Automatic Tracking Camera

6.111 Project
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Outline

- Overview
- Audio Processing and Triangulating
- Video Processing and Tracking
- Integration of Video and Audio
- Required Hardware
- Conclusion (Potential Add-ons)
Overview

- Automatic Intrusion Detection and Anti-Theft Device
- Security Camera that tracks moving objects using both video processing and audio targeting
- Video processing used when an object in view of the camera is moving to follow the direction of movement
- Audio processing used when no objects are moving in order to find the object causing the sound
- After object is targeted a snapshot of the objects center will be stored into RAM
Overview Block Diagram

Master Controller

Debounce

Camera_Mv[1:0]

Snapshot

Manual_Overide

Reset

Clk

Move_Camera[3:0]

Cant_Move[1:0]

Mic 3

Mic 2

Mic 1

Audio Processor

A_Angle[5:0]

A_Motion

Moving

V_Motion

V_Angle_H[5:0]

V_Angle_V[5:0]

Moving

Take_Picture

Picture memory

Pic[x:0]

Display_Type

Video_Out[x:0]

Display Module

Camera

Camera Motor

Camera_YUV_IN[x:0]

Take_Picture

Video Processor

Mic2

Mic1

Reset

D_Camera_Mv[1:0]

D_Snapshot

D_Manual_Overide

D_Reset

Overview Block Diagram
Audio Processor

Mic1 → AC97 → BPF → Fdata1[7:0] → Comparator → Direction Locator

Mic2 → AC97 → BPF → Fdata2[7:0] → Comparator → Direction Locator

Mic3 → AC97 → BPF → Fdata3[7:0] → Comparator → Direction Locator

Moving

A_Motion

A_Angle[5:0]
Audio Processing Pipeline

- AC97 performs A/D conversion
- Band Pass Filter only lets through 500Hz-1KHz frequencies
- Comparator triggers Direction Locator if amplitudes pass threshold
- Direction Locator takes in audio data to locate sound source based on differences in sound arrival times.
Direction Locator
**Video Processor**

- **camera_in** (composite video)
- **Luma Extractor**
  - **ADV7185**
    - **dig_in**, **sync[1:0]**
    - **luma_in[7:0]**
  - Part of Javier’s video module
- **Sampling Filter**
  - (downsizing and samples every other image)
  - 640x480 to 320x240
- **High Pass Filter w/ ZBT mem**
  - **frmem_start**, **old_frame[7:0]**
  - **hpf_data[7:0]**
  - **bcomp_start**, **sf_data[7:0]**
- **Block Comparison**
  - **bcomp_done**, **bcomp_start**, **angle_done**, **angle_start**, **motion_center[10:0]**
- **Frame Memory (ZBT)**
  - **v_angle_v[5:0]**, **v_angle_h[5:0]**
- **Angle Calculator**
- **To Master Controller**
Motion Detection Algorithm

- Interframe comparison
- SS LD: Sum of square luma differences for each macroblock (16pixel X 16pixel)
- Center of “movement” macroblocks calculated and sent to angle calculator
- Angle calculator determines movement of camera to center on target
Master Controller
Purpose of Master Controller

- Accept input from video and audio processors to determine which direction the camera should move
- Interface with the camera motors to control motion
- Take snapshots of the object in motion
- Control display module
- Provide debugging interface to test integration of modules
Display Control
Controls what is displayed on the LCD: either the last snapshot taken or the current camera view

Motion Calculator
Determines where to move the camera based on motion and audio detection

Picture Taker
Converts input pulse into a write enable wave for memory

Picture Memory
Stores the last snapshot of motion

Switch Inputs
D_Manual_Override
D_Display_Type

Button Inputs
D_Reset (All Modules)
D_Snapshot
D_Camera_Mv[1:0]

Motion Detection Inputs
V_Motion
V_Angle_V[5:0]
V_Angle_H[5:0]
A_Angle[5:0]
A_Motion

Clk → All Modules

Looking (sent to video and audio processors)
D_Manual_Override
D_Camera_Mv[1:0]
V_Angle_H[5:0]
V_Angle_V[5:0]
V_Motion
A_Angle[5:0]
A_Motion
CLK (All Blocks)

Motion Calculator

Cant_Move_Down
Cant_Move_Up (From mounting assembly)

Moving (sent to audio and processing units)

FSM

Motor Controller 1
Motor Controller 2

Stepper Motor 1
Stepper Motor 2

Look_Up
Look_Down
Look_Right
Look_Left
Required Hardware

- 3 Omni-directional Condenser Microphones
- 1 CCX-Z11 Video Camera
- 2 AIRPAX LB82731-M1 Stepper Motors
- Camera and Microphone Motor Motor Mount
- 2 doorbell buttons
- External Power supply for motors
- 2 External AC97’s
- 6.111 Labkit
Potential Add-Ons

- Sentry Gun
- Video target overlay
- Picture Browsing Interface
- Enhanced audio triangulation
- Range Finder
Conclusion

Questions