TEAM B1: IR Man

AI smart home IoT Hub

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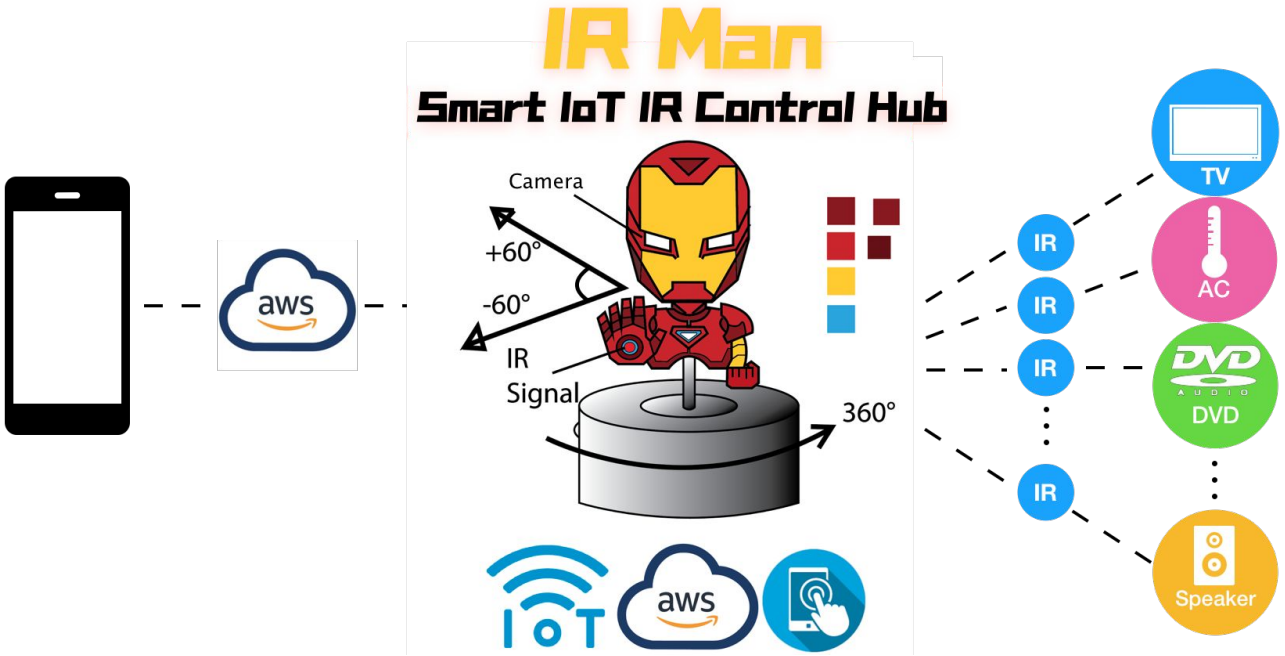
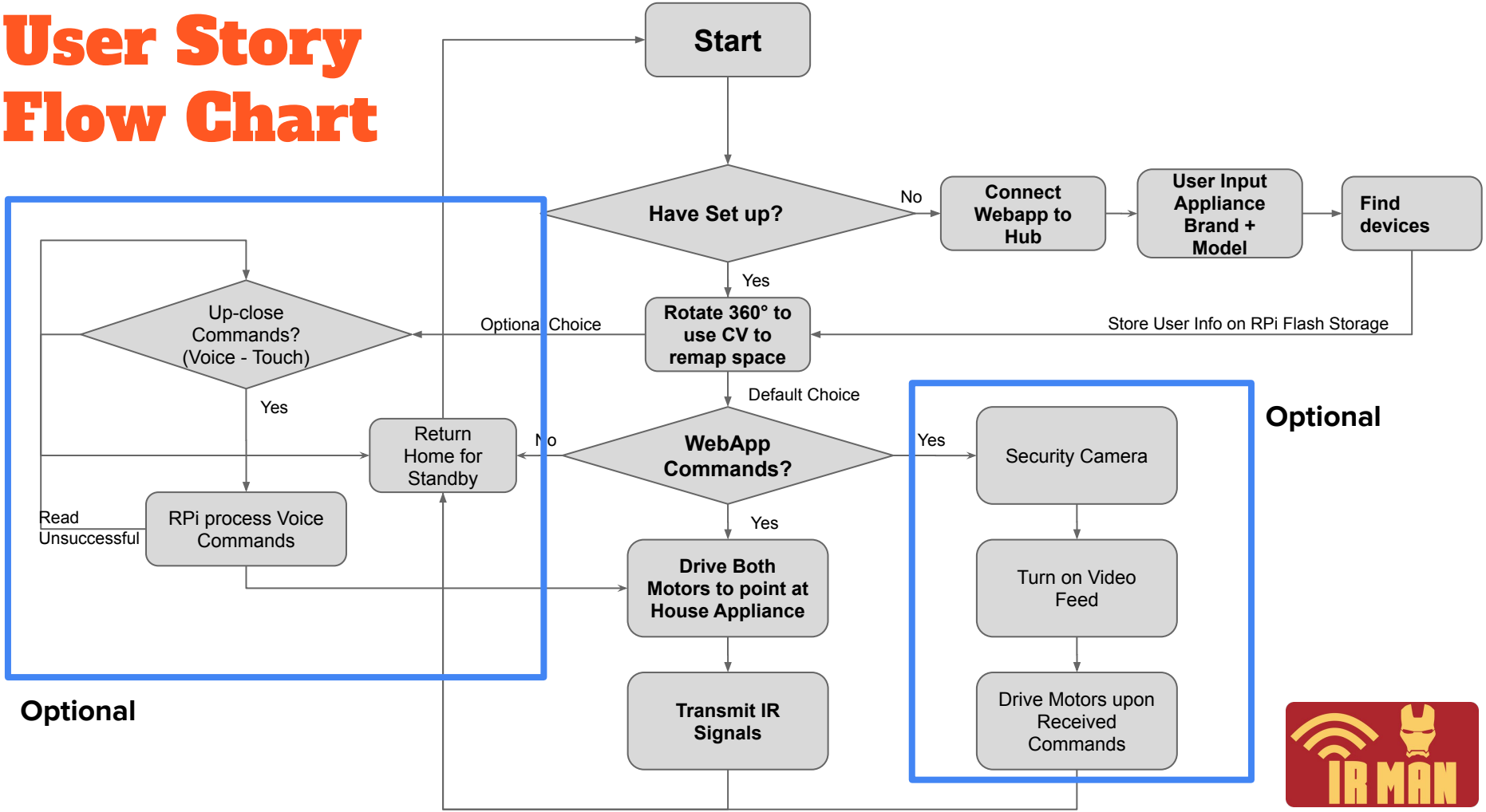
Application Area

