

Team Members:

Jonathan Lobaugh

Mohammed Hoque

Troy Tancraitor

Mentors:

Dr. Ralph Ford & Ronald McCarty

Presentation overview

- Problem Statement
- Needs
- Requirements
- Architectural design
  - Robotic layer
  - Processing layers
  - Communications layer

Problem statement

- Our objective is to develop a system that will allow the user to interact effortlessly, simplify user requests, and transfer information to and from a digital medium. It should allow for an improvement of the interface with a conventional machine in daily applications.

  - **Primary Objectives:**
    - Being able to detect the user
    - Being able to detect different human faces and remember them
  - **Secondary Objectives:**
    - Being able to understand what the users say
    - Being able to detect different voices
    - Being able to have the robot move according to the user's gesture.

Needs

- Recognize face
- Recognize voice
- Must be able to focus on user
- User authentication
- Ease of use
- Aesthetically appealing
- Respond to voice
- Low cost
- Quick reactions
- Reliable
- Accurate
- Non-threatening
- Standardized adaptors

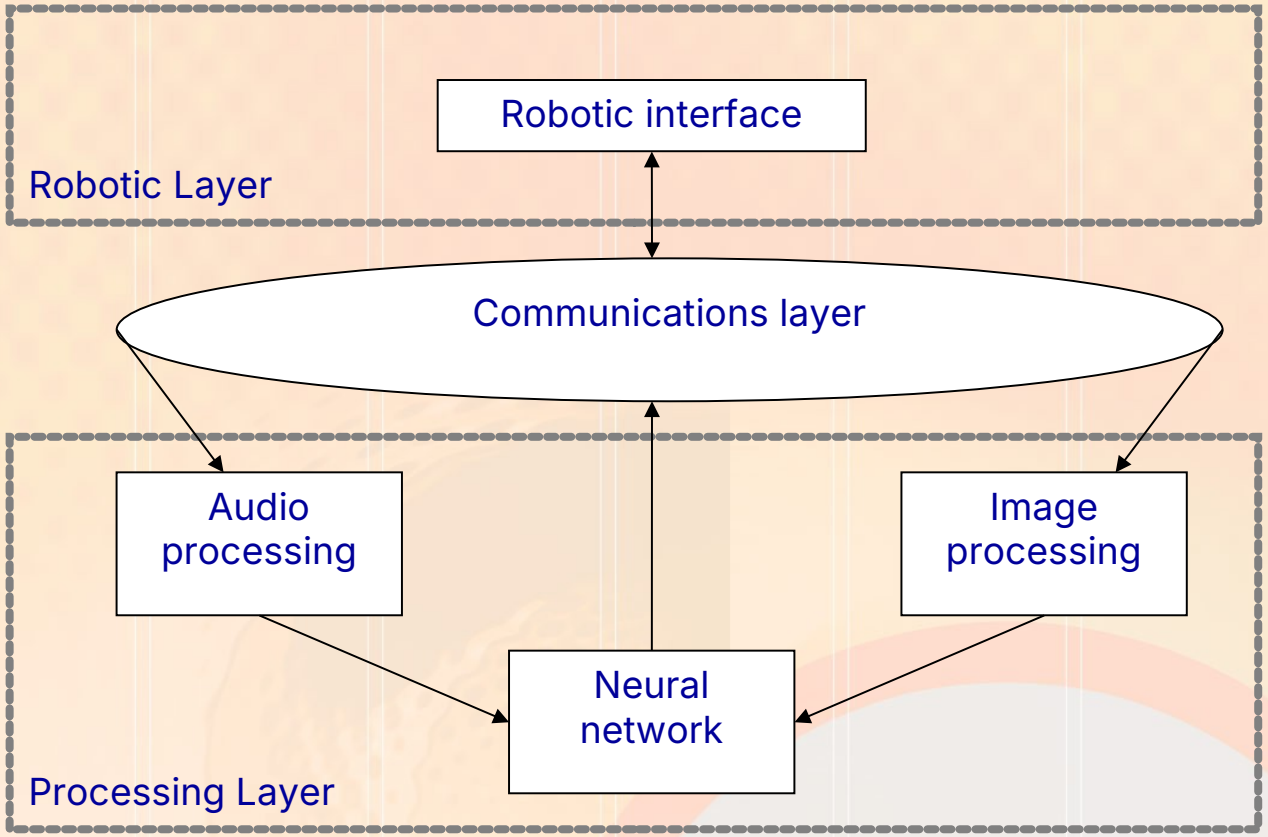
Requirements

- Ease of Use
  - Standardized adaptors
  - Centralized control
  - Minimize connections needed
- Cost
  - Less than $500 budget
- Reliability
  - Detect a user visually with 90% success rate
  - Detect a user’s voice with 80% success rate

