A Component Architecture for the Internet of Things

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Presented by: Eric Wendt

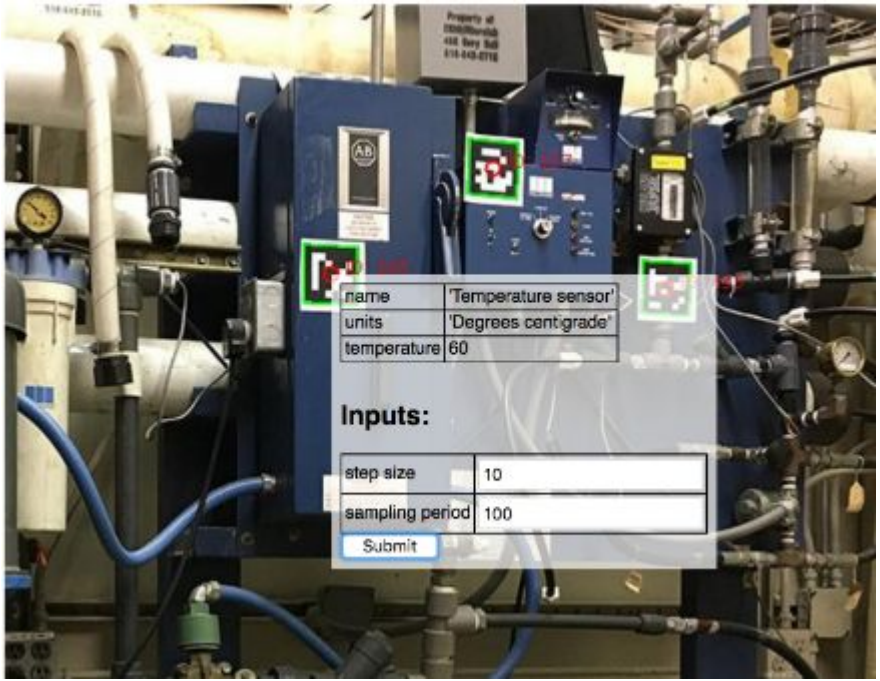
CapeCode - The Purpose

- Provides a level of determinism to counter unpredictable latencies
- Intricate IoT systems can be ‘modularized’
- State-flow does not have to be written by one vendor