Lots of IR remotes?

Why not some fun with robots



User Story Flow Chart

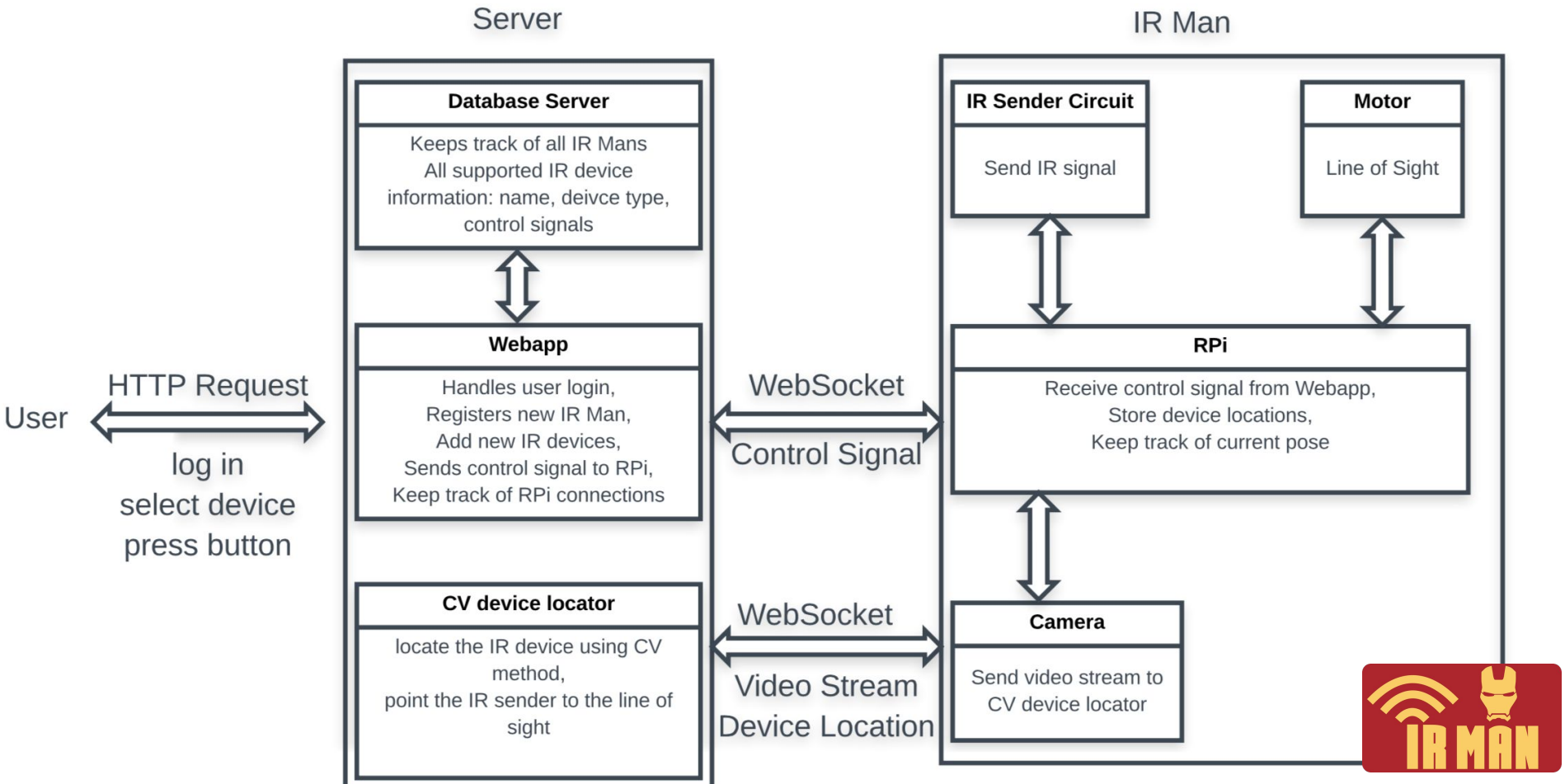


Solution Approach

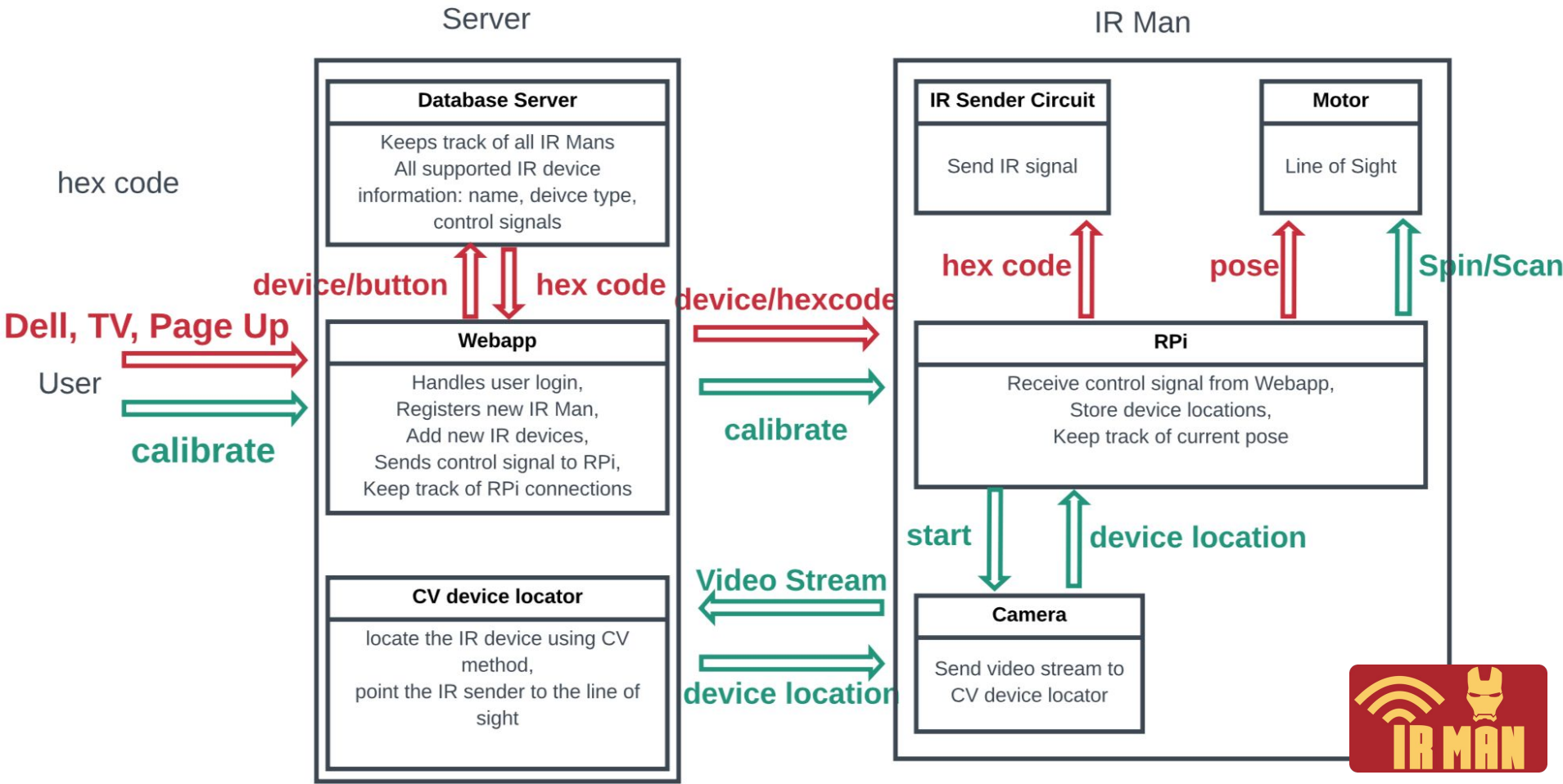
- Web App:
  - We want to be able to control our IR device remotely
  - Accessible across all platforms
- Device Locator Server:
  - Find IR device locations with Computer Vision

