

# TEAM E6:

# Intelligent Music PageFlip

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# Current Solutions



**\$13.99**

Desktop Music Stand



**\$99.95**

Bluetooth Page Turner Pedal



**\$220.00**

Page Flipper with Button Control

# To go beyond them.....



\$13.99

Desktop  
Music Stand

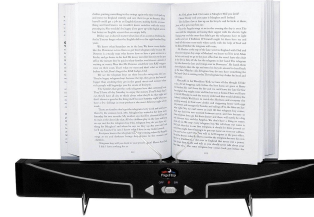
- Keyboard attachable
- Light-weight
- Affordable



\$99.95

Bluetooth  
Page Turner  
Pedal

- Bluetooth control with compatible App
- Hand/foot-free control
- Assistive technology for people with disabilities



\$220.00

Page Flipper  
with Button  
Control

- Specialized in reading music staff
- Handle mechanics of page turning well (noise control/speed ...)

# Our solution: the Intelligent Music PageFlip



# Basic Requirements

## Page Flipper (Robotics)

Flips one page at a time

Should not damage sheet music during operation

Take no longer than 5s to flip one page

## Software Program (Signal processing/image processing)

Track notes based on perfectly matching live MIDI and sheet music

Embedded in the page flipper / script running at boot

Detect end of page within one/two measures in advance and trigger the page flipper

MIDI note matching does not depend on speed of playing (BPM)

## Client Web Browser (Web Application development)

View sheet music data stored in database

User can upload sheet music to the page flipper database over WIFI

Recognized uploaded sheet music if a matching exists in the database to speed up the tracking process

# Advanced Requirements

## Page Flipper (Robotics)

Generate low noise while operating

Flip in both directions

Hold the flipped page at the turned position with an assisting arm

Take no longer than 2s to flip one page

Generate rare false-positive flips; flip the page with ~95% accuracy

## Software Program (Signal processing/image processing)

Able to track notes with a  $\leq 20\%$  error note tolerance; player not required to exactly follow the sheet music

Able to analyze advanced musical notations: repeat sign, etc.

Signal flip in both directions

Cache user uploaded sheet music in the database for future use

## Client Web Browser (Web Application development)

View tracking animation on the fly while the player is playing

Ensure low latency in transferring sheet music to the page flipper

Ensure low latency in fetching real-time tracking info from the page flipper

# Implementation

## Raspberry Pi 4

Web server framed by Django

SQLite database

RestAPI handling client requests for data

## Software Program

Scripting in Python

Image processing for matching sheet music

MIDI translation from sheet music to MIDI sequence (ScanScore)

Sliding window matching between MIDI sequences

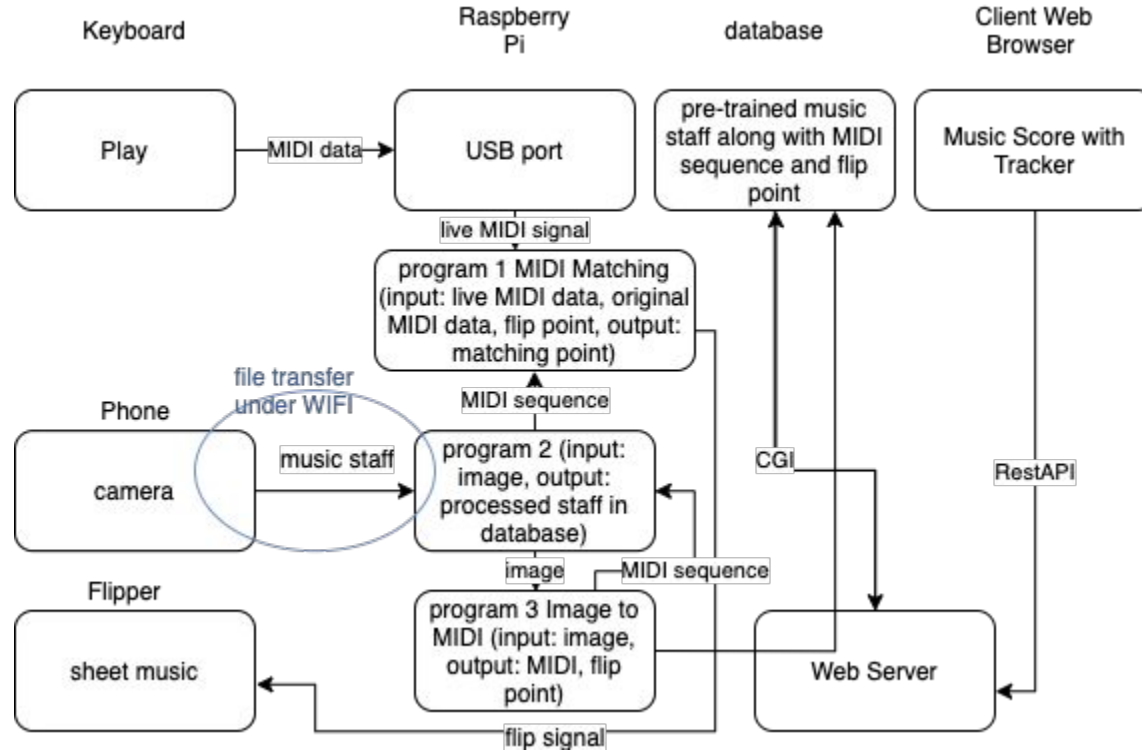
## Page Flipper

Laser cut acrylic / wood flipper, easily attachable to the keyboard

Motor with wheels attached to the music stand / use friction to flip the page over