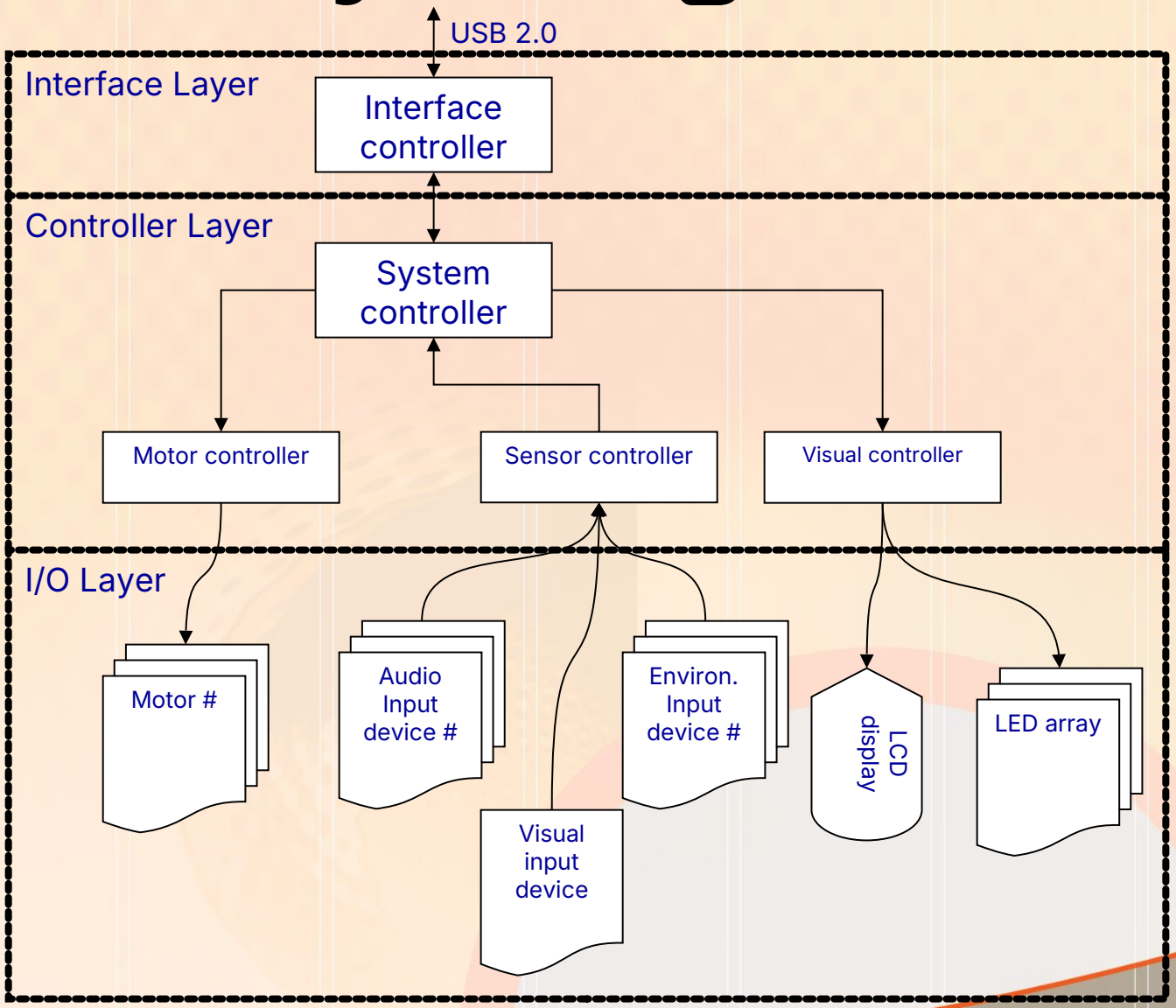
Requirements continued

- Accuracy
  - Identify a specific user with 80% accuracy
- Durability
  - System should last for the duration of the project
- Size
  - Occupy less than approximately 2 cubic feet
- Efficiency
  - Finish visual and audio computations within 0.5 seconds

