Senior Design Presentation

Automatic Page-Turning Photocopier

Team 4

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Contents

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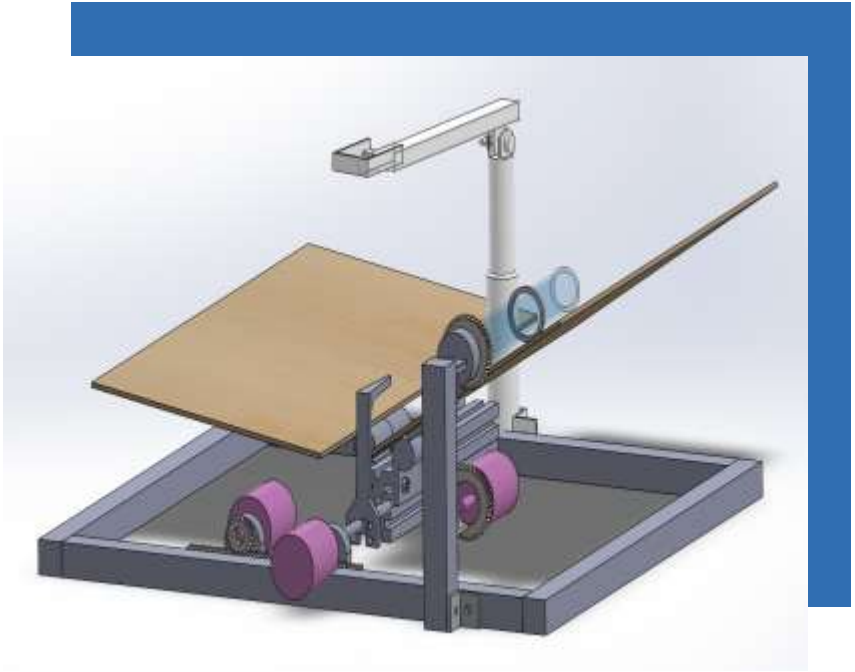

Introduction: Objective

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Existing problems:

- ❑Traditional photocopiers requires manual page-turning that causes user fatigue.
- ❑Existing automatic page-turning photocopiers are typically large in size and expensive

To address the problems above, our project is to design a compact, cost-effective **automatic page-turning photocopier**

Introduction: Block Diagram

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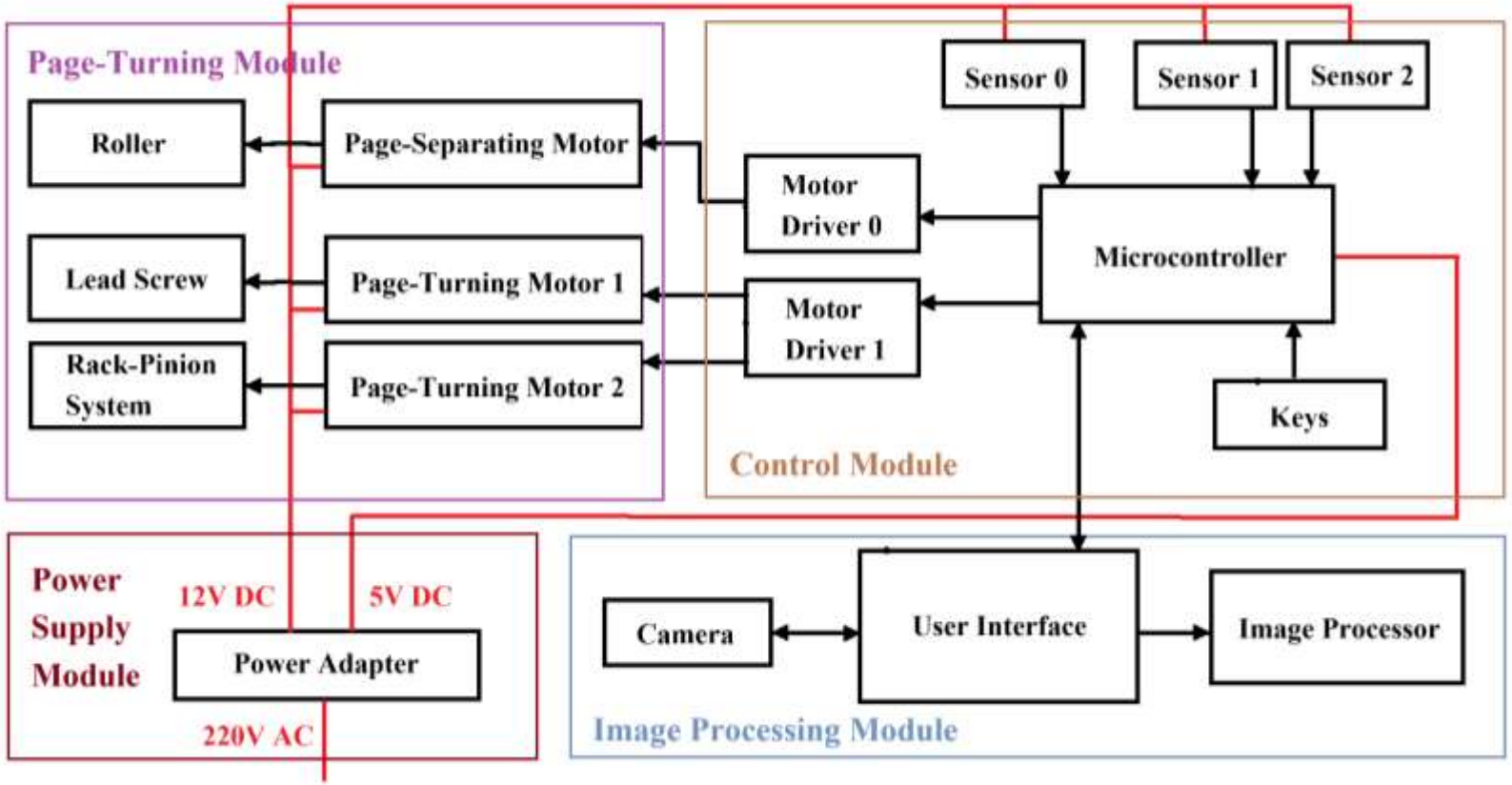
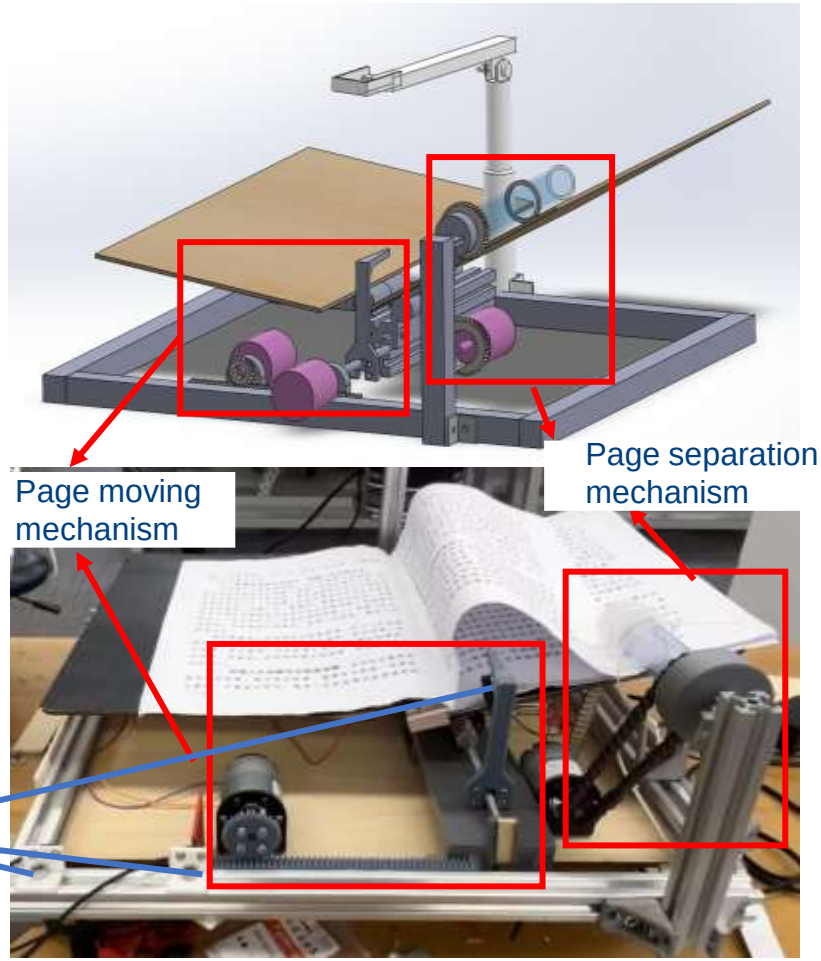


