CprE 491 Project Plan for Team "May 13-07"

Team Members: Ethan Little, Tom Moser, Scott Schroeder

Project: Gesture and Voice Recognition for Automobiles (senior design project)

Problem Statement

Some in the industry see gesture recognition as a technology that will make in-vehicle systems easier and less distracting to operate. Garmin wants to explore the best applications of gesture technology for its next generation OEM infotainment systems. These systems will include an array of modes/features including navigation, audio/entertainment, communication, vehicle information and other miscellaneous applications (streaming music applications, social media, etc). The system must provide usability advantages over switches, buttons and touchscreens, providing either safety (i.e., less distraction) or convenience advantages, by using gesture recognition technologies.

Goal

Provide a distractionless environment for drivers by leveraging gesture recognition for simple tasks interfacing with the vehicle. This means that drivers can focus on driving without having to pay attention to their dashboard or fiddle with their infotainment system. We will implement a system that allows someone to operate certain aspects of their vehicle (media/entertainment, GPS navigation) through gesture commands.

Gesture Recognition List

1) Media/ Entertainment
    - Volume control
    - Music track control
    - Power On/ Off
    - Phone (calling and texting)
2) GPS Navigation
    - Pinch zoom
    - Panning
3) Automobile System Controls
    - Interact with menu
    - Make selections
    - Turn on voice recognition

Potential Use Cases and Benefits

1. Interact with center stack display interface with the ability to scroll lists, pan/zoom maps, seek up/down (radio, tracks), and switch modes (nav, audio, communication, etc.) with the users arm and hand in a comfortable position (i.e., without reaching for the display or other controls). Gesture is not thought to completely completely replace the touchscreen, but be a complementary technology.

2. Interact with automobile menus to make settings changes and request information. This means the driver does not need to take their eyes off the road to look at the dashboard for information.

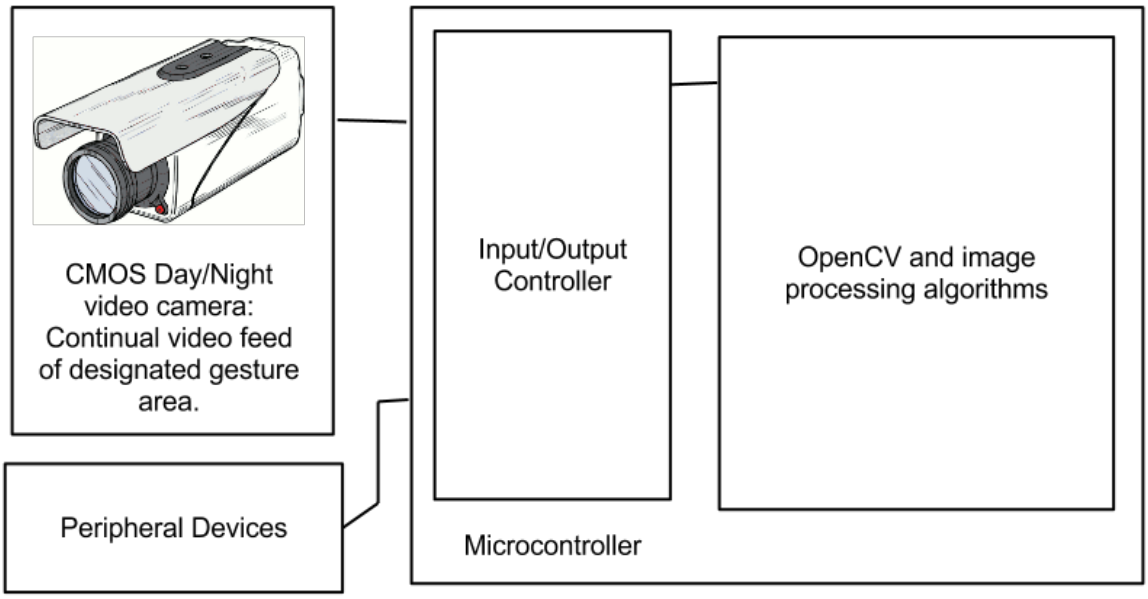
System Description

The system will be comprised of an IR sensor connected to either a computer or an embedded processor that will be used to determine which gesture was performed by the user. The user will have a list of “known” gestures that they can refer to that they can use to interact with the display of the infotainment system.

