EZBackUp
Team 20

Justin Charles, Justin Lam, Zhiyang Jin, Exiang Zhou, Austin Carroll

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Meet our Team

Christopher V. Hollot
Faculty Advisor

Justin Charles
Computer Engineer

Austin Carroll
Mechanical Engineer

Zhiyang Jin
Electrical Engineer

Exiang Zhou
Computer Engineer

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Background

- Over **50,000** accidents a year are related to towing

- **800,000+** blind spot accidents occur each year

- Easy to prevent with the use of a camera system

- Difficult to back into certain spaces, increased chance of hitting something behind you

Problem Statement

Driving is a task that many Americans undertake daily, it is a necessary function of human life today and will continue to be prevalent into the future. While this may be true, there will always be a need for added safety.
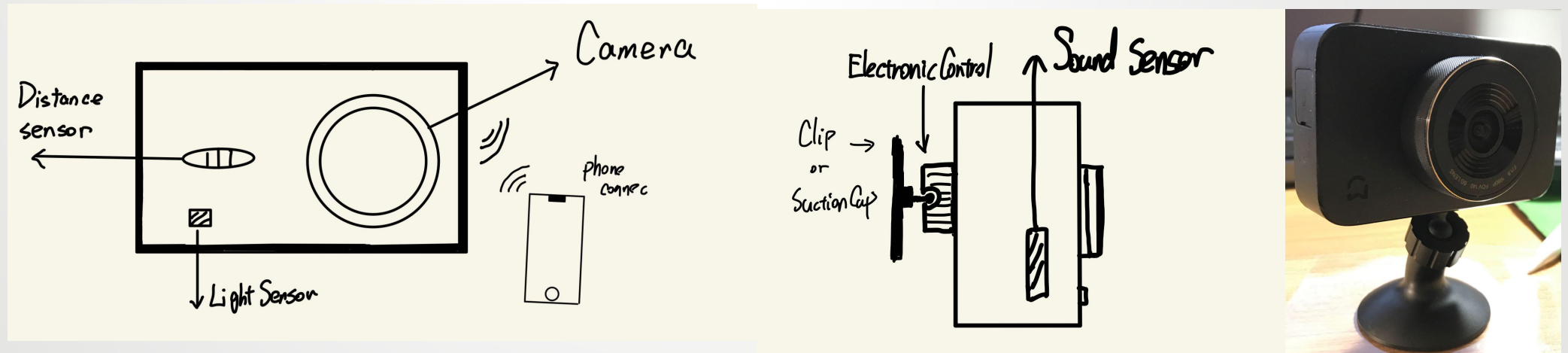
Project Goal

Problem: Driving is a task that many Americans undertake daily, it is a necessary function of human life today and will continue to be prevalent into the future. While this may be true, there will always be a need for added safety.

Goal: We aim to create a backup camera system that is easy and accessible to install and use, while also being convenient and adding safety for the users driving experience.

Design Sketches:

Project Goal

We aim to create a backup camera system that is easy and accessible to install and use, while also being convenient and adding safety for the users driving experience.
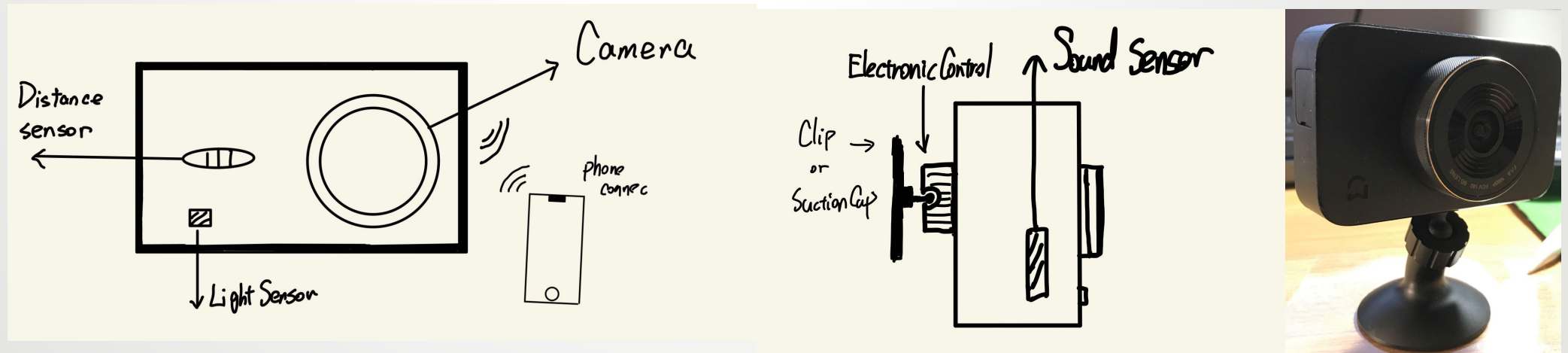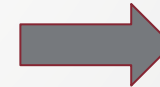
Design Sketches:

Project Goal

Adapted for:
- Tow Cars (boats, cars, campers, etc.)
- UHAUL, Rented Vehicles

Functionality:
- Multiple Views
- Proximity Sensing
- Easily Mounted/Dismounted
- Wirelessly connected to Phone App

Realization:
- Enhancing Safety

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Specifications and Testing – Qualitative

System Specification	Test Plan
System will use up to 3 video systems wirelessly connected to smartphone	Inspect that up to 3 video feeds/sensors/motors will work on display
System display will show up to 3 video feeds, one feed may be chosen at a time	Inspect app to check that video feeds can be viewed and changed by user
System will provide distance and audio to the user via smartphone	Inspect app to check that distance and audio is output
Camera will have night vision capabilities	Inspect video feed at night and check that objects are visible
Camera Systems will be self powered	inspect that the system will work being self powered
Camera/Sensor system will be mountable and dismountable to vehicle	Mount system on vehicle and test by driving
System will be easy to set up	Survey 10 people with setup, ask to rate on a scale of 1–10 complexity of set up. <3 should be chosen.

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Specifications and Testing – Quantitative

System Specification	Test Plan
System will give a slow audio alert when ≤2ft and an increasingly faster alert when ≤1ft	Get distance using sensors, manually measure distance
System cameras will rotate in intervals of 30 degrees on a horizontal axis	Measure angle change when given rotation input for cameras
Individual camera systems will have power for up to 3 months at a time without replacement	measure change in power over a day to estimate power loss

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Hardware Block Diagram
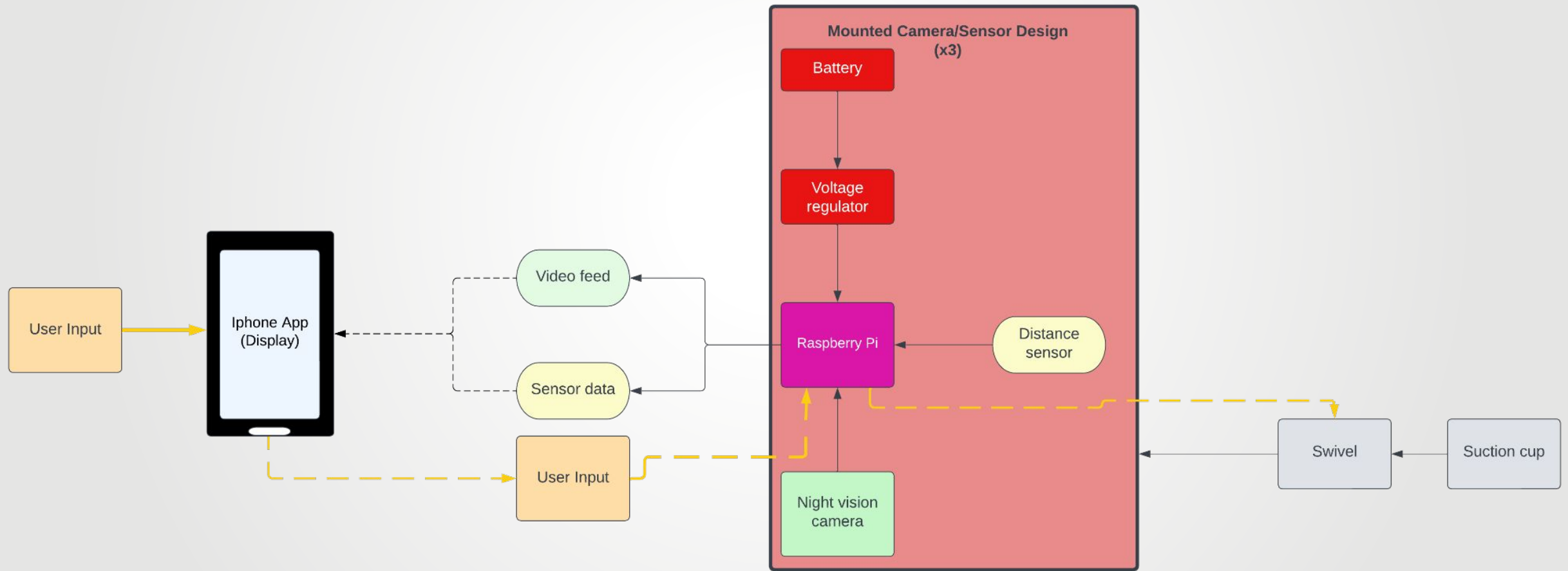
Wirelessly Data Transfer