Design and Verification: Page-Turning Module

This module has two mechanisms: **page separation** and **page moving mechanism**:

- A motor-driven roller and chain system to rotate a drum
- A lead screw inserts or withdraws a strip into the gap
- Rack-and-pinion system completes the flipping motion.



Design and Verification: Page-Turning Module

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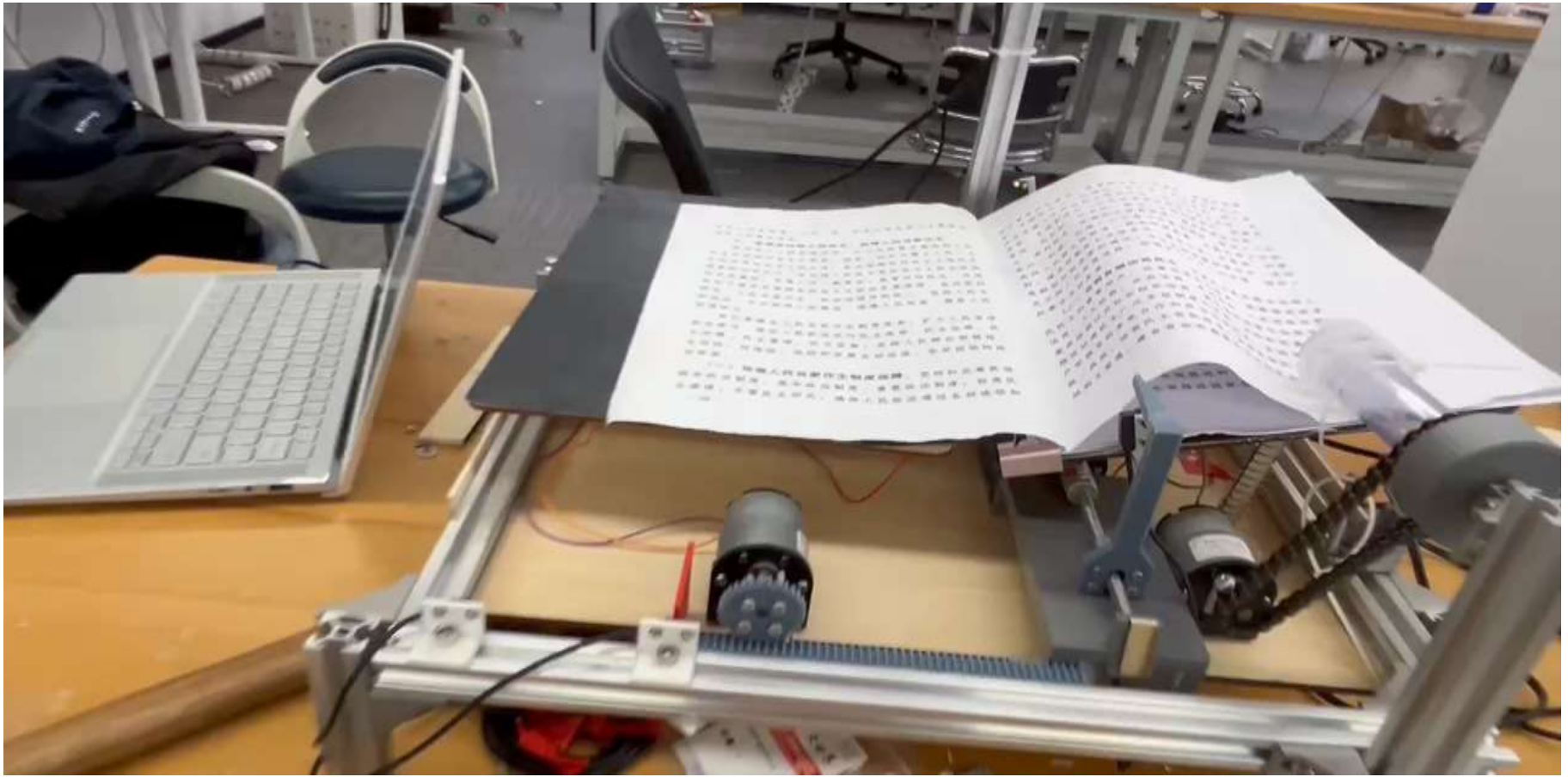

Design and Verification: Page-Turning Module

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Requirements:

- ≥ 80 % success rate
- < 20 s/cycle

Verification:

- B5 size
- 14 seconds per cycle
- 83 % success rate

Experiment No.	1	2	3	4	5	6	7	8	9	10	Mean
Success Rate (%)	80	60	100	60	90	80	100	80	90	90	83

