Gesture Recognition Remote Control

Wolfe Styke

6.111 Final Project

The Gesture Creators: Wands

- Each Wand
  - 1 sphere of LEDs attached to end of wand
  - 1 button to turn on/off LEDs
- Two Wands
  - different color LEDs for more gestures
- Set list of gestures which will be understood by labkit hardware

The Gesture Interpreter: Labkit (Part 1)

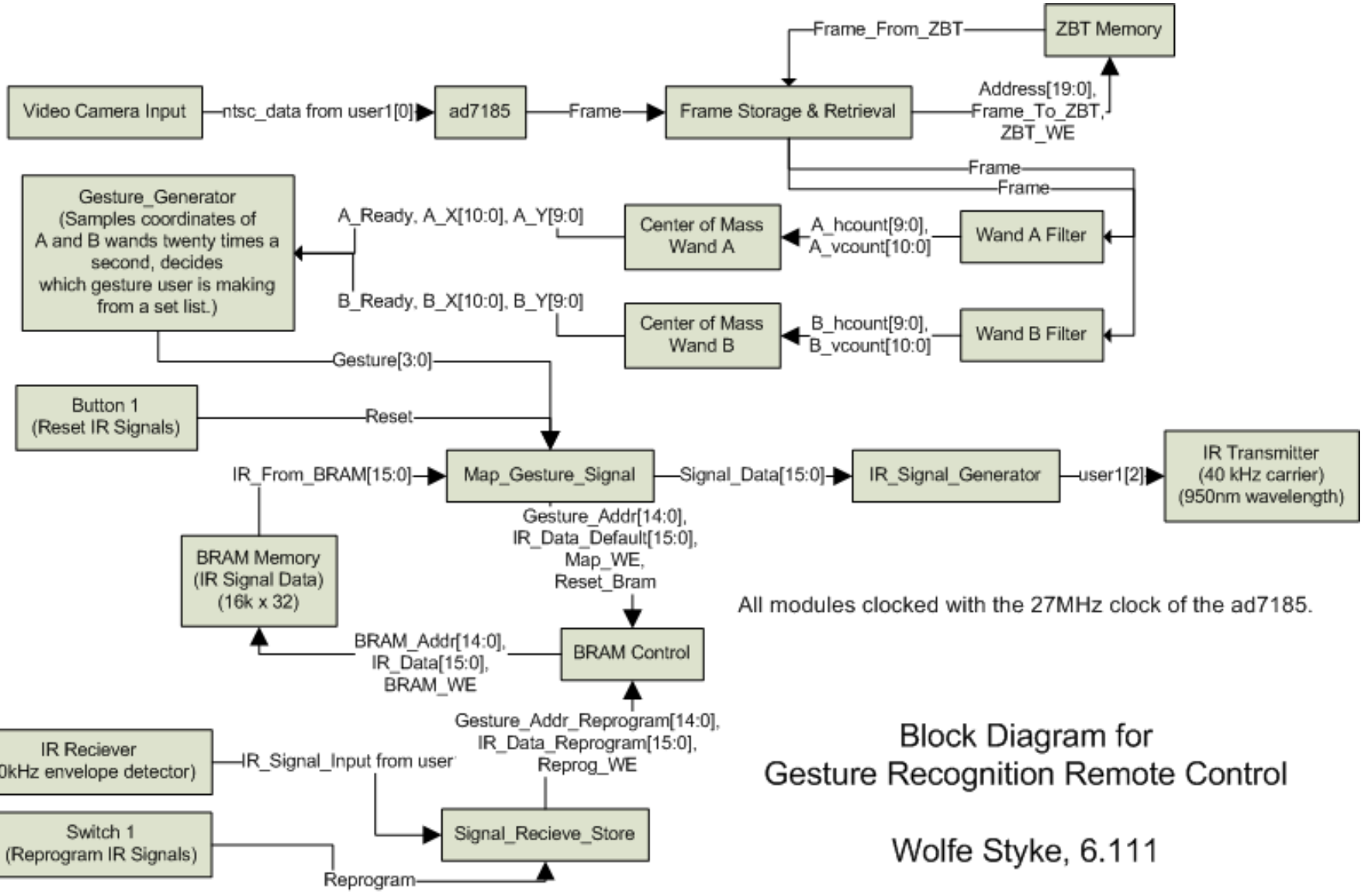
Purpose: To allow user to create gestures with wands that create corresponding changes in the state of a device normally controlled by IR remotes.