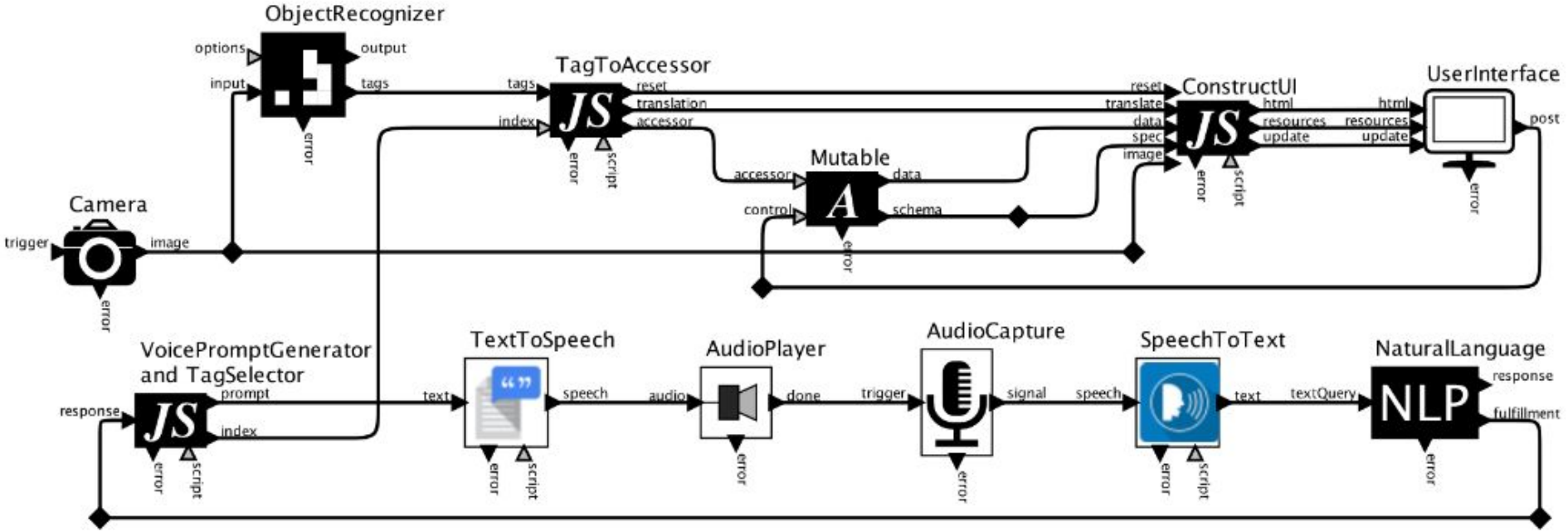
The Example

The Example

AR goggles show heads-up display



The System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ConstructUI
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UserInterface
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post
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Camera
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VoicePromptGenerator
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TextToSpeech
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speech
error
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AudioPlayer
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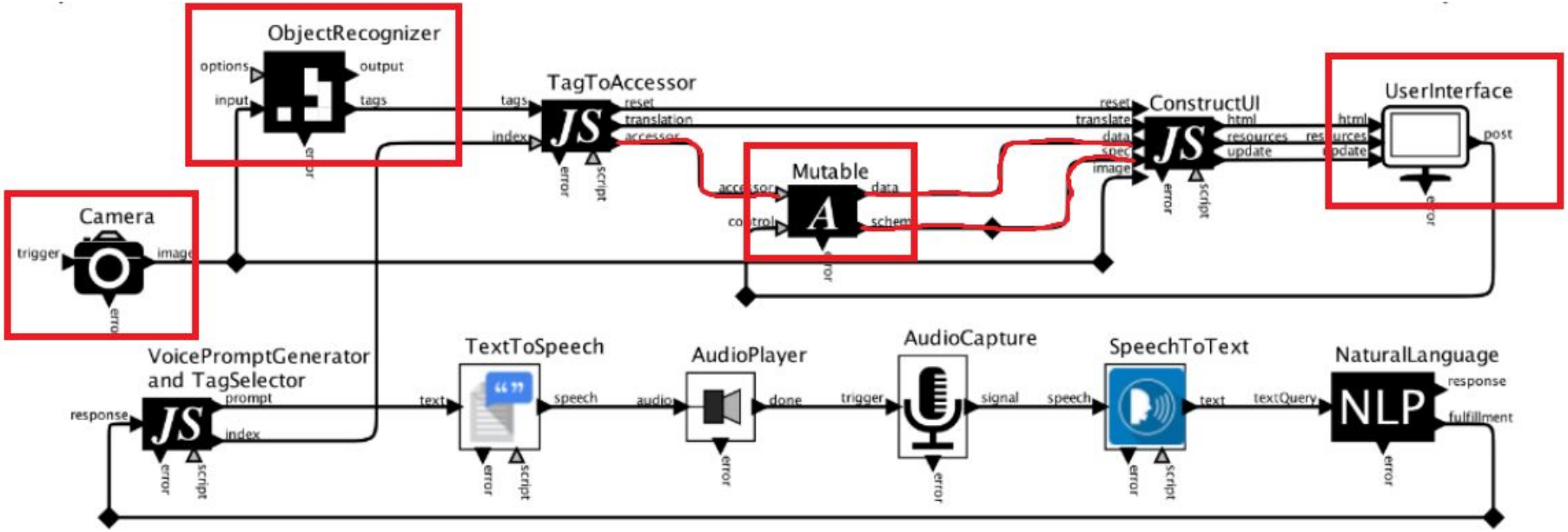
error
AudioCapture
trigger
signal
error
SpeechToText
speech
text
error
script
NaturalLanguage
textQuery
response
fulfillment
NLP
error

Assessors

- Code for processing and transforming data
- proxies/services that interact with IoT devices, strictly NOT human users.
- The “reusable” component of the architecture