WIFI Direct

WiFi Direct is built upon the same WiFi technology used by most modern consumer electronic devices to communicate with wireless routers.

Transmission speed is 100 times faster than Bluetooth
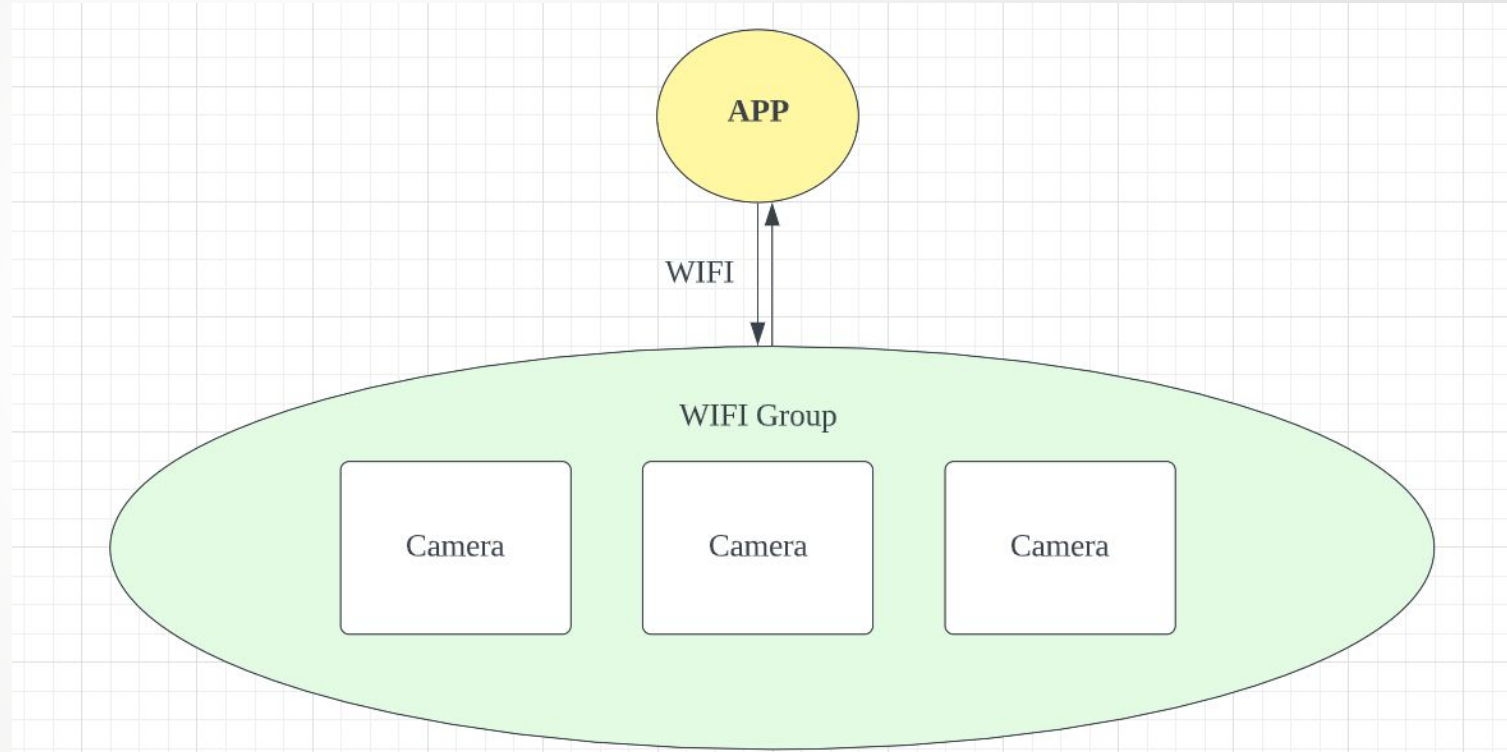
Software Diagram
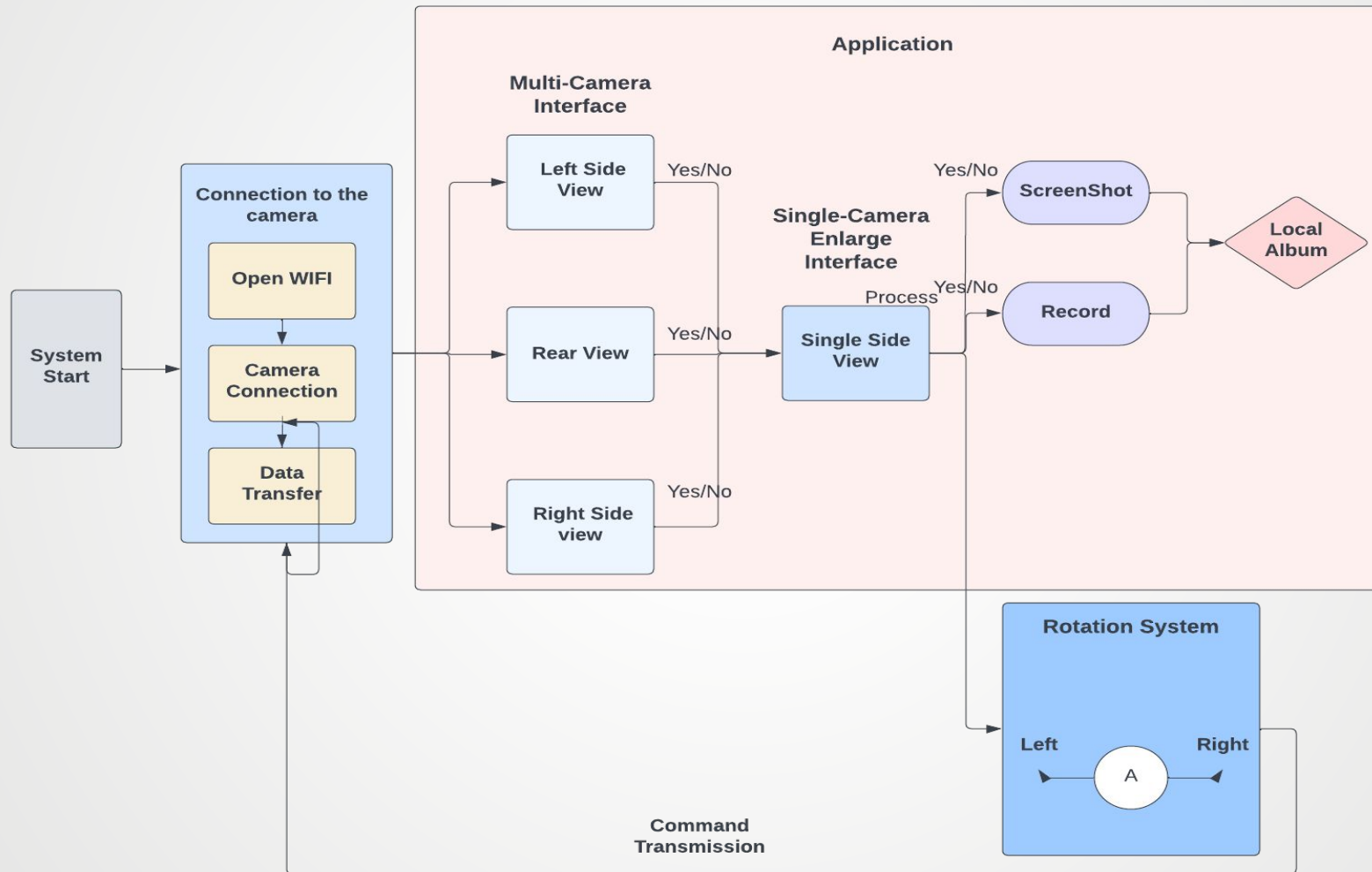
Software Design Sketch