Design and Verification: Page-Turning Module

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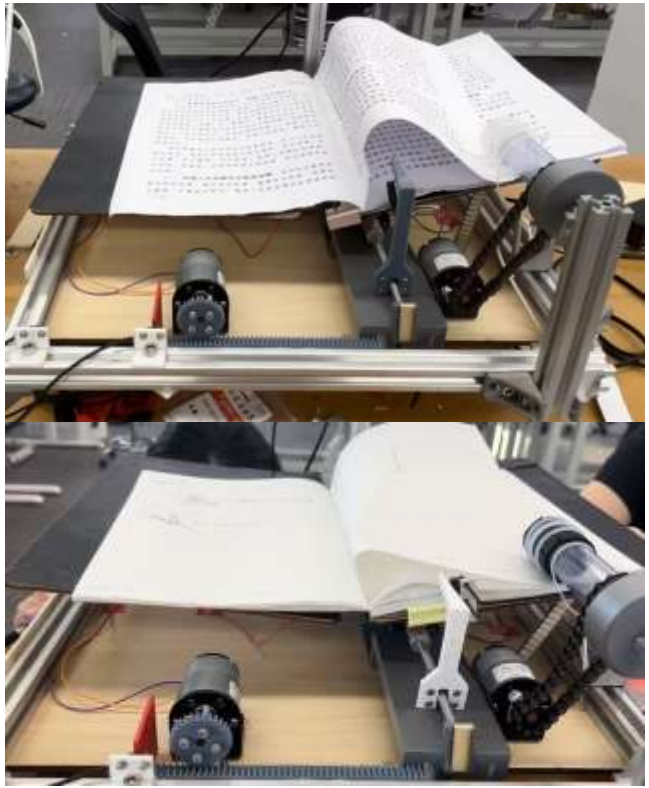
Requirements:

- Support diverse paper types

Verification:

- A4, B5 size



Materials			
Mass	340.1 g	228.1 g	181.5 g
Deformation of Profile	0 mm	0 mm	0 mm
Degree Error	1°	0°	0°

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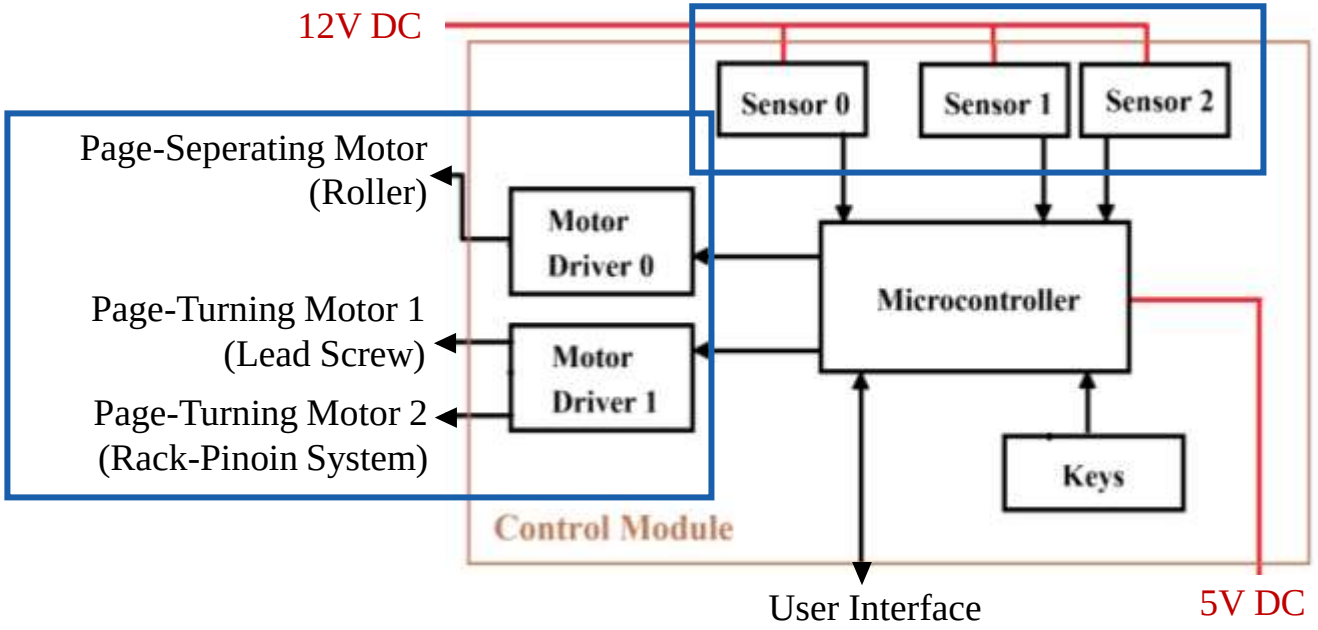
- **Motor Controlling**
  - Motor driver: L298N
  - Receive GPIO inputs from sensors
  - Generate PWM and GPIO outputs for motor drivers



Design and Verification: Control Module

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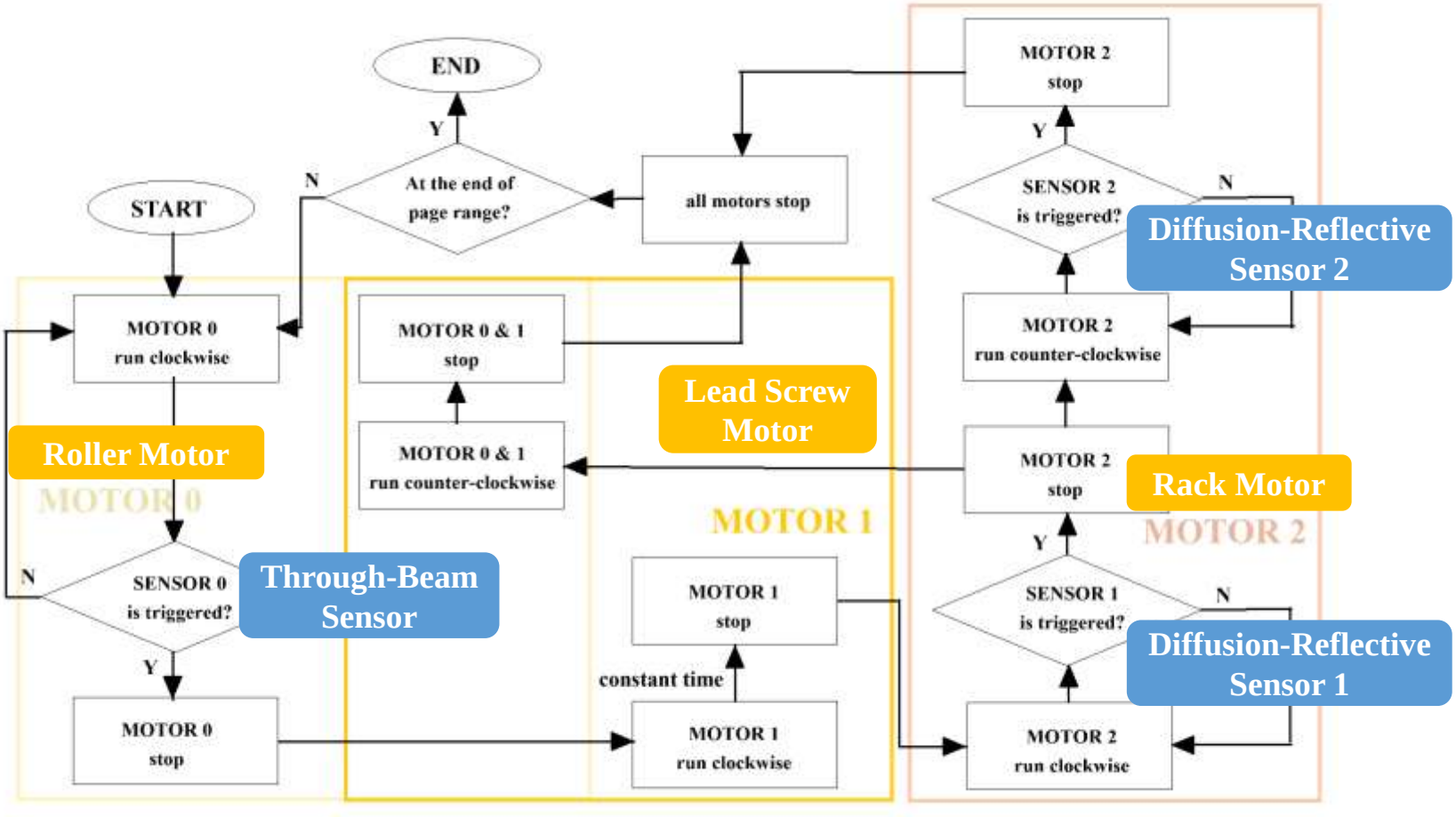