Assessors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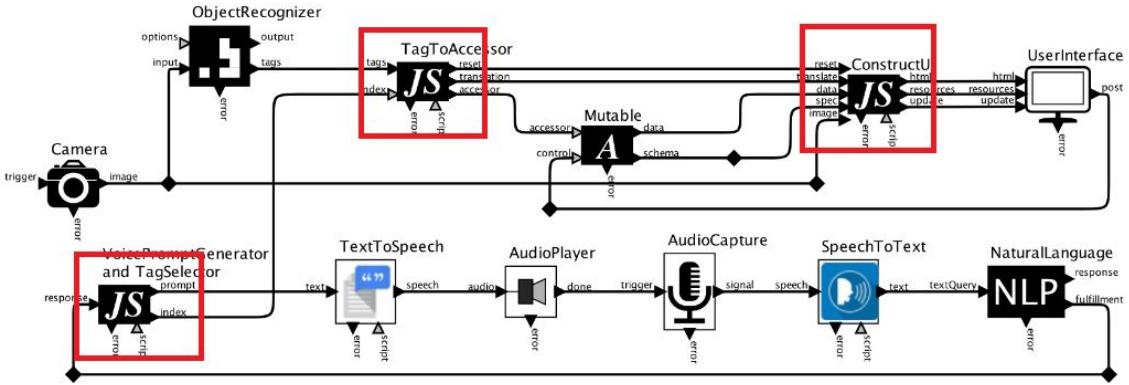
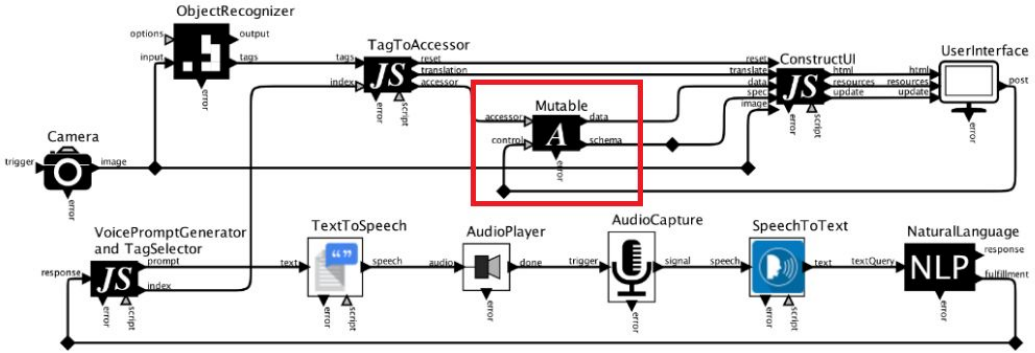
JS nodes



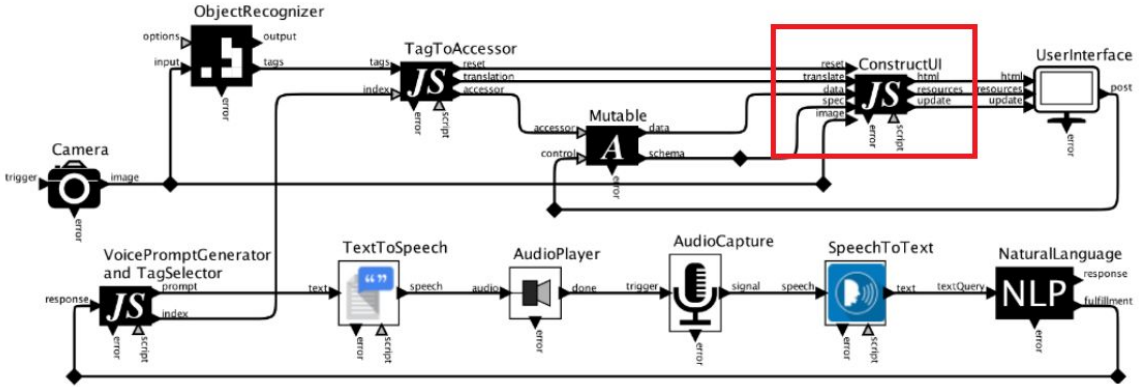
- Non-reusable scripts written in JavaScript
  - Not portable between vendors
  - Device/hardware-specific

Mutable

- Source code “template” for accessor
- Can be thought of as an abstract class
- When an accessor is passed to the Mutable node, it is reified and replaces it.



Endpoint



- The reified accessor is passed to another human-interactive component, such as the UI
- Any further input or data can be forwarded back to the accessor
- ConstructUI is JUST data and JS code, NOT an accessor