Camera

- **Arducam**
  - Angle of view: 100 degree (D) x 80 degree (H)
  - High frame rates: 30fps@1080P - 90fps@480p
  - Max Resolution: 2592*1944
- **Night Vision**
  - Camera will have night vision functionality
  - Built in automatic IR cut switch

ArduChip Block Diagram
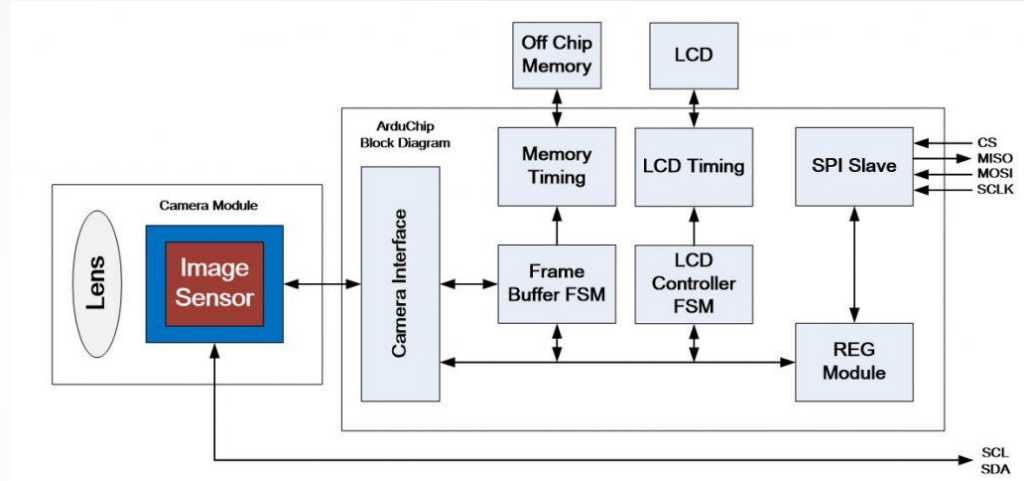
IR-CUT Switch Automatically

IR Sensitivity During the Night

Visible Light During the Daylight

Distance Sensor

- HC-SR04
  - Sensor to detect distance between vehicle and other objects

Supply voltage	1.7V to 3.6V
Measurement Range	0.8 inches to 15feet
Current Drain	0.65µA
Output Data Rates	100ms

Motor and Mounting System

Motor

- **Adafruit NFMA-17 12V 350 mA Stepper Motor**
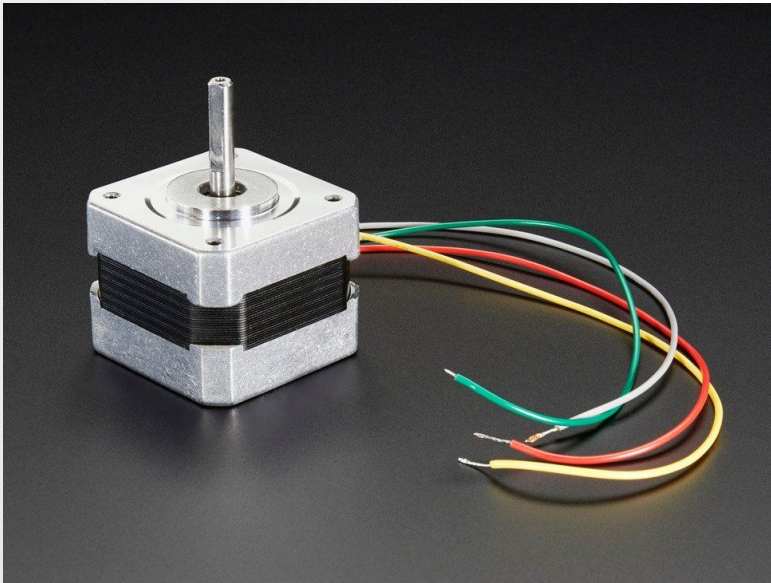
Mounting System

