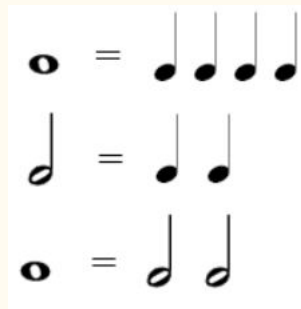
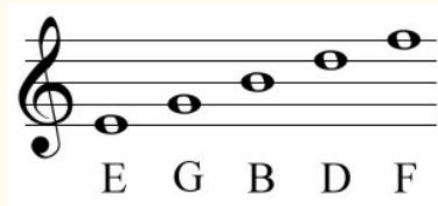
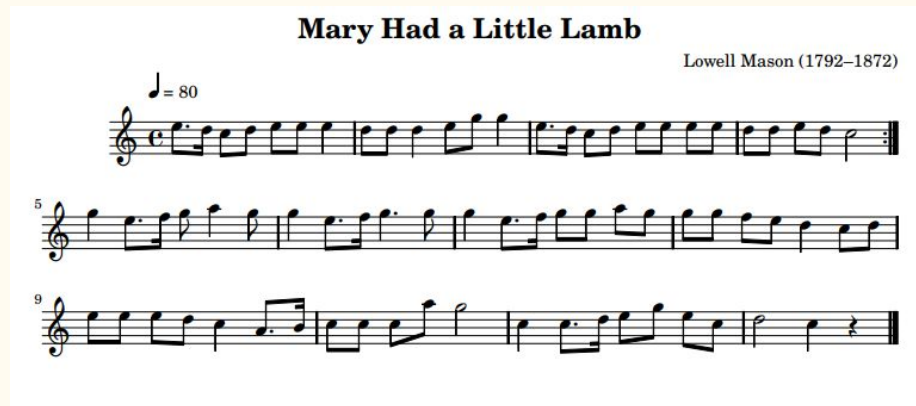


Optical Music Note Detection

By Daozhen Lu, Anirudh Jhina, Michael Guo

Goal

1. Detect objects written on a music sheet.
2. Recognize the detected notes and extract their information which includes the label and type of the notes.
3. Transform the note data into a midi sound file so that it can be played back through speakers.



Agenda

- Review previous research papers.
- Perform Segmentation on music sheet image.
- Detect notes
- Convert notes to Midi



Edge Detection

- Convert the sheet music image into gray scale for processing.
- Apply Canny edge detection to the image to binarize the image and isolate the edges.




Line Detection

- Apply probabilistic Hough transform on the binary edge image.
- There are many inaccuracies in the line detection.

Mary Had a Little Lamb
Lowell Mason (1792–1872)

$\text{♩} = 80$



The image displays a musical score for the song "Mary Had a Little Lamb" by Lowell Mason. The score is written on three staves in G-clef (treble clef) and 2/4 time. The tempo is marked as $\text{♩} = 80$. The title "Mary Had a Little Lamb" and the composer's name "Lowell Mason (1792–1872)" are at the top. The score is overlaid with green lines that represent the detected edges of the musical notation. These lines are not perfectly straight, illustrating the inaccuracies in line detection mentioned in the text. The first staff contains measures 1-4, the second staff contains measures 5-8, and the third staff contains measures 9-12. Measure numbers 5 and 9 are explicitly labeled at the start of their respective staves.

Line Detection

- Define parameters for the staff lines such as distance between the lines of the staff to improve on the detected lines in the image from the Hough transform step.
- In the graph shown in figure 1, the region circled in yellow denotes an entire staff and the valleys circled in red denote the horizontal lines in the staff. The peaks circled in green denotes the halfway point between two staves.