High-level Architectural design



Robotic layer diagram



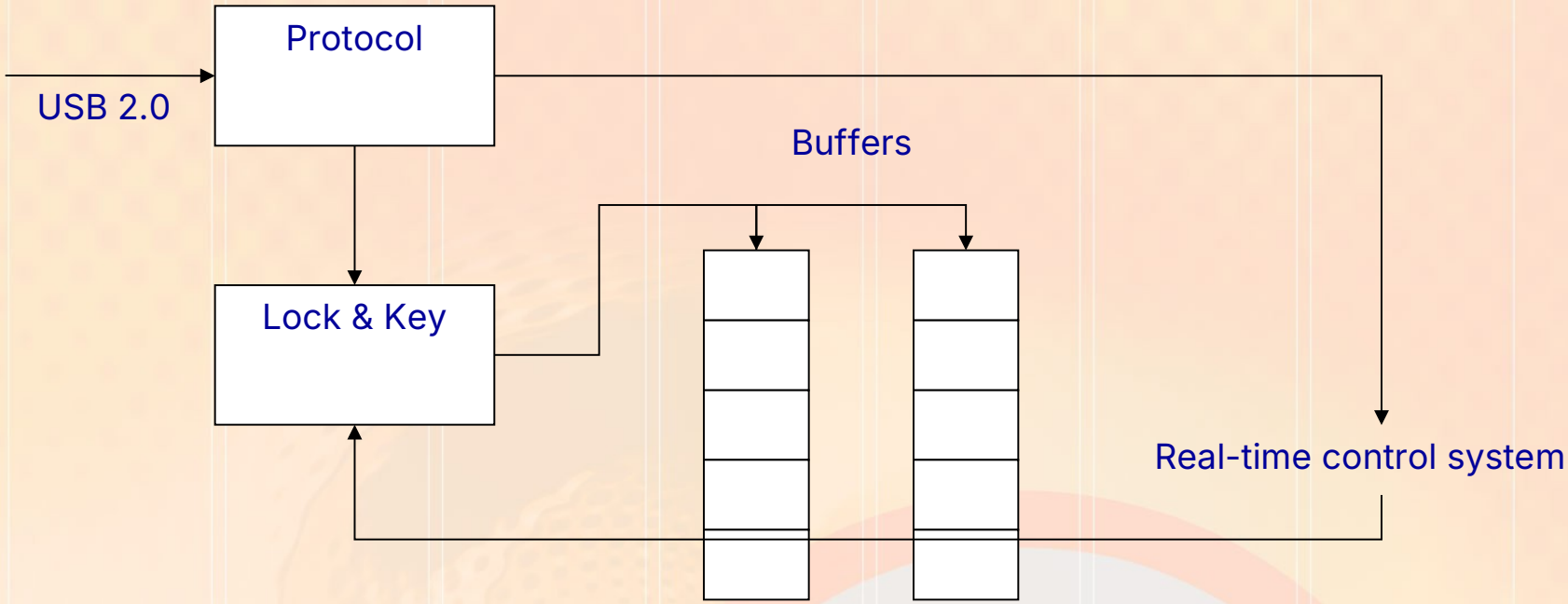
Robotic layer

- I/O control
  - Microcontroller based sub-systems
  - Main “System” will oversee control of sub-systems
  - Three main sub-systems
    - Sensor
    - Motor
    - Visual

Robotic layer

- Output
  - Audio
  - Motion
  - Imaging
- Input
  - Communications
  - Control

Communication layer diagram



Communication Layer

- Represents the link between the robotic and processing layer
- Coding will be done in C/C++
- We will be using a USB 2.0 connection
- Two forms of data being transferred
  - The audio will be in digital audio form
  - The images will be a 512x512 bitmap
- Two buffers to store the data
- RTCS will send back commands