Discrete-Event Systems

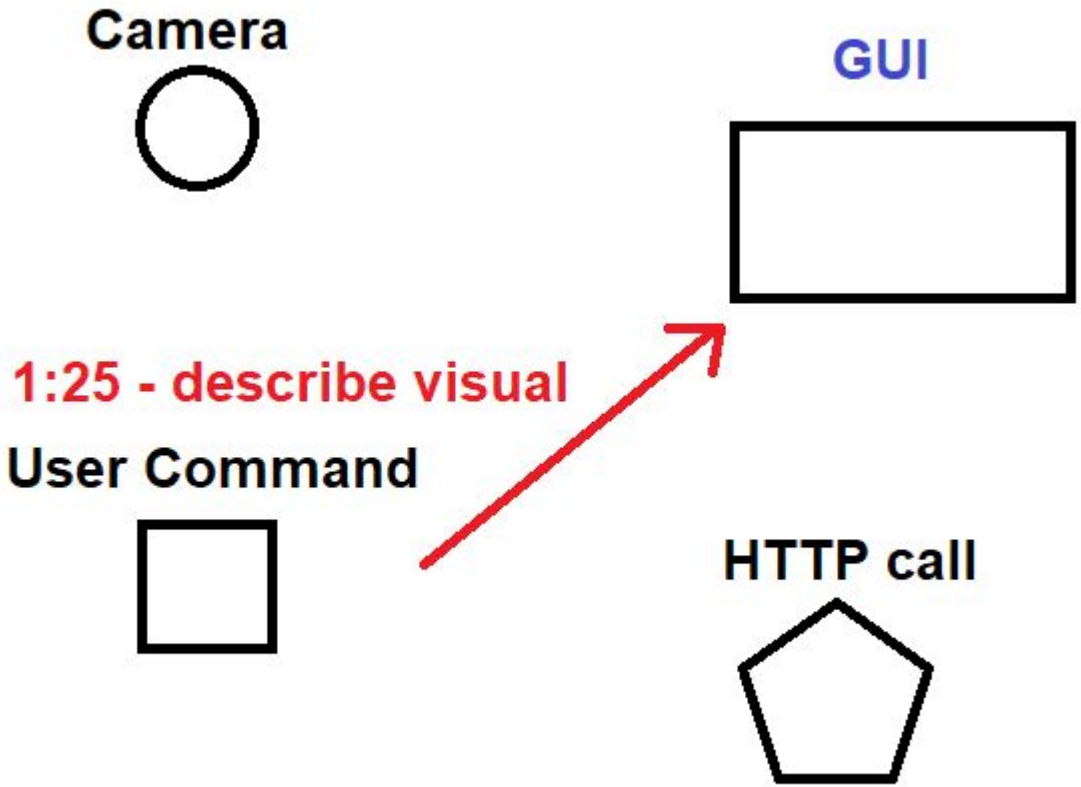
- Goal is to reduce non-determinism
- Relies on a system of timestamps to determine flow of execution
- Coupled with atomic callbacks, provides ease of programming and scalability