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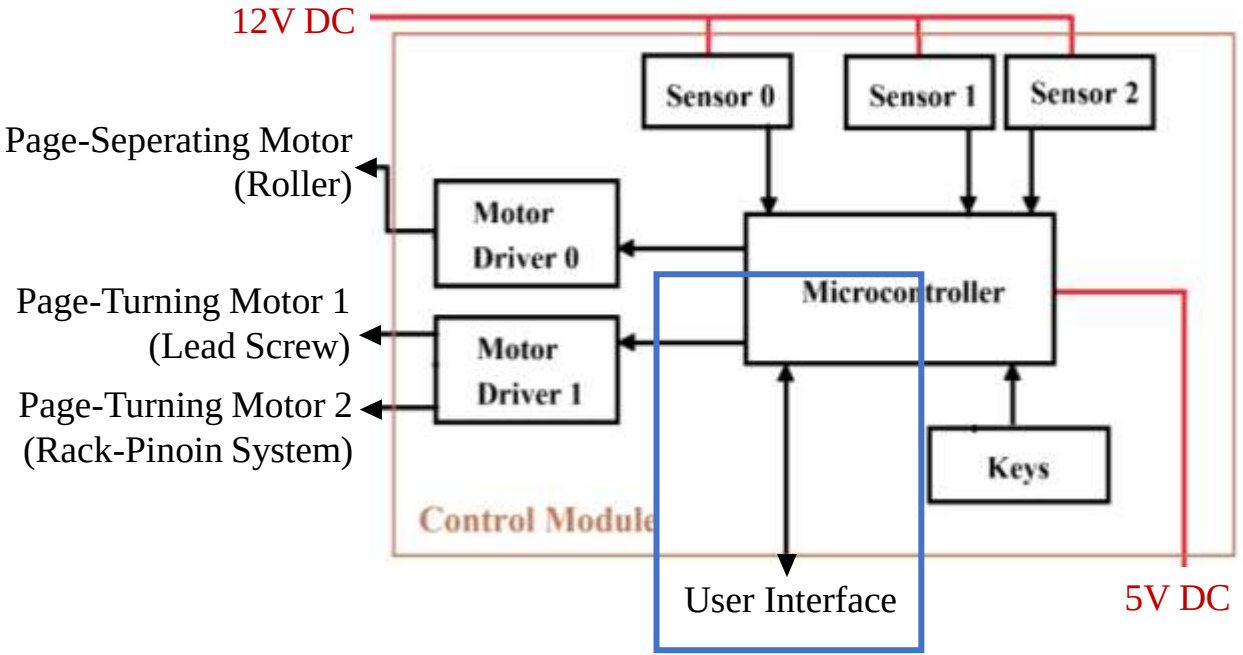
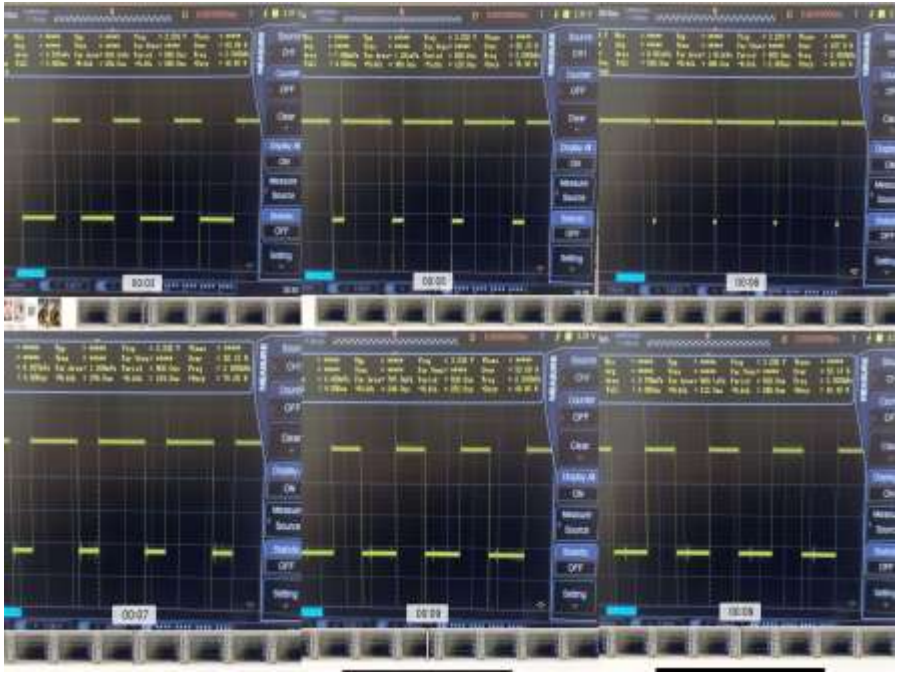
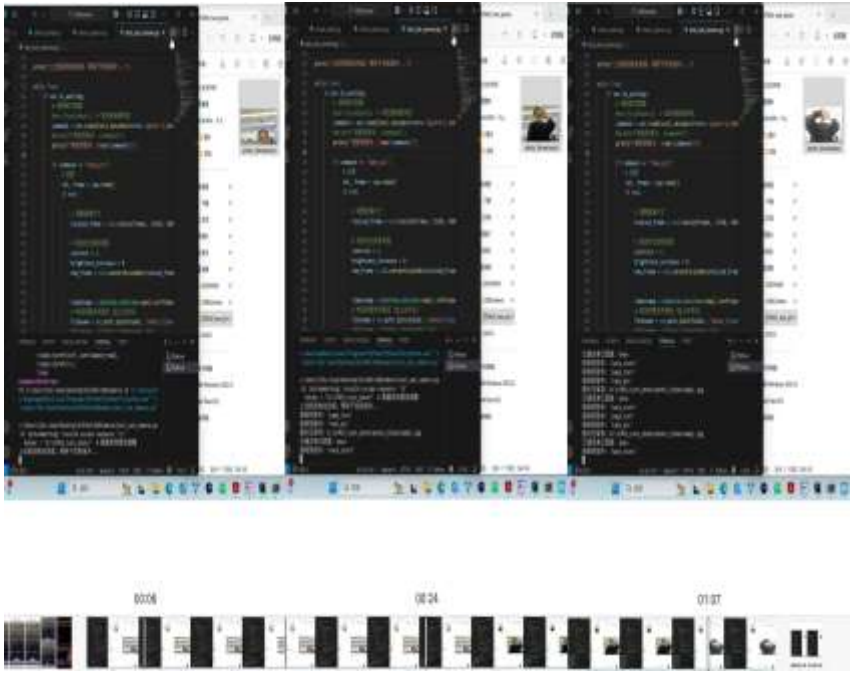
- **Communication with PC**
  - USB-to-serial-port driver: CH340
  - Receive commands and personallized presetting from user interface
  - Update page-turning module status to PC