- Input:
  - A ntsc video camera
- Output:
  - infrared (IR) transmitter for controlling external devices (tv)
- Internals:
  - ZBT memory:
    - to store incoming frames from camera
  - Image Filters:
    - to find presence and location of each wand in frames
  - Gesture Identification:
    - to determine gesture based on samples of wand movement
  - IR Signal Finder:
    - to look up the corresponding code for each gesture identified
  - IR Signal Generator
    - to create the IR signal sent to the IR transmitter output

The Gesture Interpreter: Labkit (Part 2) (time permitting)

Purpose: Allow device to be reprogrammed to function like any remote control.

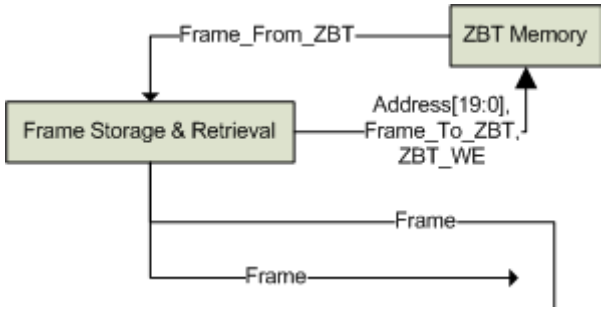
- Input:
  - IR Reciever
  - A labkit button
- Internals:
  - IR signal analyzer and storage
    - to analyze a pre-determined sequence of signals from a new IR remote control
    - to store this set of signals in the BRAM memory


Frame_From_ZBT
ZBT Memory
Video Camera Input
ntsc_data from user1[0]
ad7185
Frame
Frame Storage & Retrieval
Address[19:0],
Frame_To_ZBT,
ZBT_WE
Frame
Frame
Gesture_Generator
(Samples coordinates of
A and B wands twenty times a
second, decides
which gesture user is making
from a set list.)
A_Ready, A_X[10:0], A_Y[9:0]
Center of Mass
Wand A
A_hcount[9:0],
A_vcount[10:0]
Wand A Filter
B_Ready, B_X[10:0], B_Y[9:0]
Center of Mass
Wand B
B_hcount[9:0],
B_vcount[10:0]
Wand B Filter
Gesture[3:0]
Button 1
(Reset IR Signals)
Reset
IR_From_BRAM[15:0]
Map_Gesture_Signal
Signal_Data[15:0]
IR_Signal_Generator
user1[2]
IR Transmitter
(40 kHz carrier)
(950nm wavelength)
Gesture_Addr[14:0],
IR_Data_Default[15:0],
Map_WE,
Reset_Bram
BRAM Memory
(IR Signal Data)
(16k x 32)
BRAM_Addr[14:0],
IR_Data[15:0],
BRAM_WE
BRAM Control
All modules clocked with the 27MHz clock of the ad7185.
Gesture_Addr_Reprogram[14:0],
IR_Data_Reprogram[15:0],
Reprog_WE
IR Reciever
(40kHz envelope detector)
IR_Signal_Input from user
Switch 1
(Reprogram IR Signals)
Signal_Recieve_Store
Reprogram
Block Diagram for
Gesture Recognition Remote Control
Wolfe Styke, 6.111

Video Interpretation (Pt. 1)