Camera

GUI

User Command

HTTP call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1:25 - describe visual
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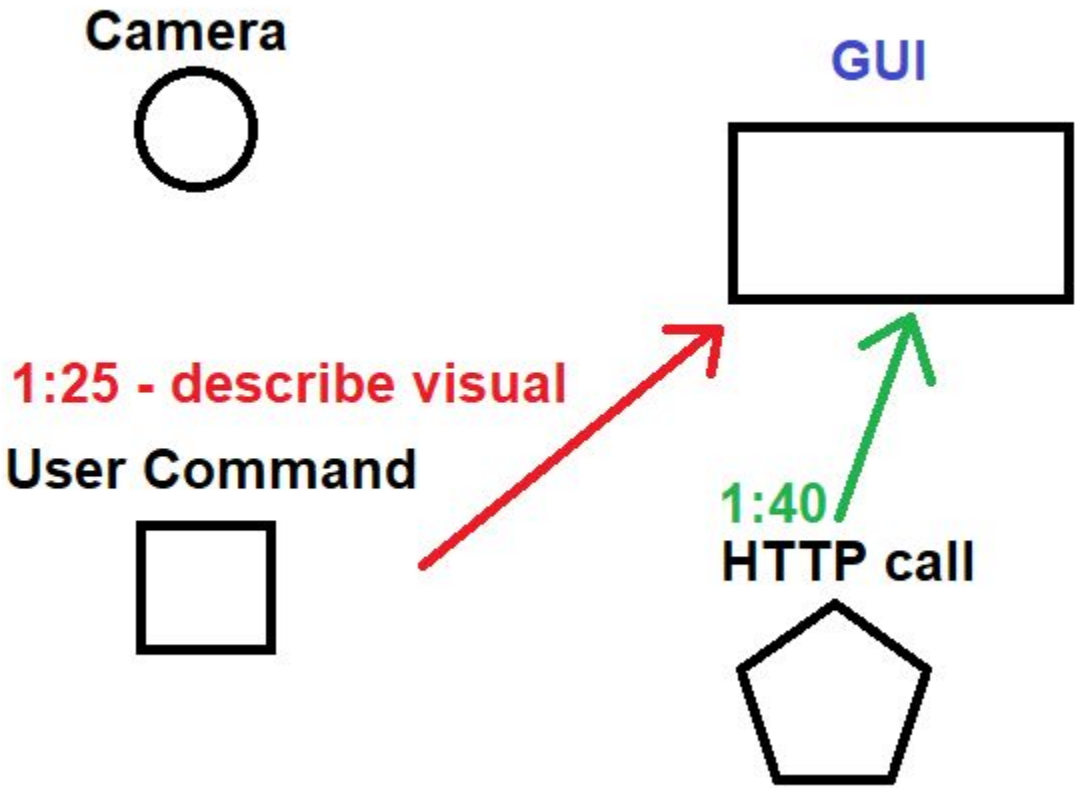