Design and Verification: Control Module



PWM Outputs Test Result



UART Transmission Test Result

- **Components**

- **Camera**
  - A 1920×1080 high-resolution camera

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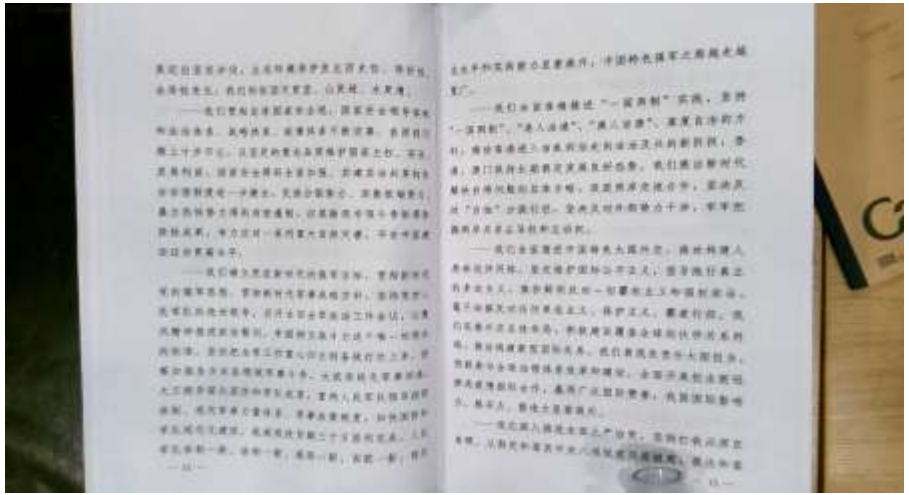
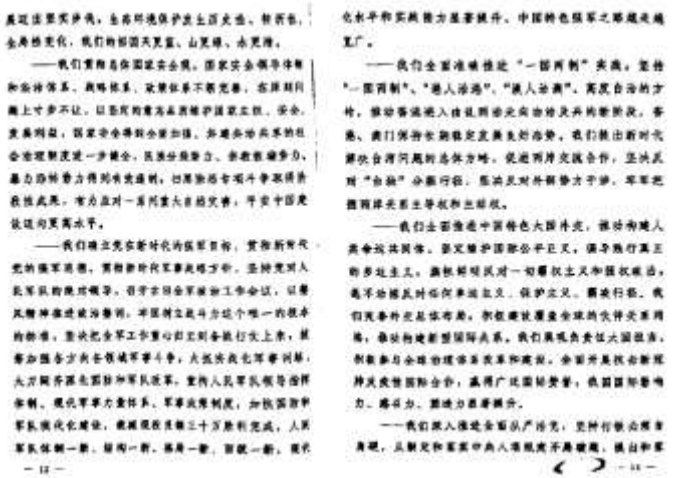
Image Processor

- A Python program that refines the raw images captured by the camera
- Cropping + page dewarping



Original Captured Image



Processed Image

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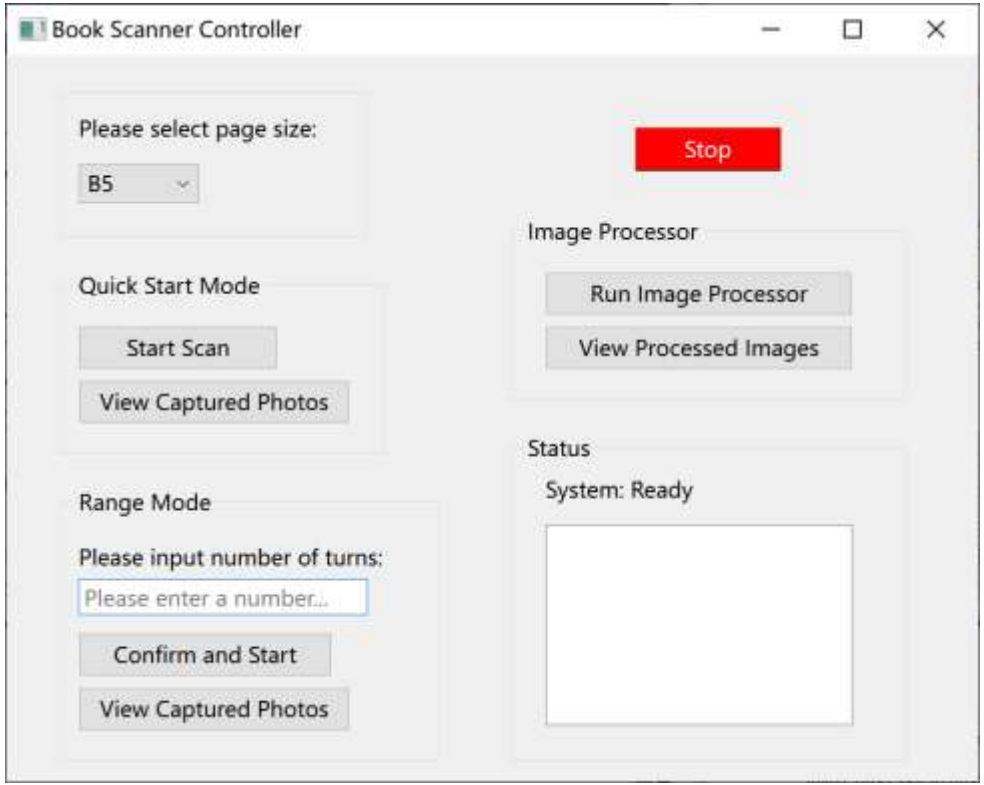
- **User Interface**