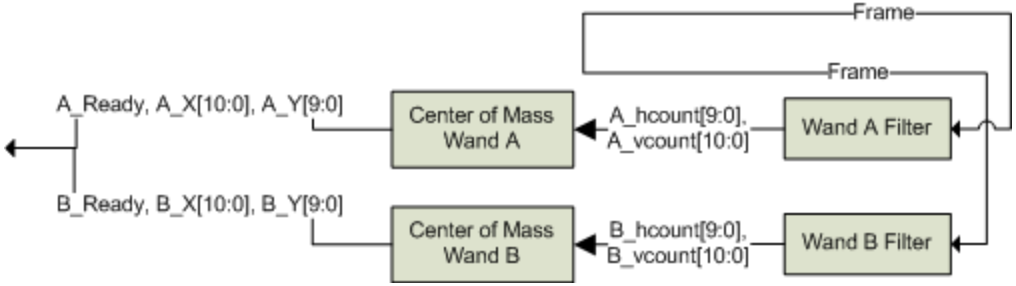
- The ad7185 module
  - Clock: 27 MHz – used for all modules
  - Every four clock cycles:
    - Video info sent in order: Cr, Y, Cb, Y
      - Luminance sampling rate: 13.5 MHz
      - Color sampling rate: 6.5 MHz
  - Will be reused from existing module designs.

ZBT Memory



- ZBT Memory
  - controlled via frame storage and retrieval module
  - takes in frames from video interpreter
  - passes frames out to the filters

Filters



- Filter (input: frame)

  >> determines if and where a wand is lit up <<

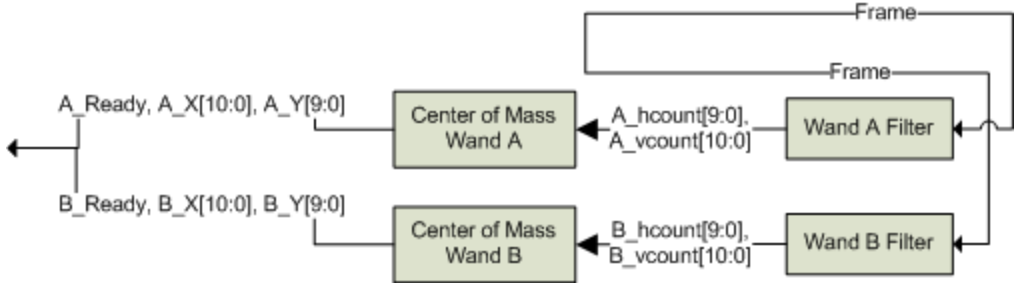
  – luminance -> detect presence of wand

  – color -> detect which wand is gesturing

  – output:

    - coordinates of pixels where wand being tracked resides

Center of Mass

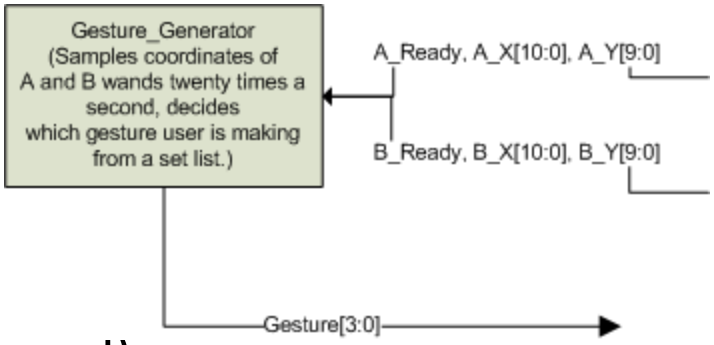


- Input: Coordinates of pixels where wand is found

- Internals:
  - Detect presence of wand by finding a jump in total number of pixels of a certain color or luminance
  - Find average hcount and vcount of pixels noticed
  - Implementation Idea:
    - stop analyzing the data for a frame after the line with the largest number of pixels signifying a wand are detected, then use that line's hcount and the average the vcounts showing pixels for that line