- **CONBOLA Heavy Duty Suction Cups**
- **3-D Printed Camera Mount**

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MDR Deliverables

- **Camera mounts can pan horizontally**
- **Cameras can be accessed and controlled through mobile app**
- **Cameras can switch to night vision mode**
- **Sensors provide correct data and communicate with the system successfully**
- **Microcontroller correctly taking in inputs and sending output to the user through WIFI direct**
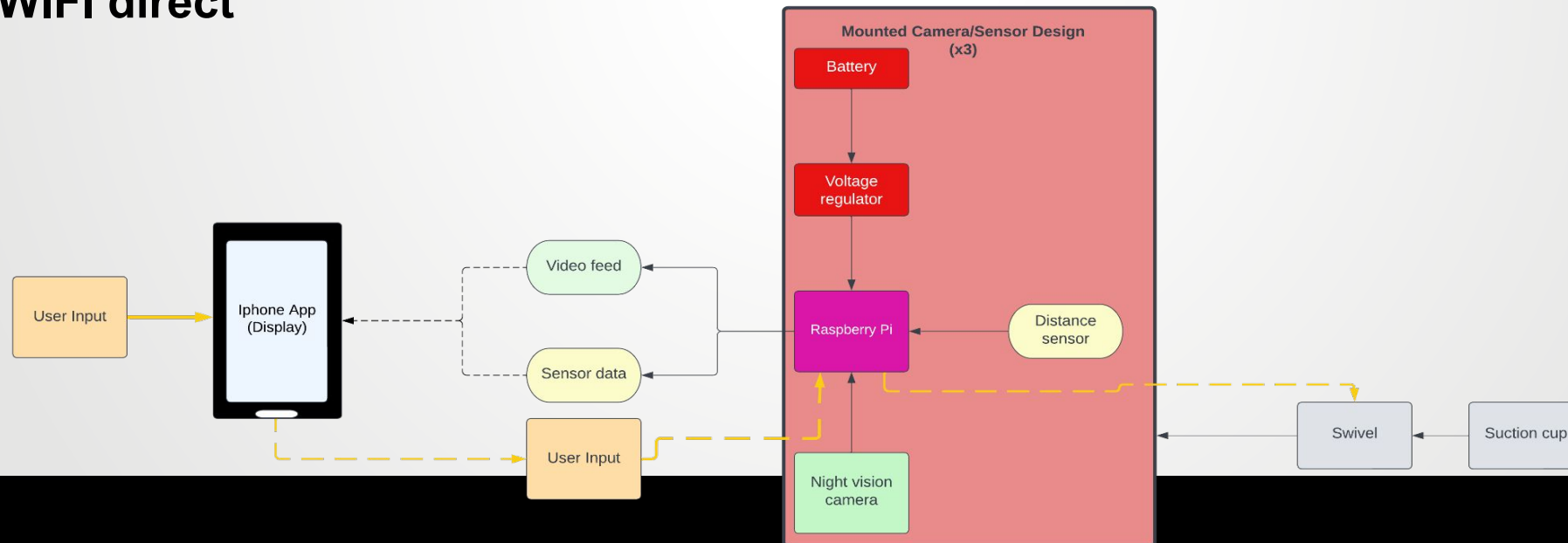
MDR PCB Deliverables