Requirements & Verification (Image Processor)

- Processing time (< 3 s per page)

Number of Pages	Processing Time	Processing Time Per Page
5	14.79 s	2.96 s
10	27.15 s	2.72 s
15	43.67 s	2.91 s
20	55.58 s	2.78 s

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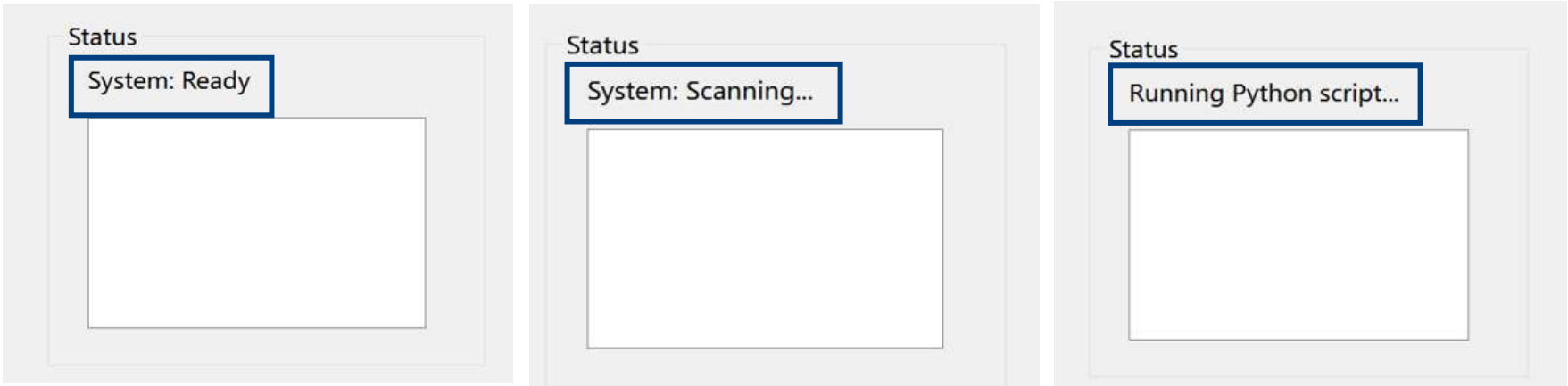
- **Requirements & Verification (User Interface)**
  - Range Mode
  - Status Display



User Interface of Three Different States

Success and Challenges

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Success:

- Turn a page within 15 seconds
- Acheive about 83% success rate
- Be able to handle documents in different size, especially A4 and B5 size
- The content in processed images is clear and legible

Success and Challenges

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Challenge

Failed demo at page-turning process

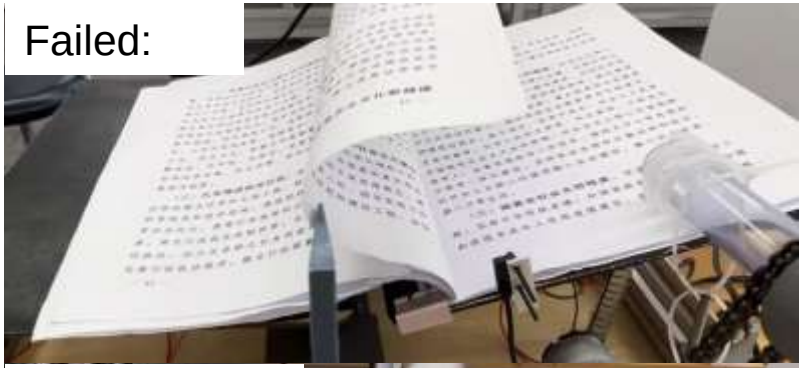
➢ Reason

- Crease on paper
  - uneven stress distribution
  - smaller elastic modulus
  - smaller curvature
- Short moving range of strip

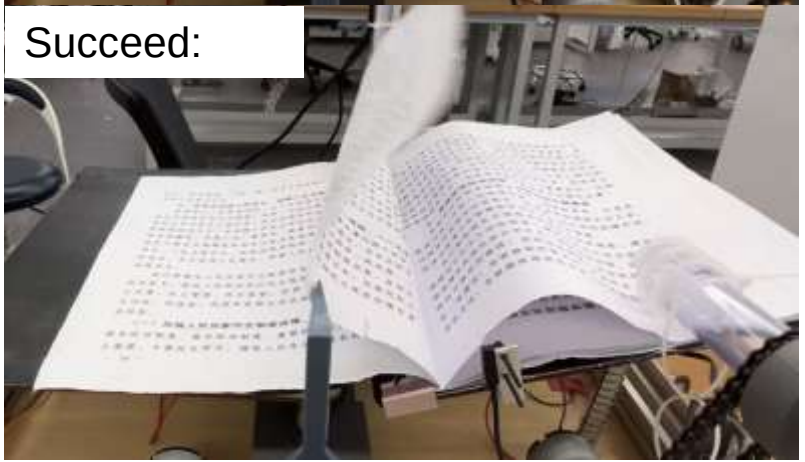
➢ Solution

Increase the moving range of the strip

Failed:



Succeed:



Conclusion: SWOT

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Strength

- Compact and cost-effective
- Produces clear and legible scanned images with minimal artifacts

Weakness

- Page-flipping speed might be slower for large-scale use

Opportunity

- Growing demand for digitization
- Potential integration with OCR and cloud storage for smart document management

Threats

- Fragile materials still pose risk of damage
- Existing commercial solutions dominate market