- RPi:
  - 2 DOF Robot
  - Motor Control: point to IR device
  - Send out IR signal to IR Circuit

System Architecture



System Interaction

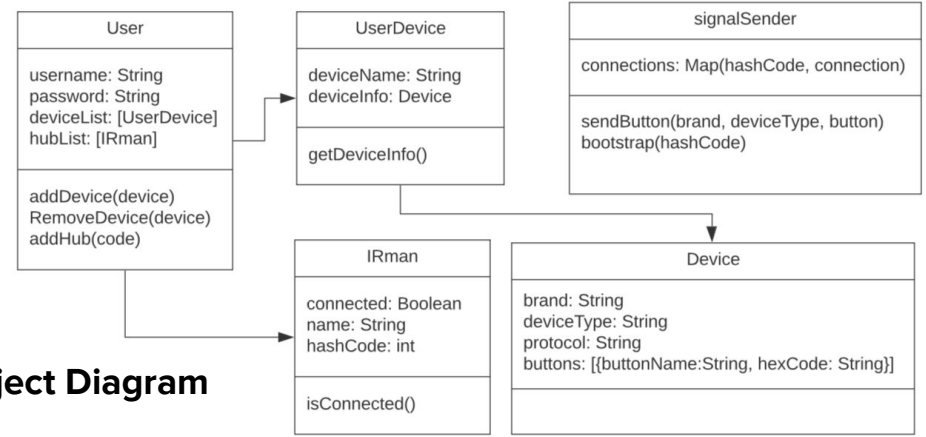


Software Design

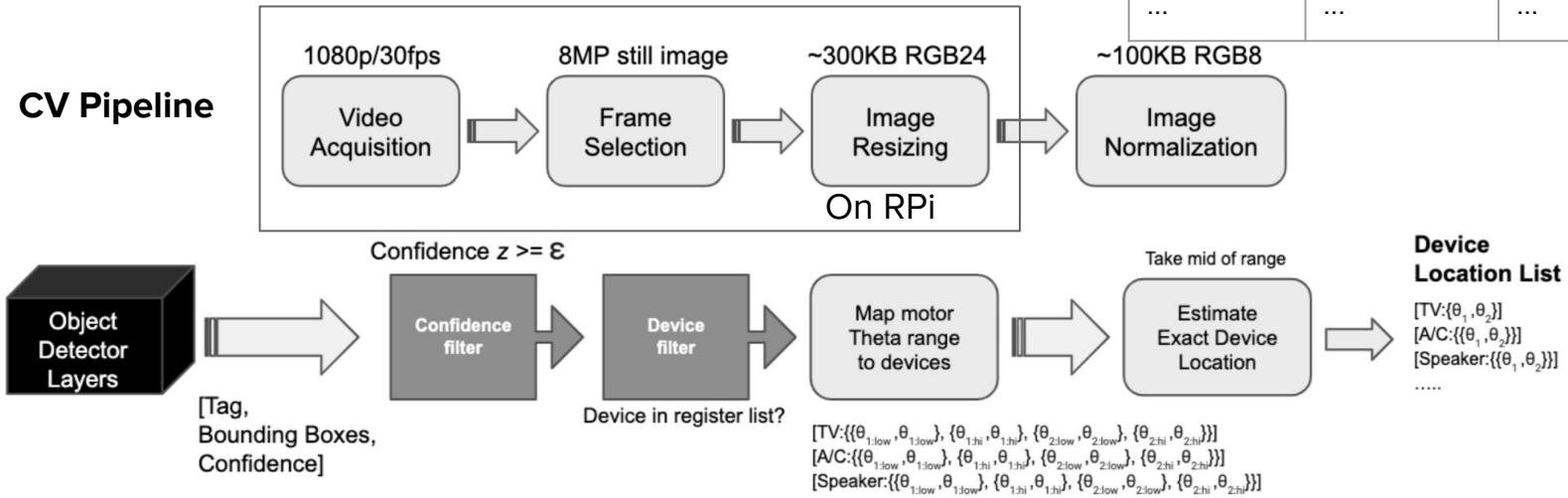
Webapp Routing Table

URL	Path	Usage
GET/POST	/login /logout	User login/logout
GET/POST	/register	Register new user
GET	/devices	Display user's device list
GET/POST	/devices/new	Add new devices
GET	/devices/:id	Go to device control panel
POST	/send/:id	Send signal to RPi
...	...	...