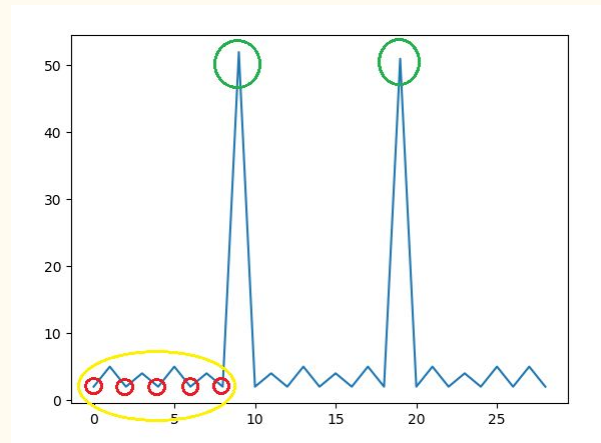


Figure 1

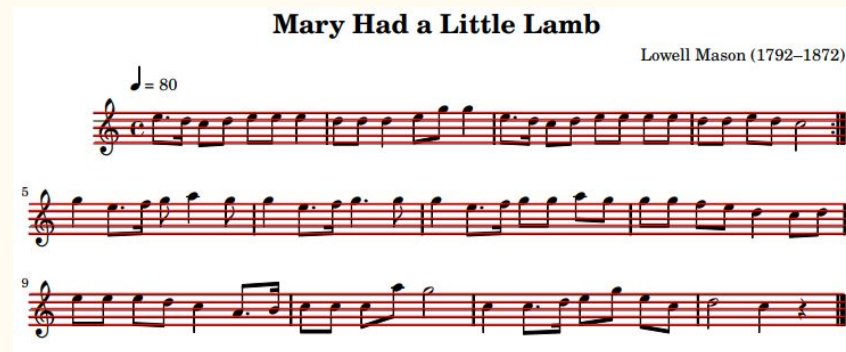


Figure 2

Line Detection

- Alternate method to detect lines with less automation through thresholding sum of row pixel values.

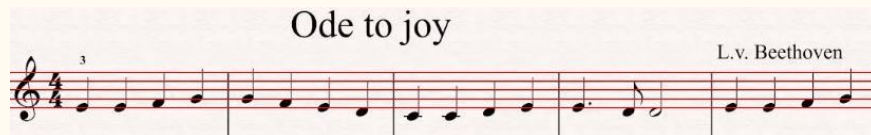


Figure 1

Note Detection

- Find the position of each note by the vertical tail of the note.

Antre Sheet Music

Ode to joy

L.v. Beethoven



Mary Had a Little Lamb

Lowell Mason (1792–1872)



Mary Had a Little Lamb

Lowell Mason (1792–1872)



Note Detection

- For each detected note, scan vertically through each staff line and gap between staff line to determine if there is a note

Antre Sheet Music

Ode to joy

L.v. Beethoven

The image displays three staves of musical notation for the 'Ode to joy' section of Beethoven's Ninth Symphony. Each staff is overlaid with a grid of blue and green rectangles, representing the vertical scan for notes. The first staff is labeled with a treble clef and a key signature of one flat. The second staff is labeled with a '5' and a treble clef. The third staff is labeled with a '9' and a treble clef. The notation includes various note values, including eighth and sixteenth notes, and rests. The green rectangles are positioned on the staff lines, while the blue rectangles are positioned in the gaps between staff lines, indicating the vertical scan for notes.

Note Detection

- To determine the length of the notes, the same vertical scan method is applied.

Mary Had a Little Lamb

Lowell Mason (1792–1872)

$\text{♩} = 80$

The image displays a musical score for the song "Mary Had a Little Lamb" by Lowell Mason. The score is written on three staves in treble clef with a common time signature (C). The tempo is marked as $\text{♩} = 80$. Each note in the melody is accompanied by a green vertical bar, which represents the duration of the note as determined by a vertical scan method. The first staff contains measures 1 through 4, the second staff contains measures 5 through 8, and the third staff contains measures 9 through 12. The notation includes various note values such as quarter, eighth, and sixteenth notes, as well as rests.

Convert notes to music

Mapping the notes we recognized from the music sheet into the parameters that can be save as music file in python. Then we can save the file.



Further Improvements

- Improve on consistency between images
- Recognize chords.
- Recognize other musical symbols such as rests and pitch modifiers.



Member Contributions

Daozhen Lu:

- Created the first working implementation of our music detection algorithm in the “project.py” file.
- Fixed and updated midi mappings for the output of our algorithm.
- Use see if two notes are connected algorithm and detect $\frac{1}{8}$ notes.
- Make $\frac{1}{16}$, $\frac{3}{16}$ notes detection for many song.
- Made edits and adjustments on the final report.

Michael Guo:

- Improved on the original implementation in the “project.py” file by adding additional features and detection heuristics to allow detection on different music sheets.
- Generated all images for the final report as well as wrote up wall sections of the final report aside from section 3.4.
- Explored and attempted various other algorithms such as hough circles, and orb with no success.
- Generated and labeled limited note images and attempted to train them in the neural network.

Anirudh Jhina:

- Initially tried experimenting with the image pre-processing using adaptive mean & gaussian thresholding with canny edge detection and hough line transformation
- Implemented the notes to midi file conversions