Conclusion: Future Work

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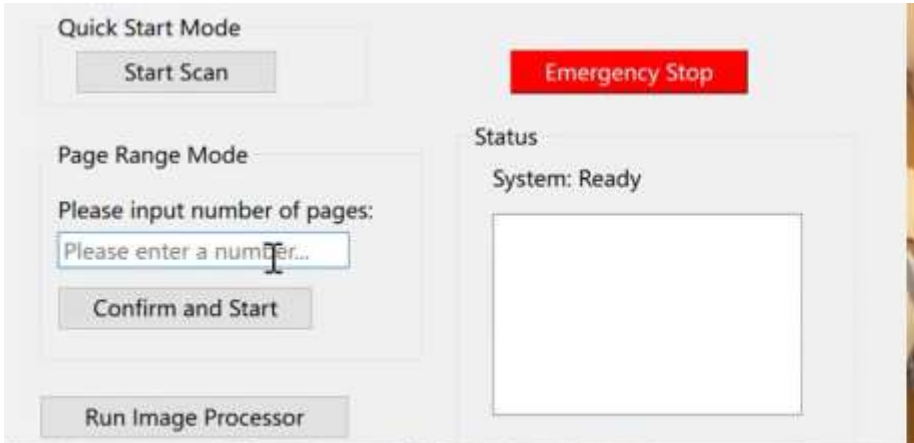
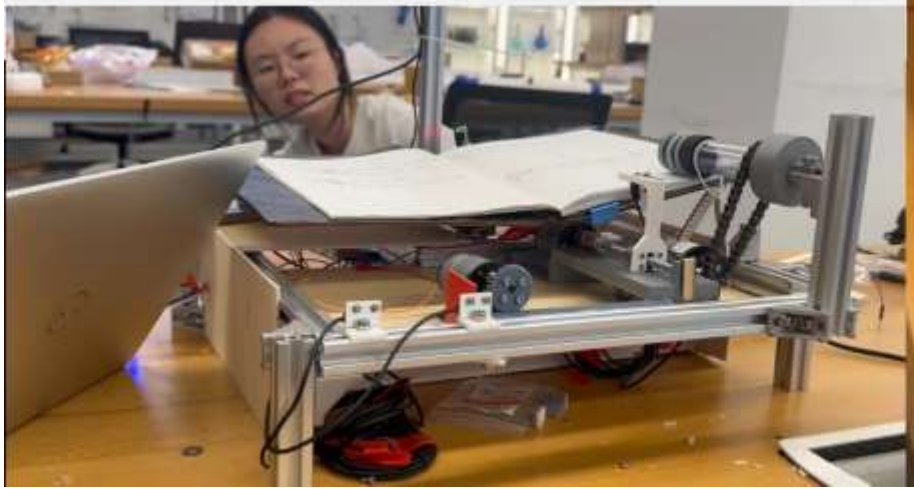
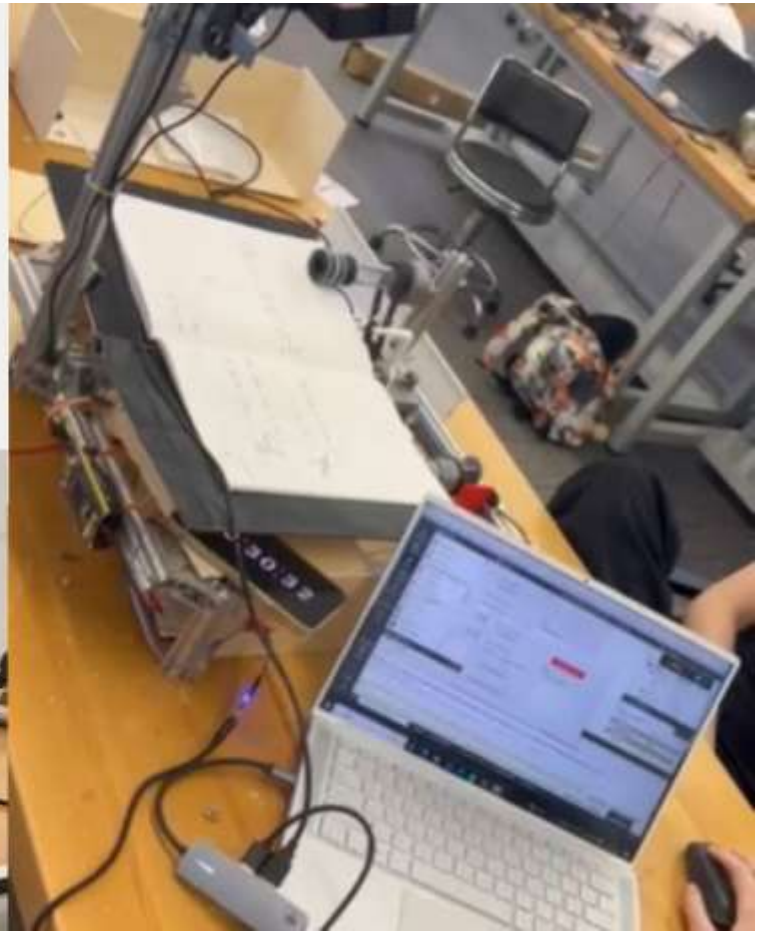
- Adaptation work for more types of books
  - Books with different materials and sizes
  - Longer moving range for strip
- Reduce the time required for a page-turning cycle
  - Choosing motor with greater speed
- Text recognition function
  - OCR
- More user-friendly services
  - UI interface with more choices

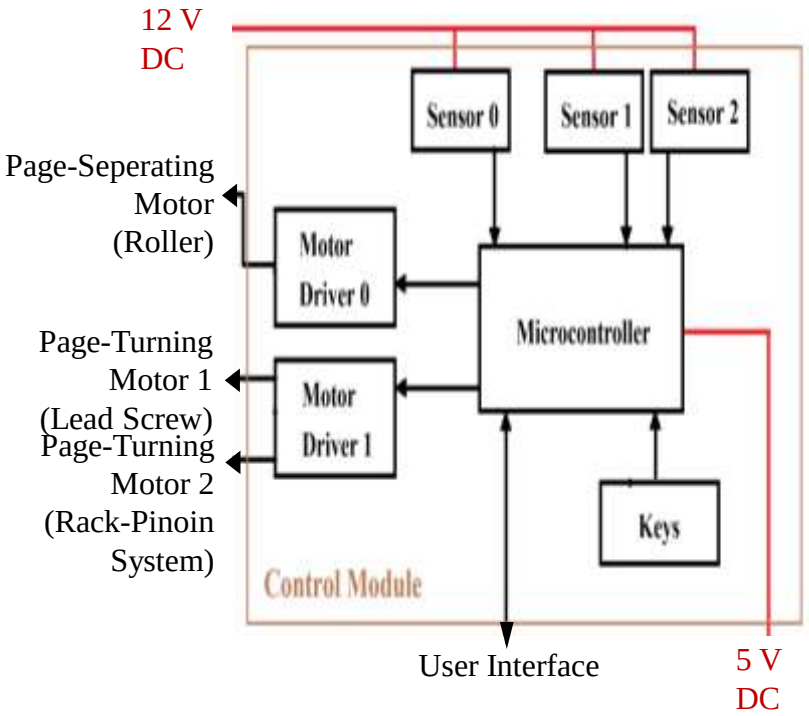

Thank You!
ECE445/ME470
Team 4


Quick Start Mode
Start Scan
Emergency Stop
Page Range Mode
Please input number of pages:
Please enter a number...
Confirm and Start
Status
System: Ready
Run Image Processor

