Shape DJ

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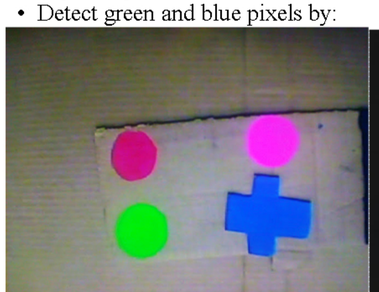
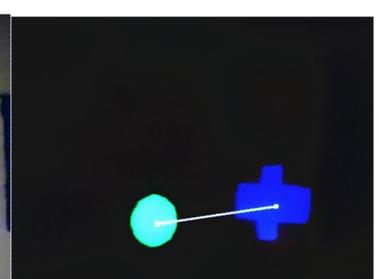
Video Processing

Color Filter

- Scans pixel from camera sequentially (left to right)
- Separate pixel into Red, Green, Blue (RGB) components
- Detect green and blue pixels by:



Unfiltered Camera Frame

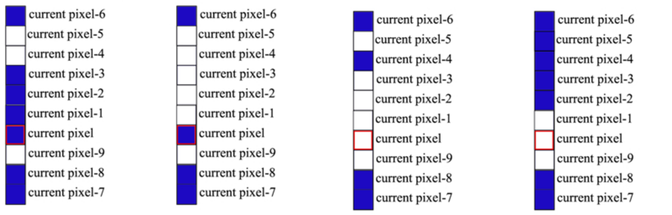


Filtered Camera Frame

- Identifying if pixel is desired color

  Thresholding: Pixel RGB components must be above a threshold for the desired color, but below another threshold for the other 2 components.
- Eliminating stray pixels

  Majority Filter: The color of the past 10 pixels are stored in a circular buffer. If the majority of these pixels are the same color and the current pixel is that color, then the pixel is decided to be correctly identified.



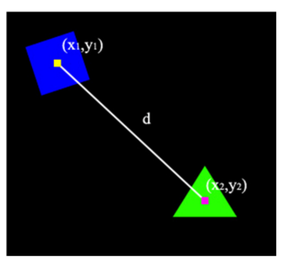
Pixel correctly identified as blue | Pixel incorrectly identified as blue | Pixel correctly identified as not blue | Pixel correctly identified as not blue

Centroid Calculation

Average x-y coordinates of pixels that are correctly identified to be the desired color

Display

- Filtered shapes
- Estimated centroids of shapes
- Distance between shapes

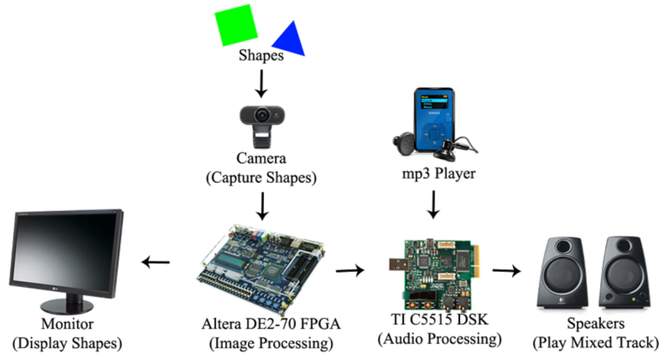


The values (x_1,y_1) and (x_2,y_2) are sent to the TI DSK to control sound effects

Introduction/Motivation

The electronic dance music market has grown significantly over the past few years. However, the learning curve and cost of the equipment are a deterrent to people with little or no musical background. Shape DJ aims to provide an intuitive musical experience for people of any musical background as well as an inexpensive and small alternative to the costly and bulky DJ equipment on the market. Users will be able to pick a track of their choice and modify the song with several effects.

System Overview/Block Diagram



Altera DE2-70 FPGA

- Read camera frames
- Apply color filtering
- Calculate shape centroid
- Send centroid coordinates to DSK
- Display filtered shapes and calculated centroid on monitor

Texas Instrument C5515 Digital Signal Processing Kit (DSK)

- Receive x-y coordinates of the centroids from FPGA
- Read audio data from mp3 player
- Add sound effects to audio based on location of centroids
- Output modified audio to headphones/speakers

Future Work

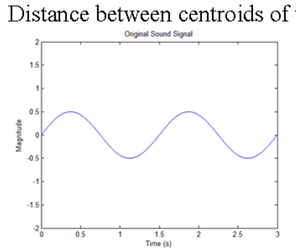
Future goals with Shape DJ include:

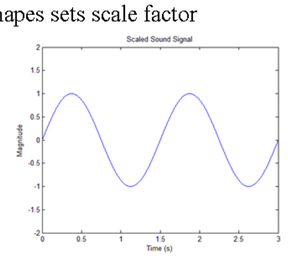
- Adding more sound modifications: Reverb, Pitch Shift, Echo, etc.
- Moving to a software-only version so that users can use Shape DJ on computers and smartphones
- Improve image processing to determine orientation of shapes
- Implement scale-invariant feature transform (SIFT) to do 'real-world' object recognition

Sound Processing

Volume Change

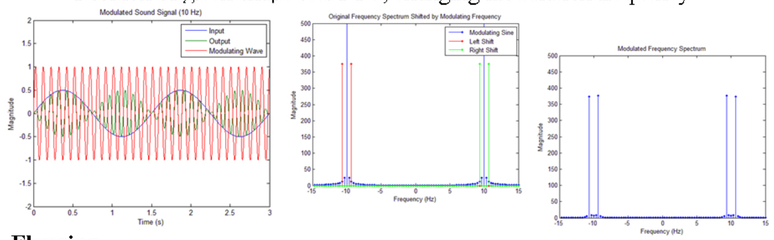
Effect:
Audio is made louder or quieter
Implementation:
Input audio is scaled.
Controller:
Distance between centroids of the shapes sets scale factor





Ring Modulation

Effect:
Audio is given bell-like, metallic overtone
Implementation:
Input audio is mixed with a sine wave, meaning the frequency spectrum of the input is shifted by the modulation frequency. Using a direct digital synthesizer (DDS), a sine table is sampled at different rates set by the frequency tuning value (FTV).
Controller:
Position of green shape sets FTV, changing modulation frequency



Flanging

Effect:
Audio is given whooshing, "jet-plane like" effect
Implementation:
Input audio is added to a version of itself that has been given a small, gradually changing delay from .1 ms to 5 ms. The small delays create destructive interference which leads to an evenly spaced comb filter in the frequency domain.
Controller:
Position of the blue shape sets rate of change of delay, changing the spacing of the comb filter notches