Processing layer diagram

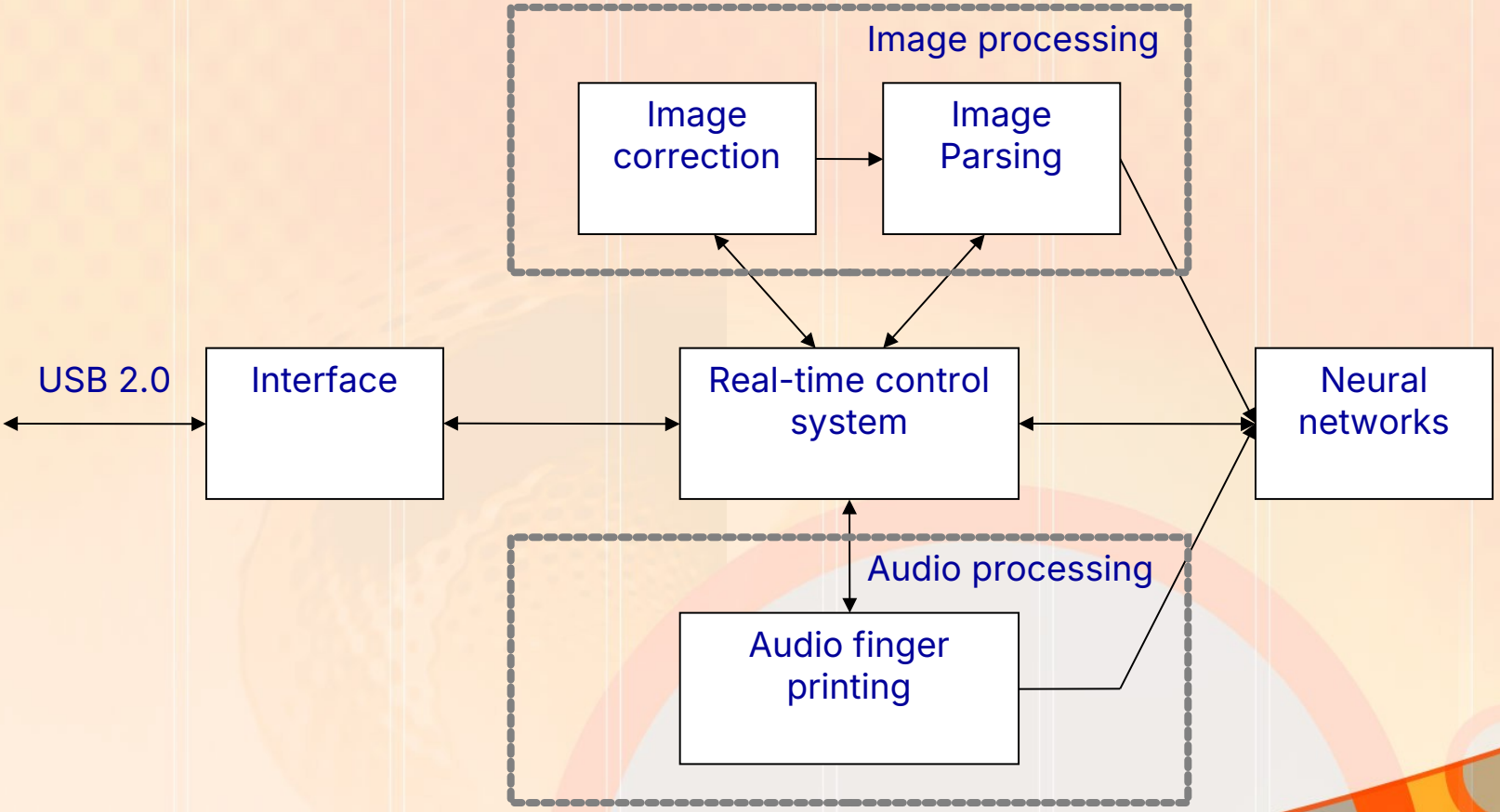


Image layer diagram

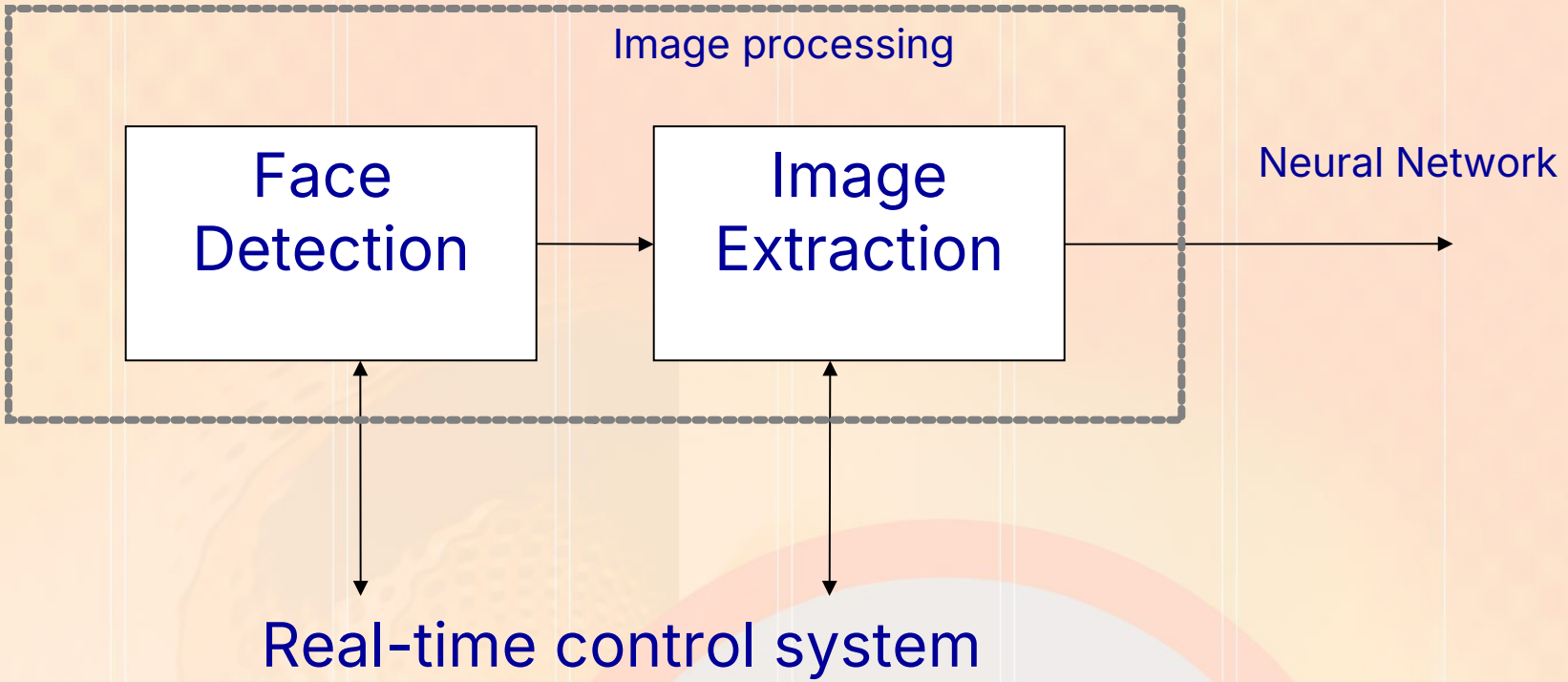


Image layer

- Inputs
  - 512 x 512 bitmap image
- Task
  - Detect and parse face
- Output
  - 10-15 distinct features of the face
  - extracts and frames into a 100x100 format
  - Vectors containing distance values of distinctive features

Audio layer

- Uses a known database of users vocal information
- Compares this information to the inputted vocal information from the real-time system
- Uses a system of longest common subsequences analysis of minor vocal waveform patterns
- Computes likelihood of known-user ownership of voice
- Relays known user identity with percentage of certainty

Neural network layer

- Trained with inputs that are defined by the Image layer
- Trained with 7 users
- Inputs
  - 100x100 images from the Image layer
  - Audio percent similarity
- Output
  - Percent similarity of known users
- Returns the percentage to the Real-time control system

Real-time control system

- Controls the amount of time a process is allotted to run
- Manages input and output of data to the interface layer
- Determines robot's actions during idle processing time
- Allocates CPU time to priority processes
- Controls programmed responses to robotic interface; audio, optical, and mechanical