Two assisting mechanical arms

# Solution Approach





# Testing & Metrics

RPi

Able to trigger page flipper based on button control

Able to trigger page flipper based on the flip signal output from the software program

Software Program

Tracker works on pseudo MIDI sequence generated from the input sheet music

Tracker works on pseudo MIDI sequence with missing / wrong notes

Able to send flip signal to raspberry pi when flip point is detected

Latency of the real-time tracker < 1 measure / 1s

Able to match input sheet music with database entry

Speed of image matching and fetching MIDI sequence from database < 5s

Page Flipper

Flipping mechanism works on button control

Flipping mechanism works on flip signal

Optimize speed of page flip < 2s

# Challenges

## Raspberry Pi 4

Set up Raspberry Pi as a web server

Design a database structure to optimize the time needed to query the database

Ajax for viewing real-time data on the webpage

## Software Program

Non-trivial to decide when/which direction to trigger the turner

Tune threshold of error tolerance

Camera calibration for better matching sheet music

## Page Flipper

Take multiple trials to design mechanism that prevent damage while flip one page at a time

Need control of speed / noise of operation

Light weight: careful choice of material and structure design

# Division of Labor

## Jiameng

Implement Camera Calibration

Implement the real-time MIDI tracker

Handle communication between software program and RPi: send flip signal to rasp pi

## Tracy

Design and CAD turner

Control stepper motor with Raspberry Pi

Fabricate Turner with Laser Cut / 3D Printing

Control Turner with PID

Implement Bluetooth Flip Signal Receiver

## Candy

Setup web server with Django and SQLite database

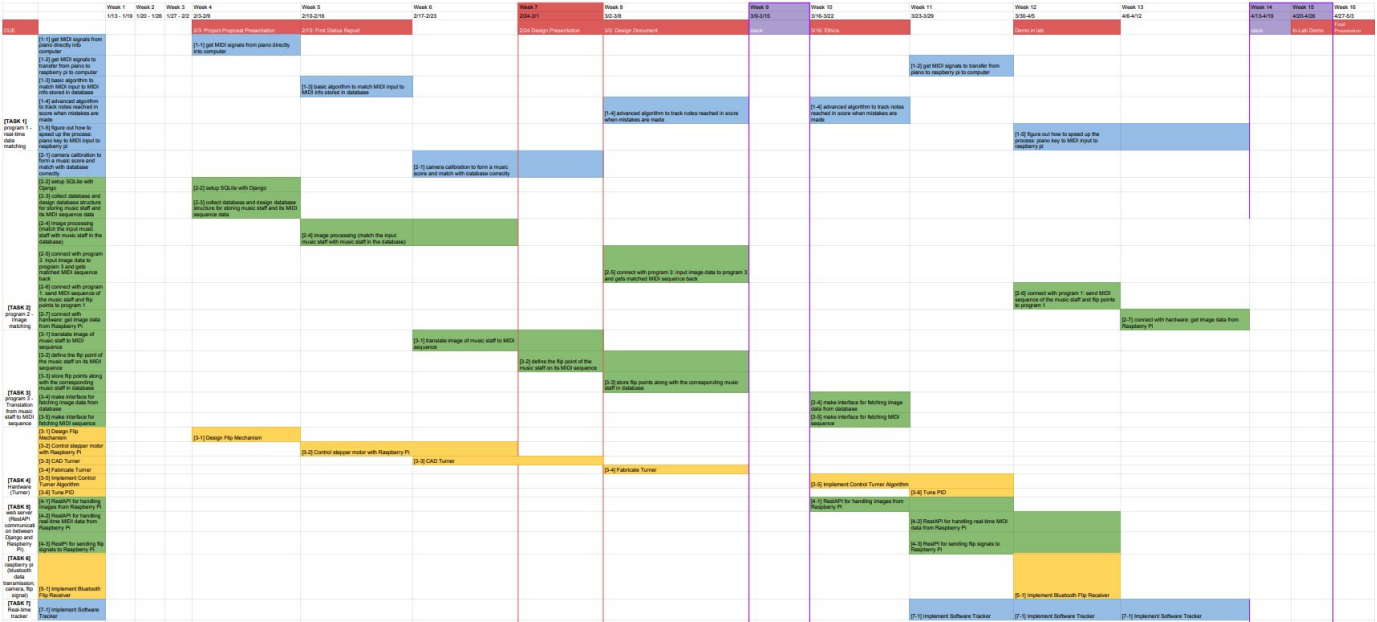
Collect + analyze sheet music and store in database

Translate sheet music to MIDI

Build RestAPI for data transfer between client and server

Implement image processing for sheet music matching

# Schedule: Gantt Chart



- Due
- Slack
- Jiameng
- Candy
- Tracy