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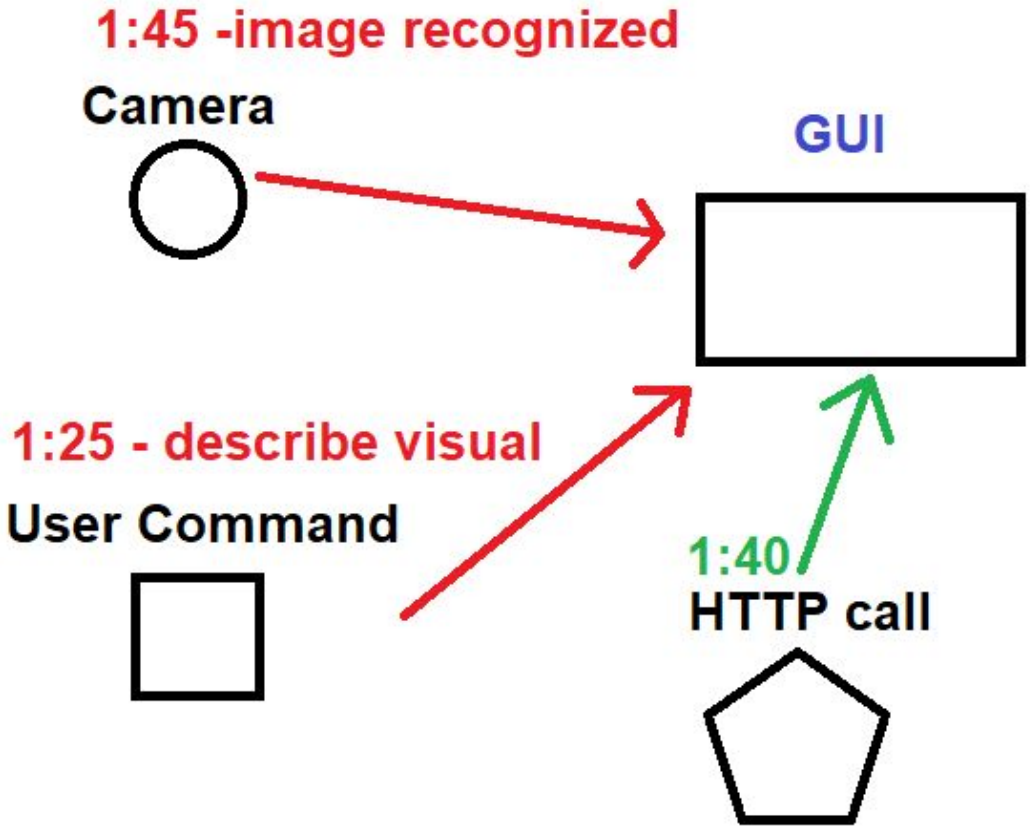
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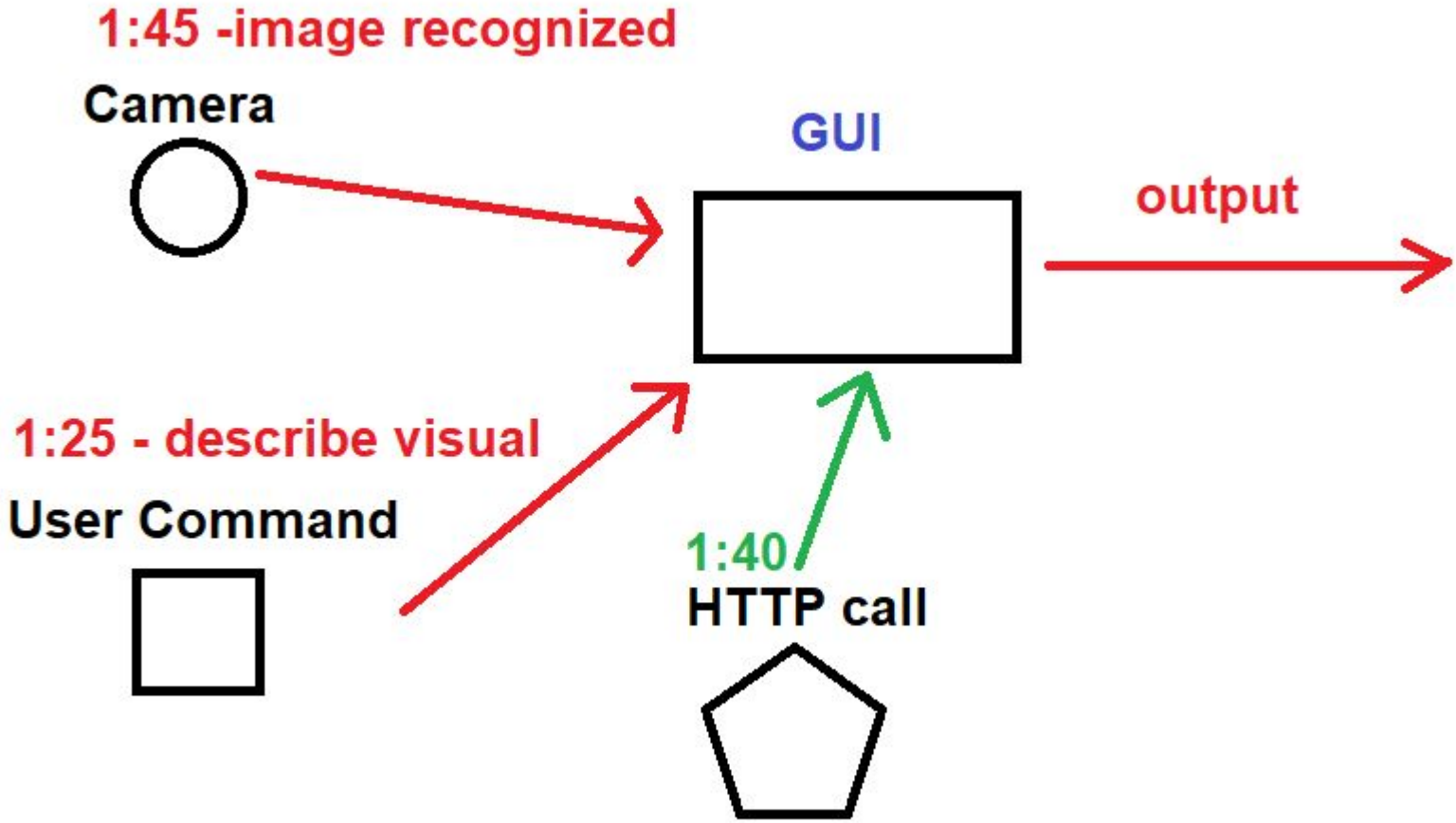
