EZBackUp

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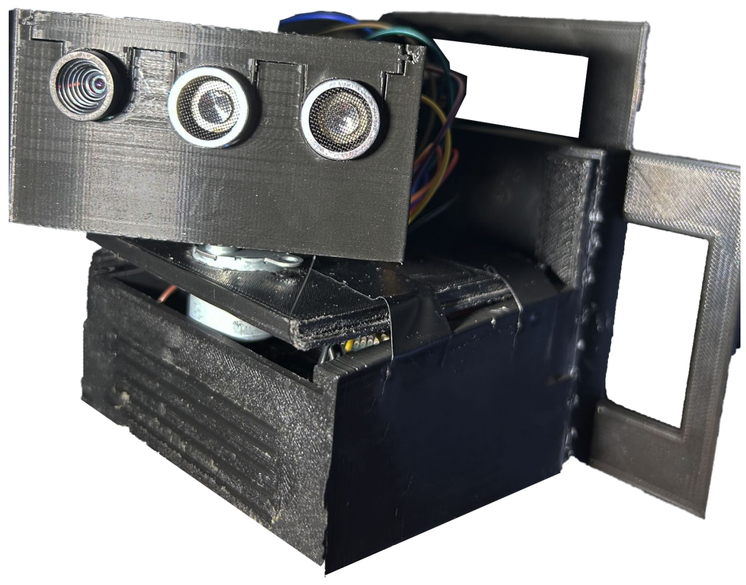
Abstract

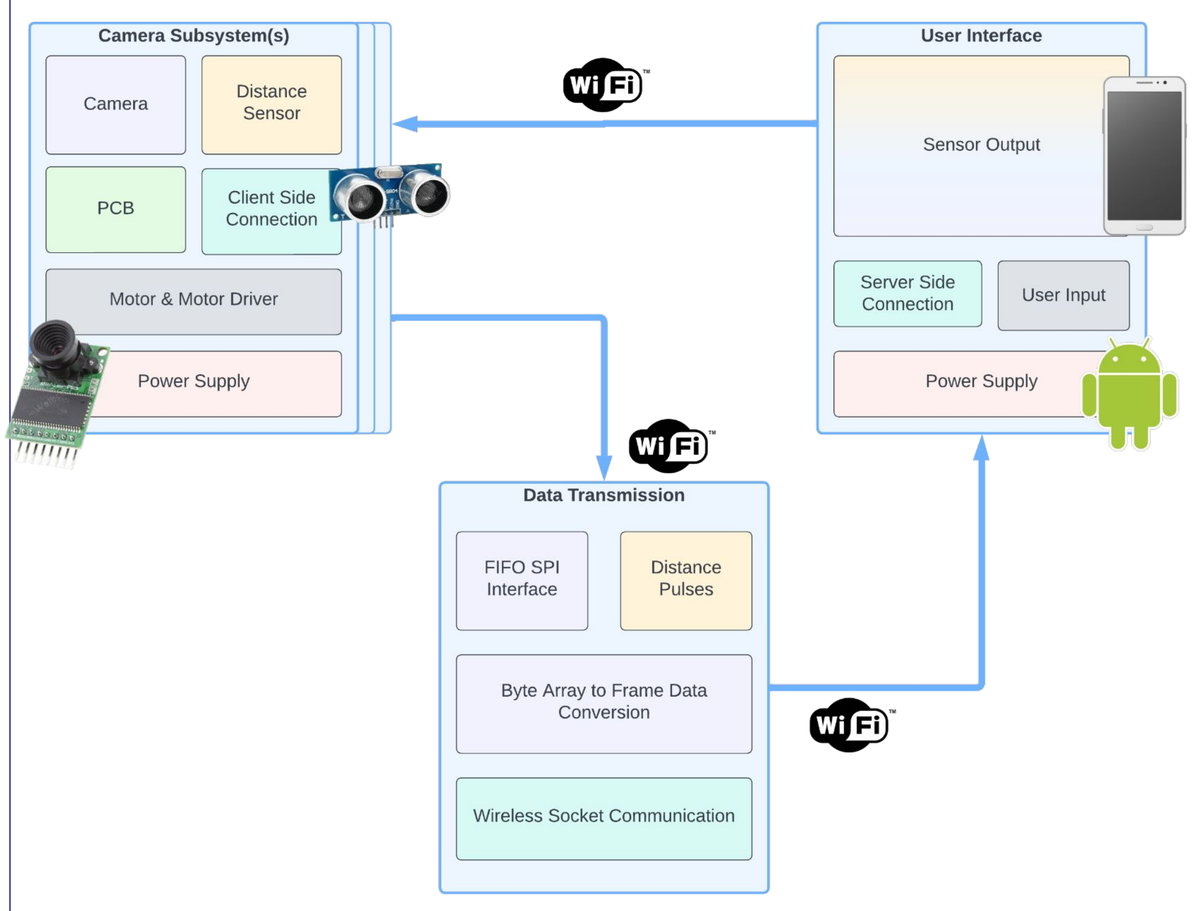
Our group's objective is to make a much more accessible camera that can easily be mounted onto any vehicle, specifically designed for vehicles that will be towing. It can be difficult to be conscious of your surroundings when towing and there are not many simple solutions to this problem. Our design looks to solve this problem by creating multiple backup cameras that can be placed anywhere on a car, tow trailer, or objects on the tow trailer. These cameras will all be wirelessly connected to a centralized app that will be easy to use for drivers. For tow vehicles that have a large turning radius or have trouble seeing when backing up, turning, or generally driving, this design could make daily tasks for the driver easier and safer overall.