PCB Schematic

- Microcontroller, distance sensor and night vision camera PCB connection

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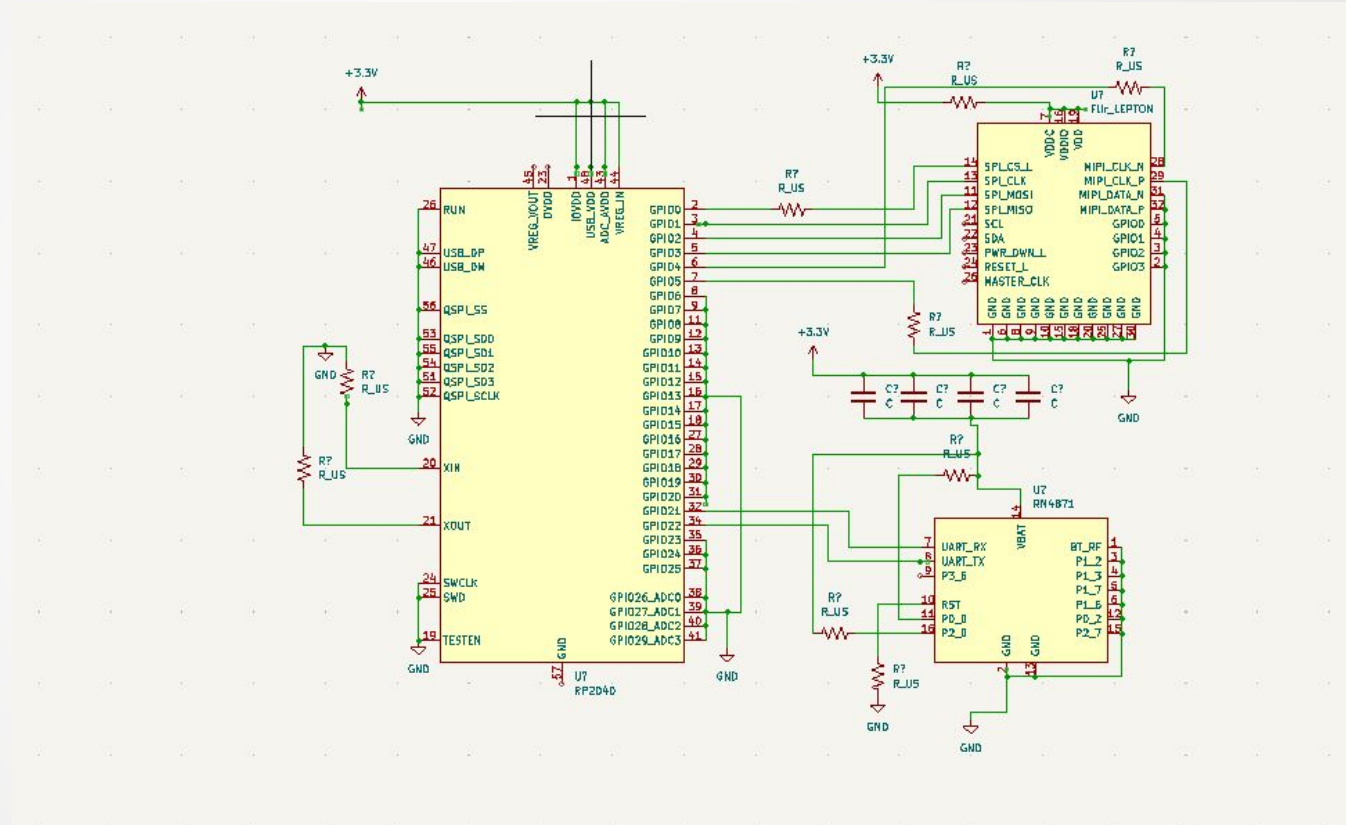
Parts List

- **Raspberry Pi x3**
- **Lithium Battery**
- **HC-SR04 Distance Sensor x3**
- **Arducam Day&Night Vision Camera x3**
- **Suction Cup 4 Pack**
- **Custom PCBs**
- **A4988 Stepper Motor Driver Carrier x3**
- **Adafruit NFMA-17 12V 350 mA Stepper Motor x3**
- **3D Printed Parts**

- **$30**
- **$18**
- **$84**
- **$20**
- **$200**
- **$15**
- **$42**
- **$0**

Total: $409

Team Roles

Justin Charles

Logistics lead:

1. Sensor and Camera Software design

2. Communicate with team and course coordinators

Zhiyang Jin

PCB lead:

1. Breadboard design and PCB design.

Exiang Zhou

Software Lead:

1. Mobile software design and development

2. Data transfer with cameras

Austin Carroll

Mechanical Lead:

1. Camera Mount

2. Positioning system

3. 3-D printing

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Gantt Chart

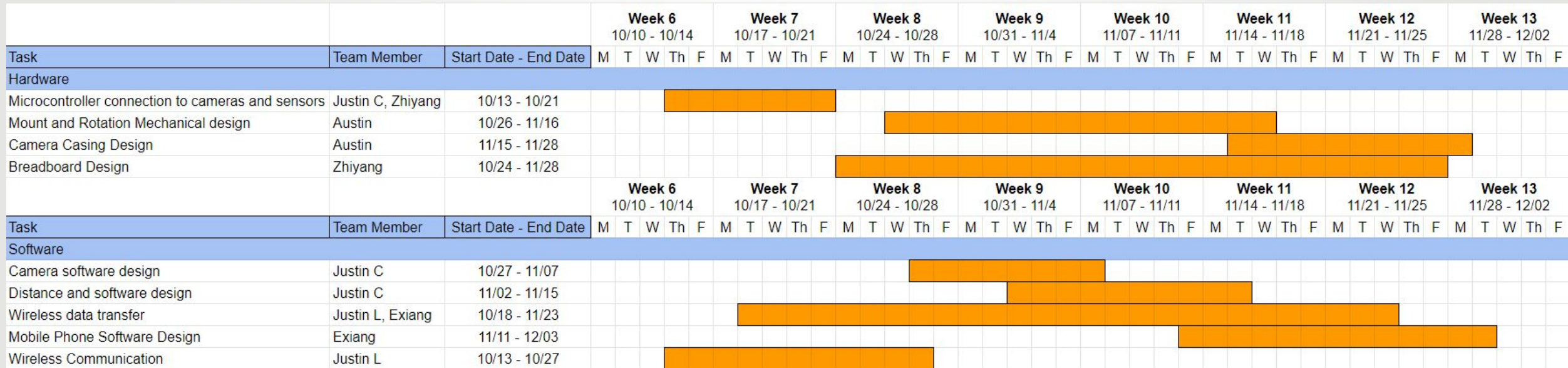				Week 6 10/10 - 10/14					Week 7 10/17 - 10/21					Week 8 10/24 - 10/28					Week 9 10/31 - 11/4					Week 10 11/07 - 11/11					Week 11 11/14 - 11/18					Week 12 11/21 - 11/25					Week 13 11/28 - 12/02				
Task	**Team Member**	**Start Date - End Date**	M	T	W	Th	F	M	T	W	Th	F	M	T	W	Th	F	M	T	W	Th	F	M	T	W	Th	F	M	T	W	Th	F	M	T	W	Th	F	M	T	W	Th	F
Hardware																																										
Microcontroller connection to cameras and sensors	Justin C, Zhiyang	10/13 - 10/21				▓	▓	▓	▓	▓	▓																															
Mount and Rotation Mechanical design	Austin	10/26 - 11/16														▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓												
Camera Casing Design	Austin	11/15 - 11/28																									▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓					
Breadboard Design	Zhiyang	10/24 - 11/28											▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓					

			Week 6 10/10 - 10/14					Week 7 10/17 - 10/21					Week 8 10/24 - 10/28					Week 9 10/31 - 11/4					Week 10 11/07 - 11/11					Week 11 11/14 - 11/18					Week 12 11/21 - 11/25					Week 13 11/28 - 12/02				
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Software																																										
Camera software design	Justin C	10/27 - 11/07																▓	▓	▓	▓	▓	▓	▓	▓	▓																
Distance and software design	Justin C	11/02 - 11/15																			▓	▓	▓	▓	▓	▓	▓	▓	▓	▓												
Wireless data transfer	Justin L, Exiang	10/18 - 11/23						▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓										
Mobile Phone Software Design	Exiang	11/11 - 12/03																										▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	
Wireless Communication	Justin L	10/13 - 10/27				▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓																									

Q&A

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Thank You!

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Works Cited

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Back Up Camera Collision Decrease:
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Arducam Research
- https://www.arducam.com/

Camera Panning system
- https://www.youtube.com/watch?v=hEBjbSTLytk

Background Information
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Similar Solutions
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