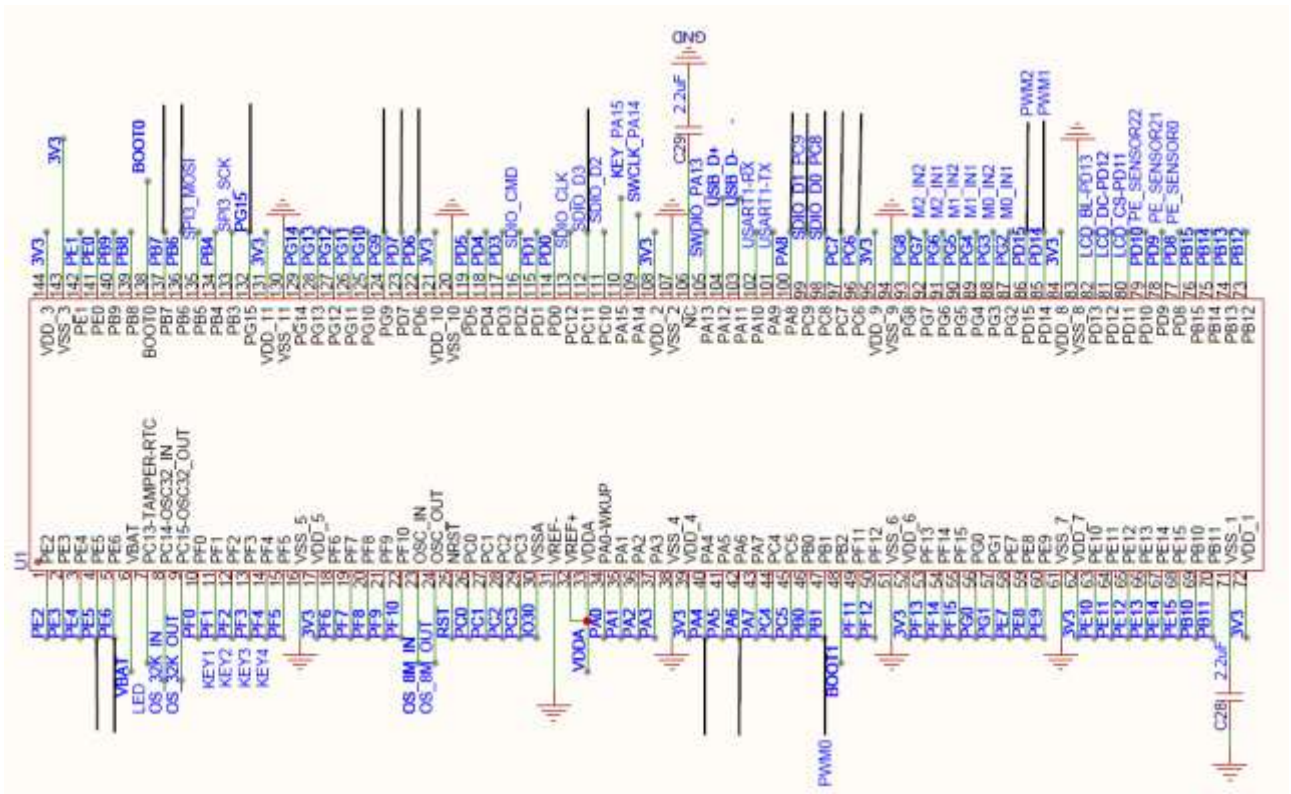




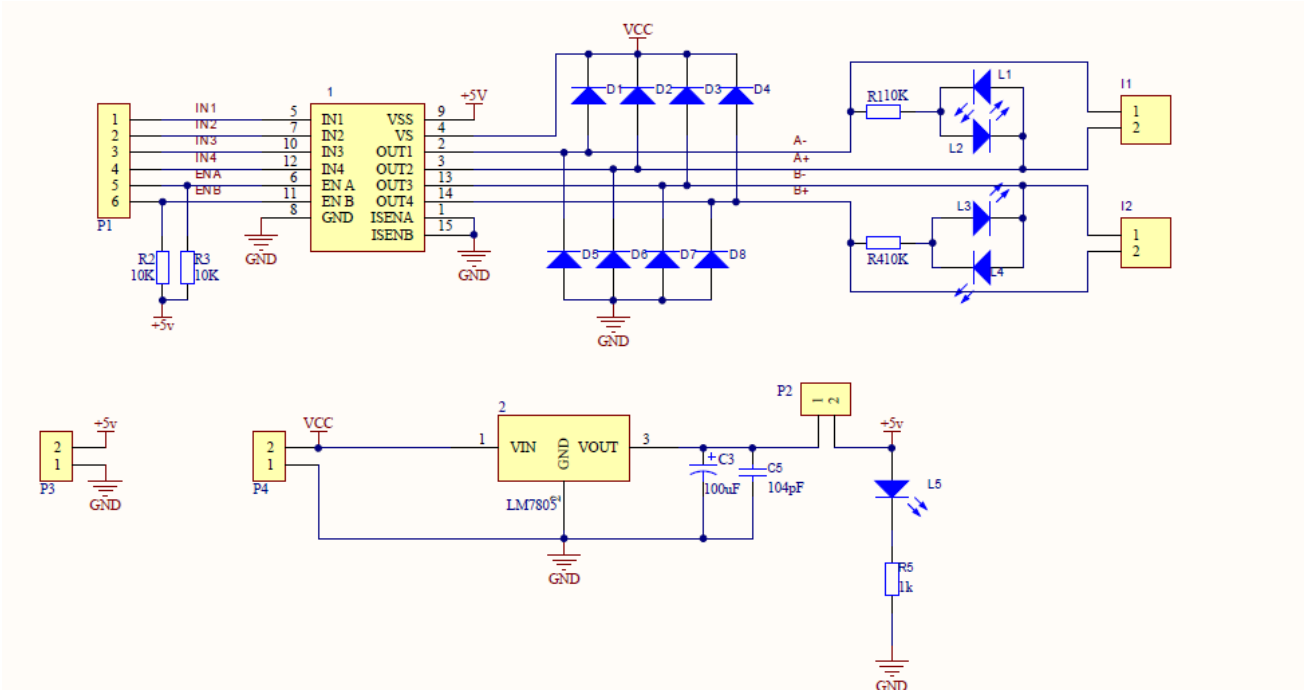
Control Module



Conponent	Device
Microcontroller	STM32F407ZGT6
Motor Driver	L298N (dual H-bridge driver)
Photoelectric Sensor	EX-13A (through-beam) EX-14A (duffusion-reflective)
USB-to-Serial-Port Driver	CH340



Microcontroller



L298N dual H-bridge Driver