System Overview

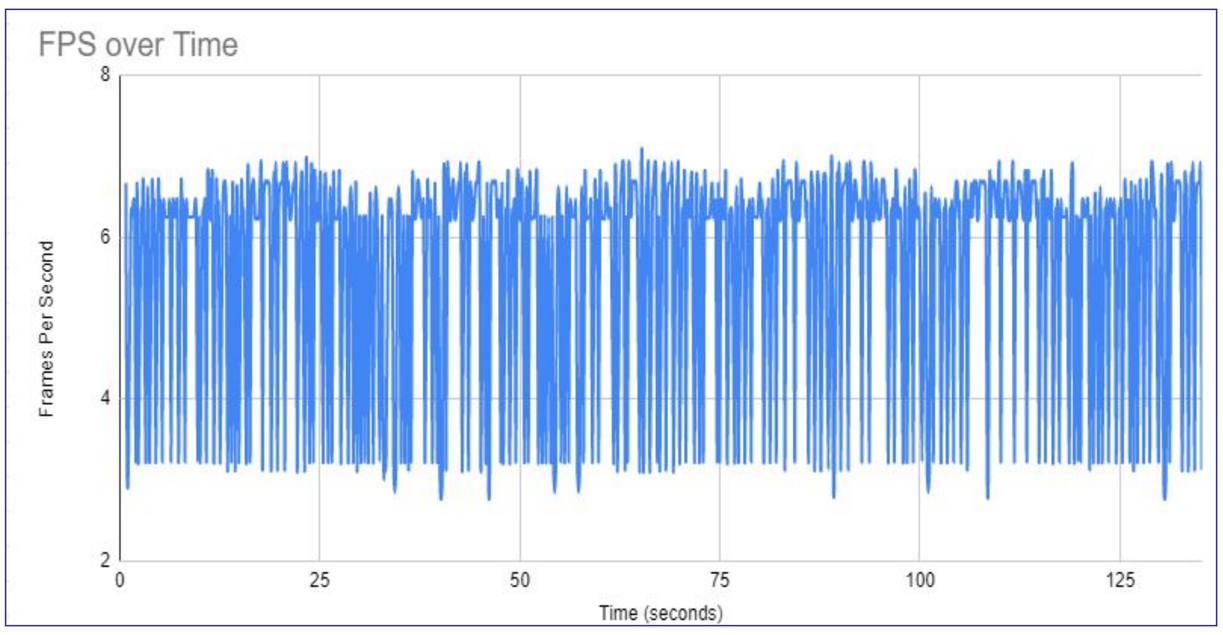


We have created an easy-to-use backup camera system. The main goal of our project was to make a product that is easy to use, quick to set up, and capable of eliminating blind spots. The user is able to attach up to 3 camera mounts to different sides of the vehicle, and wirelessly control them from an app on their phone. Utilizing wifi-direct, the user can rotate the cameras, and gather real-time distance information to avoid collisions.

System Block Diagram



Results



- Wireless Data transfer of video and distance Data
- Communication between up to three PCBs/Raspberry Pi Picos and Android Device
- Battery Life > 8 hours while powered on
- Usable in any length vehicle and trailer
- Very Slow Frame Rate

Specifications

Specification	Goal	Actual
# Units	up to 3 camera subsystems	up to 3 camera subsystems
Range (WI-FI)	> 50 ft	> 50 ft
Range (Distance)	> 5 ft	> 5 ft
Cost	< $500 per team	< $200 per team
Resolution	160x120	160x120
Latency	< 300 ms	<350 ms
Frame Rate	30 fps	5 fps
App Design	Video, Distance, Motor Input, Audio Alert	Video, Distance, Motor Input
Battery Life	> 4 hr	> 8hr
Power Consumption	< 5 W	< 4.26 W
Rotation Angle	30°	30°
Casing	Houses Components & EZ Setup	Houses Components & EZ Setup