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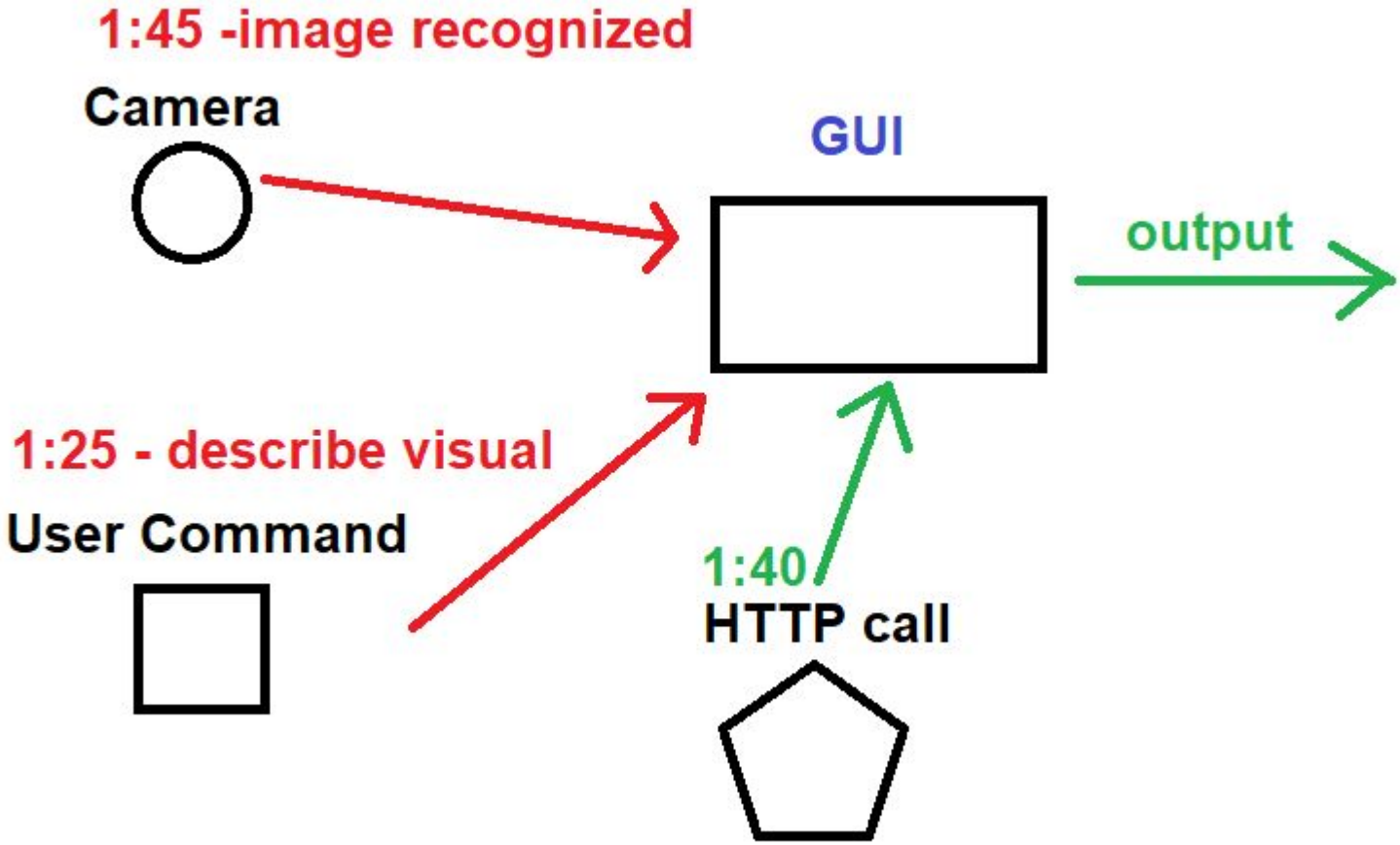
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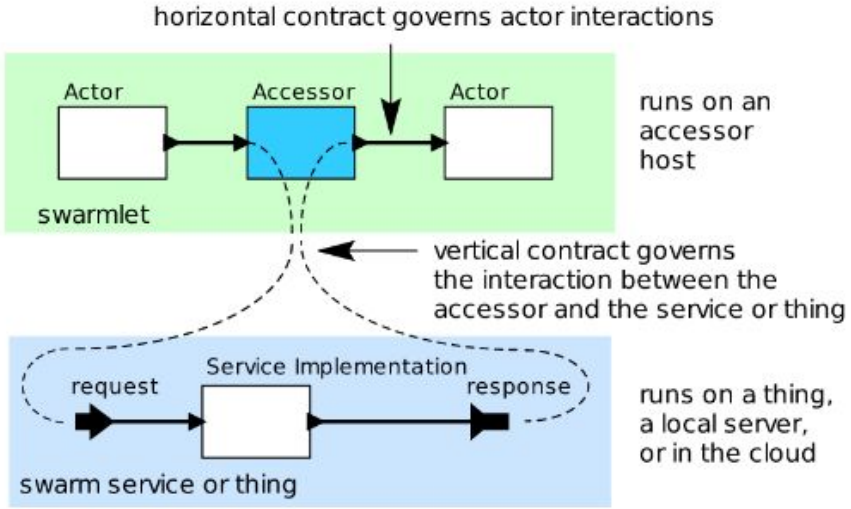
Contracts