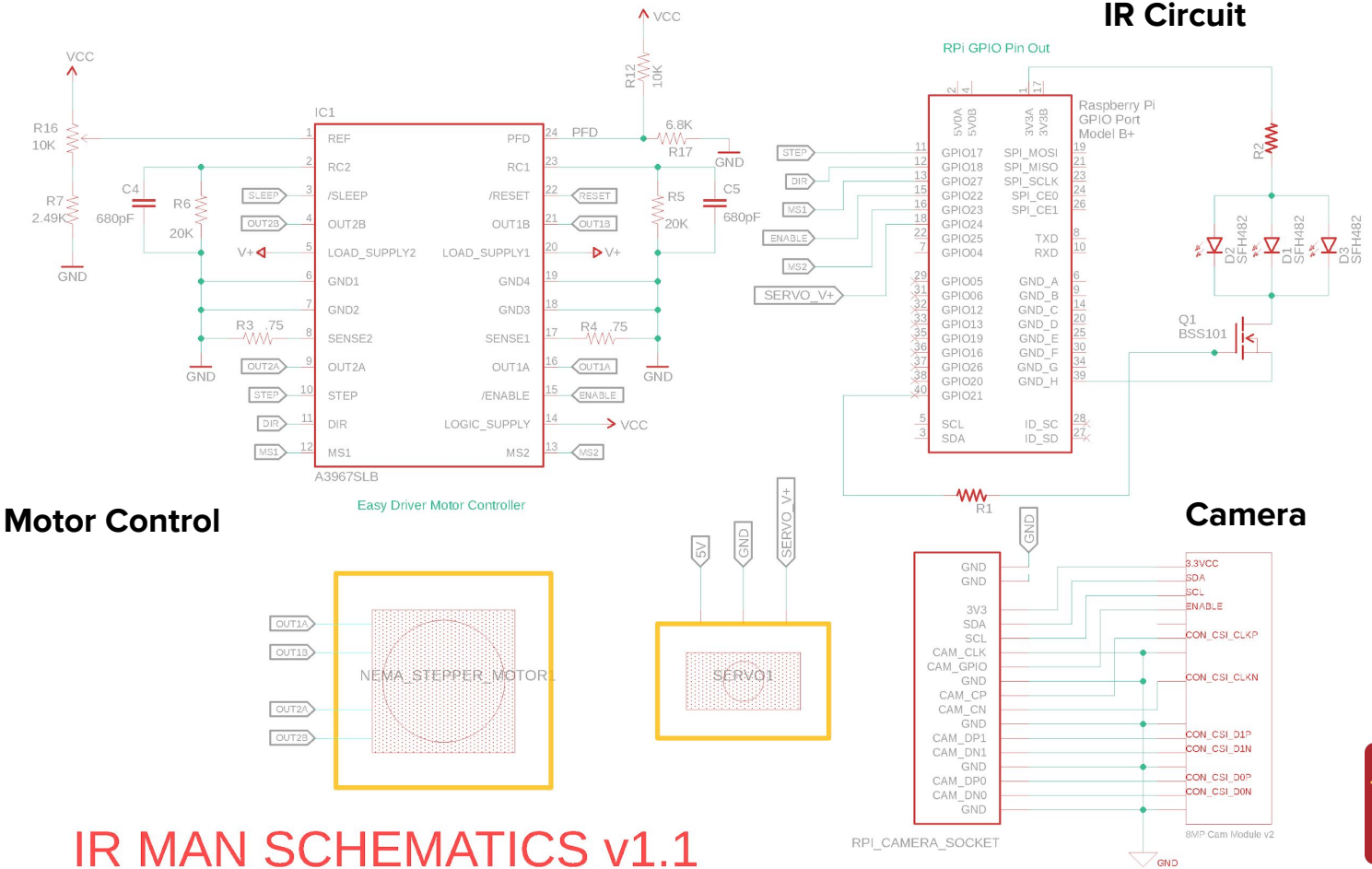
Webapp Object Diagram



CV Pipeline



Hardware Schematic



IR MAN SCHEMATICS v1.1

Implementation Plan

- Web App:
  - Node.js Express.js MongoDB for backend, passport.js for authentication
  - deploy to AWS
- Motor Control:
  - Sparkfun EasyDriver as stepper motor controller
  - NEMA stepper motor 17
- IR Circuit
  - **AVR TCON** Chip Programming for **PWM** signal for controlling MOSFET/Diode
  - LIRC for IR signal database
- Computer Vision:
  - OpenCV for image streaming, ImageZMQ for image serialization
  - YOLO v3 for object detection, OpenImages V4 as training data

Metric and Validation: component testing

Component	Requirement	Testing Method
WebApp	Responsive UI	Unit testing, manual testing on laptop/phone/tablet
WebApp	Server to RPi latency under 500ms	Timestamp, stress testing with 10 simulated clients and 3 RPi
IR Circuit	success rate of 90%	Avg success rate of all signals from 5 different devices/protocol under different environments,
Motor	± 5 degrees of correct pose Time to specific pose < 1s	sequence of 20 random motor commands(θ1,θ2)
Device Locator	Image validation accuracy > 75%	Manually set up training datasets, test against validation set.
Device Locator	RPi to server latency < 500ms	5 simulated video stream transmission to server
Device Locator	± 10 degree of the correct pose for each devices, Total time < 3 mins	5 test video stream runs in different environment with TV, fan, AC…)

Metric and Validation: system testing

Manual testing of user experience:

User register new account and IR Man device,
User add new IR devices to IR Man,
IR man scans the environment, locate all devices location,
User gets a list of devices to choose from,
User chooses a single device and goes into the device control panel,
User press a button on the control panel
