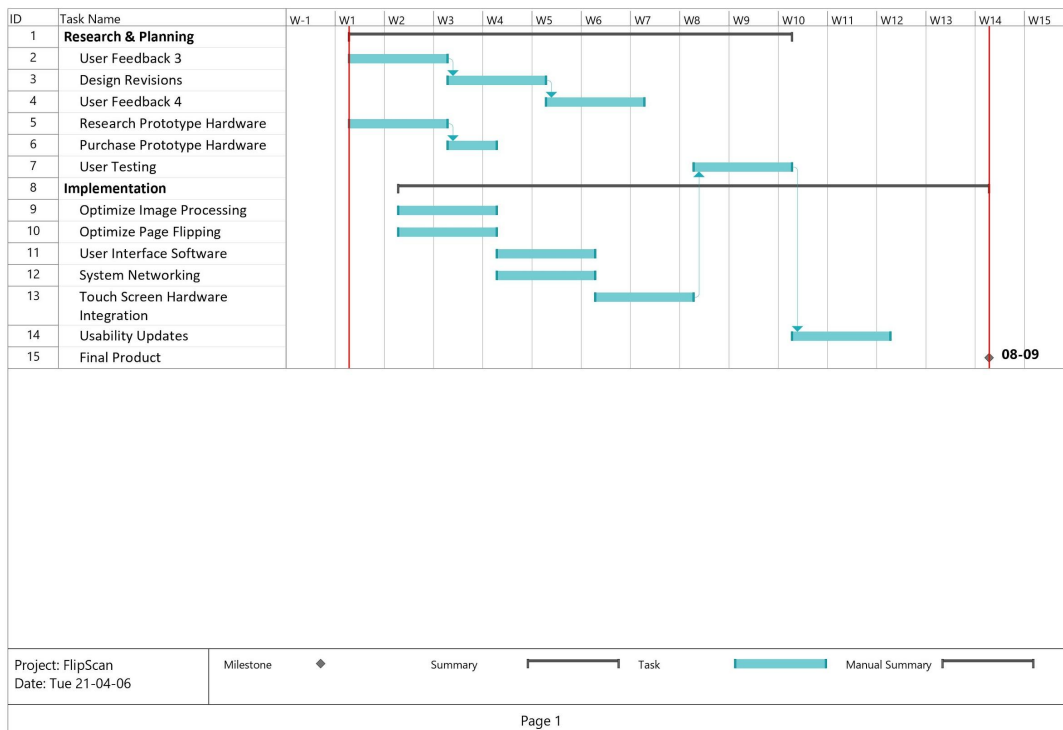


Figure 7.3: FlipScan Gantt Chart for ENSC 440

8. The Team



Aaron Shan
Systems Engineer

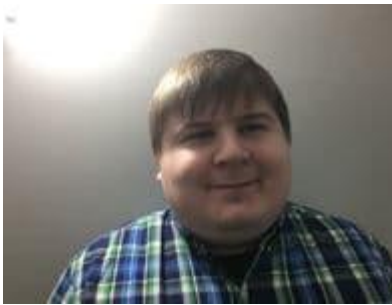
Aaron is a mechanical engineer for FlipScan . His role involves designing and building the prototype machine. His past experience includes working as a junior software developer at Know Idea Inc.



Abbas Raza

Electronics Engineering

Abbas is a marketing and budget strategist for FlipScan. His role involves researching market supply and demand for the product. His past experiences include working as a project planning assistant at BcHydro and ZE power group Inc.



Tom Doherty

Electronics Engineering

Tom is a design engineer for FlipScan. His role involves designing electrical components of the FlipScan. His past experience involves working as a circuit designer for Orbital Research Ltd.



Trevor Chow

Computer Engineer

Trevor is a Software Developer and Tester at FlipScan. His role includes developing image processing software and managing test plans. His past experience includes working as a software and system tester at Gatekeeper System Inc.



Kai Sackville-Hii
Computer Engineer

Kai is CCO and Software Developer at FlipScan. His role includes managing company communications and working on the image processing software. His past experience includes working at SAP as a software developer.

9. Conclusion

The market for automatic robotic book scanners is limited and librarians are forced to manually scan books page by page using an office scanner. FlipScan's goal is to efficiently digitize books by providing a product that fully automates the process of flipping pages of a book as well as scanning them. This will reduce the overall workload of librarians and eliminate human error for scanning.

This document outlines the members of the team as well as their relative technical experience and skills. Furthermore, it also provides a product schedule along with set milestones and deadlines.

The product is constructed following our budget guidelines. Currently, we do not have outside funding but our plan is to apply to the Wighton Engineering Development Fund and the Engineering Science Student Endowment Fund as we progress into the beta phase. Our team is confident and dedicated to building a reliable and cost effective robotic book scanner that is accessible to any consumer.

10. References

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