User Interface Description

The entire user interface for the system will be through hand gesture recognition. Feedback will be displayed to the user via a monitor or led light indicating what gesture was recognized.

System Diagram



Requirements

Functional

- Recognize 4-20 distinct hand gestures

Non-Functional

- Limit processing power required to run gesture recognition
- Minimize cost
- False positive and false negative rate less than 1 in 100

- Shallow consumer learning curve(i.e. Easy gestures)

Operating Environment

The final system will need to operate in a variety of vehicle cockpits and perform in extreme temperatures and light conditions.

Deliverables

- Executable gesture recognition code
- Hardware specifications document
- System schematics
- Testing results

Feasibility Study

There are a lot of existing technologies available for gesture- and voice-recognition. Technologies such as Leap Motion's LEAP and Microsoft's Kinect provide APIs for precise gesture recognition. There are also numerous API's (OpenCV, etc...) available for video processing that will allow us to process the signals we receive and determine what gesture a user is making.

Leap Motion's LEAP is the size of a USB drive and can distinguish your individual fingers and track your movements down to a 1/100th of a millimeter. This will allow us to recognize very specific hand gestures that will represent controls or functions in the car.

CMOS imaging is another viable option we are considering during our hardware investigation. CMOS is a cheap technology with a large amount of research already done in the processing of the signals.

Resources

CMOS Sensors with IR
Microsoft Kinect
Leap Motion
Desktop Computer
Cockpit Mockup

Milestones

Sensors Research complete - 10/2012
Choose Sensor - 10/2012
Collecting Data from sensor connected to computer - 12/2012
Able to detect presence of hand or other object - 2/2013
Recognize 1 gesture - 3/2013
Recognize 5 gestures - 4/2013
Recognize 10 with accuracy of 95% in cockpit setting. - 5/2013

Work Breakdown

Scott Schroeder:

Hardware requisition/research
Communications

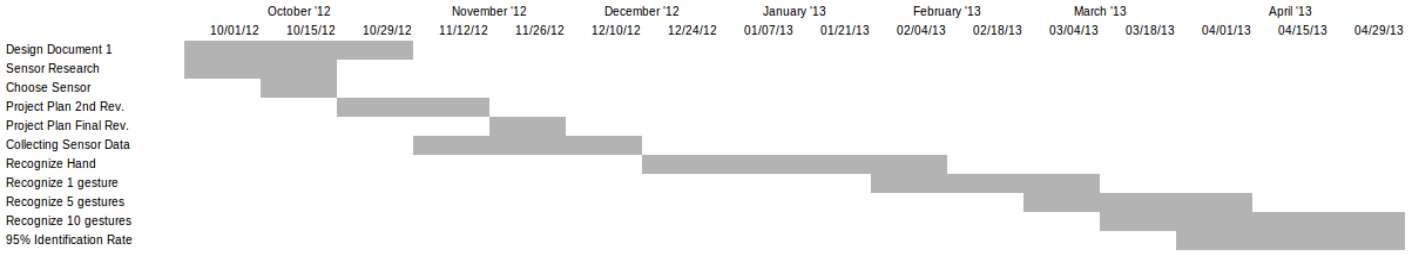
Ethan Little:

Image processing
product output

Thomas Moser:

Input capture
hardware manipulation and design

Schedule



Risks

1) Competing companies invest in similar technologies and/or beat us to market.

- Our product should be intuitive enough that it becomes second nature to our users and creates a following of dedicated customers. There are already simple implementations being brought to market, however being the first in market will not be as important if we have a quality product.

2) Our product has problems interfacing with different automobiles.

- We will strive to keep our gestures simple and our hardware widely available as to make it's installation in various sized vehicles a breeze. We will work with different automobile manufacturers down the road to customize our sensors to fit their specific needs.

3) Project may be too ambitious

- We will use the iterative design process to add additional functionality one step at a time. This will allow us to expand the product until it reaches a satisfactory conclusion or outside forces dictate its completion.

4) Our team does not have the required expertise to complete the project.

- We will use our industry contacts and faculty advisors as consultants.