- Think of contracts as APIs
- Actors are data components that communicate with a more generic Accessor -> **horizontal contract**
- The Accessor then communicates with a “Thing.” -> **vertical contract**
- Could be any service or physical device.
- Vertical contract is device-specific



Asynchronous Atomic Callbacks

- Non-blocking behaviour
- Services can activate callback functions atomically at their leisure
- Functions cannot activate while another is active

Callback functions

```
exports.setup = function() {
  this.input('trigger');
  this.output('data', {
    'type': 'JSON',
    'spontaneous': true
  });
}
var httpClient = require('http-client');

exports.initialize = function() {
  var self = this;
  this.addInputHandler('trigger', function() {
     httpClient.get(
          'http://accessors.org',
          function(data) {
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What’s the point?

- Workflow of many Iot devices can be standardized in a high-level framework.
  - Better outreach to developers
- Ensures determinism, multithreading and interrupts do not exist.
- Provides bridge between device-specific code and a general data flow model.

Security

- Accessors are untrusted code
- They run in a virtual environment usually in a browser
- Secure Swarm Toolkit uses Auth on edge devices to handle authentication and authorization

Critiques

- Robustness to network failures is not guaranteed.
- Discrete Events seem less efficient that a standard multithreading model.
- Few examples

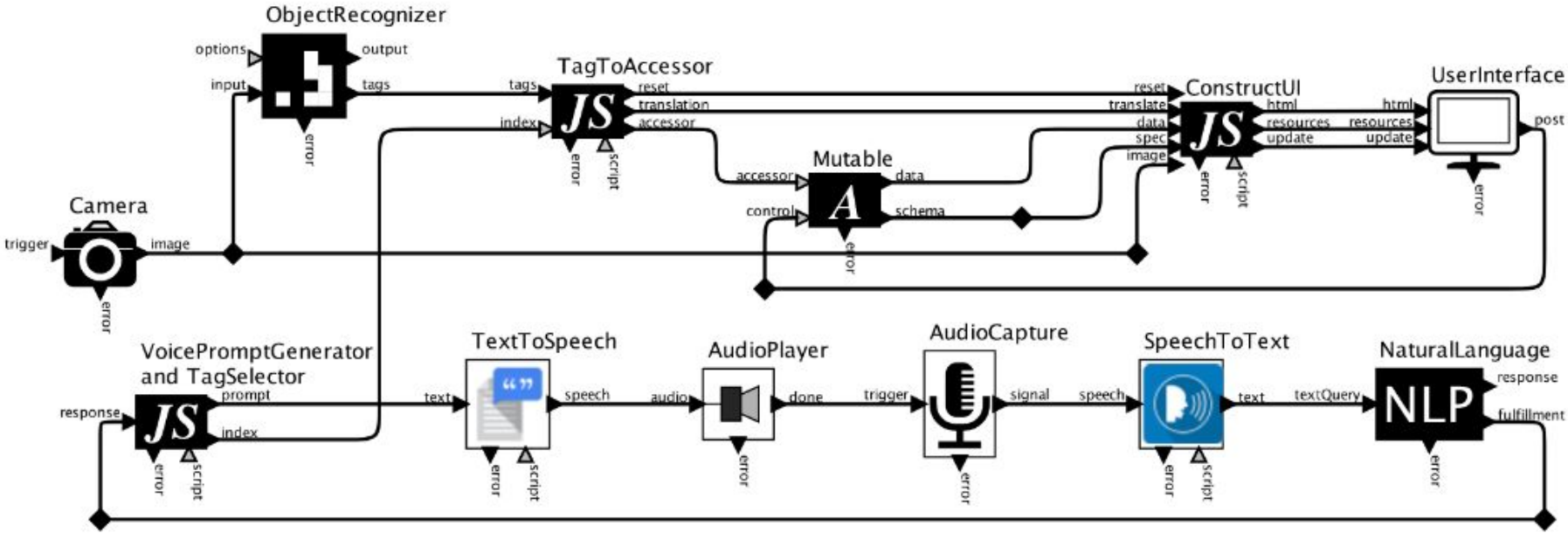
Questions

- **@Others, Gregor Peach** - I was a little confused whether or not they extended this system beyond one "device" or not. How would they handle cross device communication?
- **@samfrey99, Sam Frey -** The paper says that a properly written AAC implementation doesn't use locks and cannot deadlock, but if their implementation requires all actions to be atomic, isn't there now a far greater chance of live lock under heavy load?
- **@lrshpak, Lily Shpak -** Does the accessor add another layer of unneeded complexity?
- **@grahamschock, Graham Schock -** In the section that details coordination between these devices on the network it says unexpected non determinism is a problem. What does that mean? What is non determinism? How does it affect the system?

Conclusion

- Idea is a step towards faster development
- Descriptions were confusing, few examples provided
- Scalability and Robustness claims made are questionable

Conclusion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