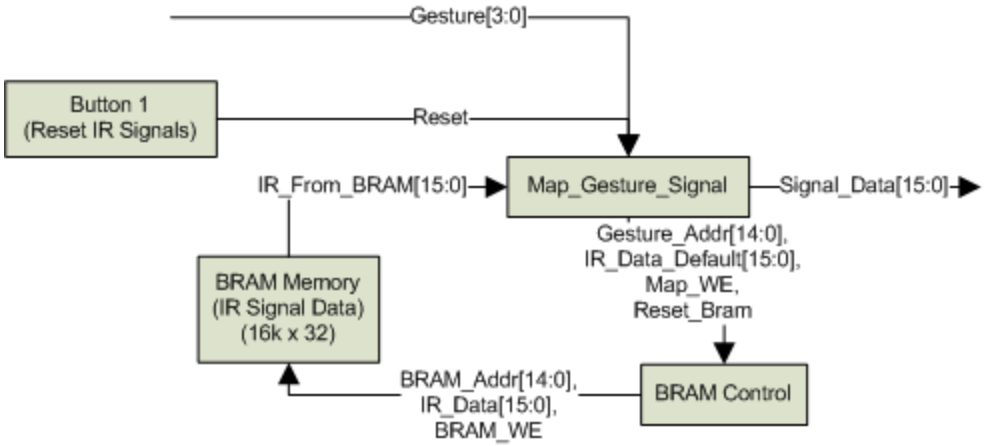
- Output:
  - Coordinates of wand's center
  - Ready signal signifying presence of a wand

Gesture Generator



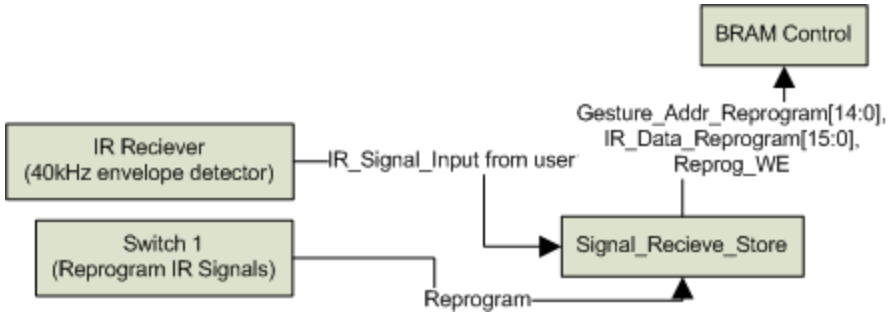
- Input (from each wand identifier):
  - ready signal (signifying presence of wand)
  - coordinates of wand
- Internals:
  - Sample coordinates of each wand roughly 30 times a sec.
  - Classify movements of each wand between samples in terms of simple directions (up, down, left, right)
  - Map list (or 2 lists from 2 wands) of directions to a pattern associated with a gesture
- Output:
  - Gesture chosen from a set list of gestures
    - 1 Wand (either wand a or wand b)
      - aUp, aDown, aLeft, aRight,
      - bUp, bDown, bLeft, bRight
    - 2Wands
      - Both (Up, Down, Left, Right)
      - Traveling (away and towards) each other

Gesture to Signal



- Input:
  - Gesture
  - Reset button
- Internals
  - BRAM memory to store IR signal data for each gesture
  - A lookup table for picking the address in the BRAM to reference for a given signal
  - A Bram Control module for giving control of the BRAM to the second part of the system (adding new signal data) when used
- Output:
  - IR Signal Data

New IR Remote Functionality



- Input:
  - IR Reciever
  - Switch on Labkit (Reprogram)

- Internals:
  - Receiving a specific sequence of signals (from IR remote)
    - ie (Vol. Up, Down, Chan. Up, Down, etc…)
  - Stores each signal in BRAM memory through gaining control of the memory via the BRAM Control module

- Output (BRAM Memory update)
  - Address of BRAM memory to update
  - Signal to update memory with
  - write enable, which also signifies the gaining of control of the BRAM memory

Signal Generator

- Input:
  - Signal Data
- Internals:
  - convert signal data to wire output highs and lows recognizable to IR Transmitter
  - emulate timing pattern for ones and zeros according to the remote control pattern
- Output:
  - wire user1[2] to IR transmitter to device controlled (TV)

Timeline

Item To Complete	Date to Complete By	Comments
ZBT Memory	11/17	
Filters	11/19	
Center of Mass	11/22	
Gesture Generator	11/24	
Gesture to Signal	11/29	
New IR Remote Functionality	If time	Extra Functionality
Signal Generator	12/1	