IR man point to the device and shoot out the IR signal to device.

Requirements:

Locating devices takes < 3 mins,

Find correct pose for all devices,

Avg success rate of IR control > 90 %,

Latency of IR commands < 2s

Risk:

What if CV based device locator does NOT work as expected:
Display the IR Man video stream on WebApp and let user control the robot to point to specific device

Project Management

Week	5	6	7	8	9	10	11	12	13	14	15
MileStones	Status1		Design Prese	Design Doc			Int. Demo				
CV Video Streaming POC & Object Detection											
Buidling the IR Circuit					☆						
IR Software on RPi											
Path Planning Algorithm											
2 DOF Motor Driver											
Mechanical Structure (Motor to Arm KD)											
ID Design											
Web app development (Back end)	Working										
IR Signal Database API											
Phase III: Integration and Testing				Approx. 150 Hours							
Prototyping (Think additional features)											
3D printing parts, Laser Cutting Parts, CNC cutting parts											
Hardware Limitations											
Software Integration											
Mechanical Integration											
Benchmark Testing and Metrics Reports											
Interim Demo (MVP DONE)											
Phase IV: Design Re-evaluation And Optimization								Approx. 100 Hours			
Improve ID Design											
Beautify UI/UX											
Reduce Latency											
Optimize for Universality											
CV Algorithm Accuracy + Speed											
Voice Control											
Machine Learning for Power Saving + User Habbits (if time											
Phase V: Final Reporting and Validation										Approx. 100 Hours	
Final Testing											
Produce Promo Video											
Final Report											
Final Presentation + Demo											

Key
Max Bai
Jiaqi Zou
Shirley Zhang
Slack Time
Max + Shirley
Jiaqi + Shirley
Jiaqi + Max
Whole Team