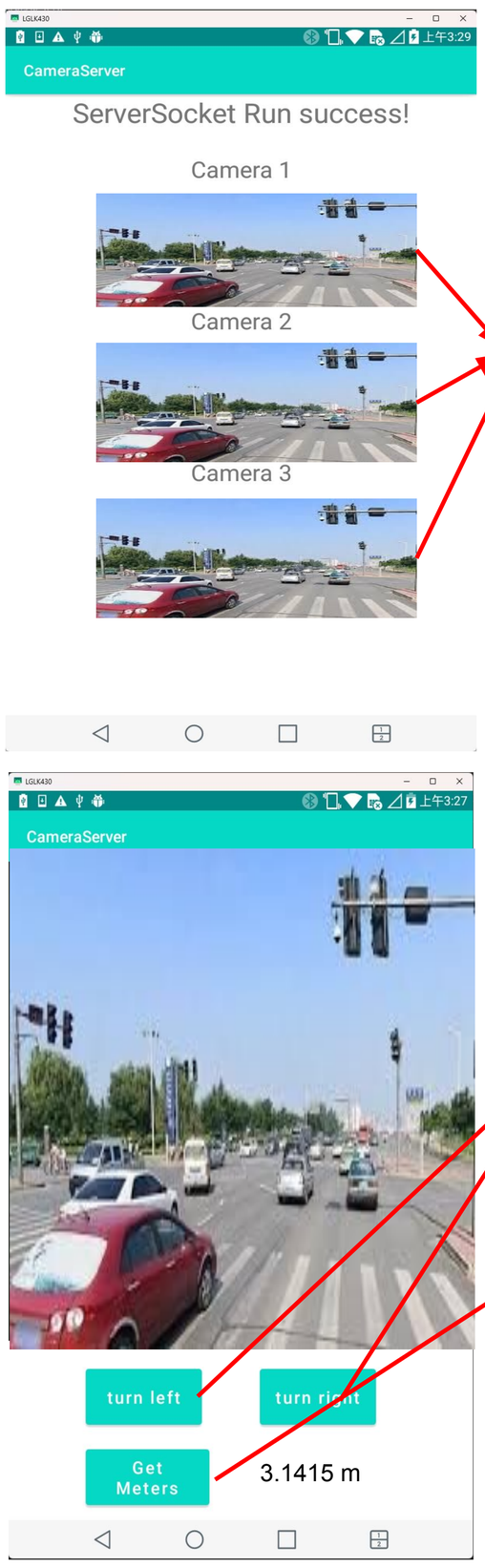
Acknowledgement

Special thanks to Professor Christopher Hollot for advising our team. Thank you to Professor Marco Duarte and Professor Russell Tessier.

Camera Subsystem Settings

- Camera subsystem can operate in low light settings

Application

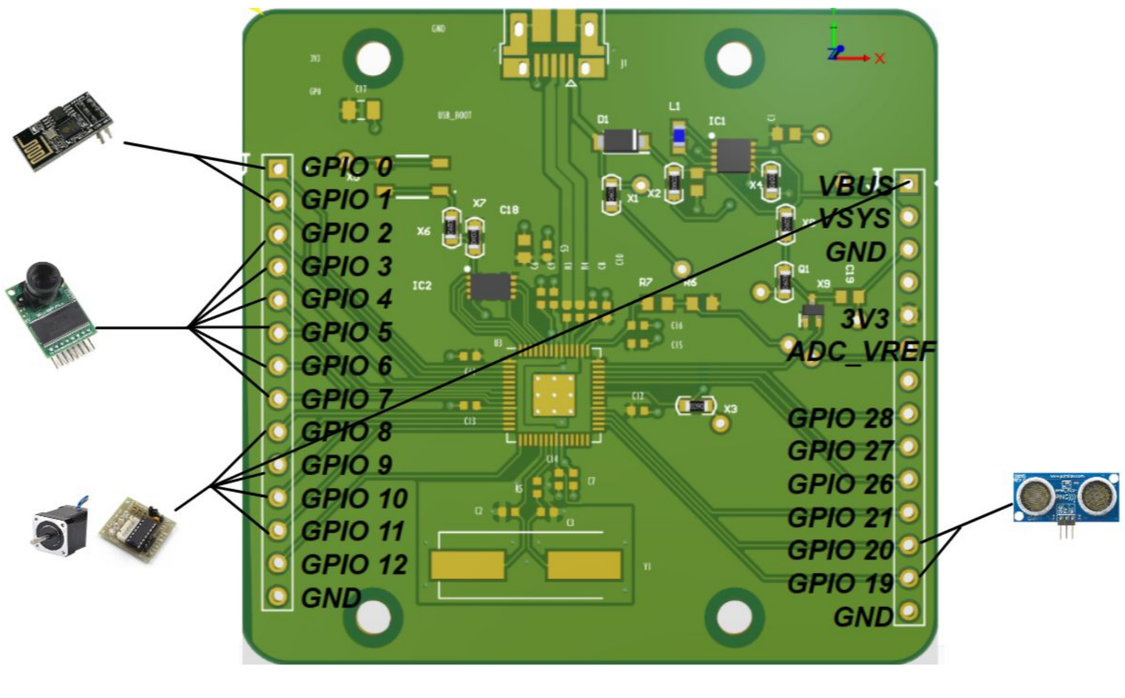


- Application is based on Android 5.0.1 and OpenCV library. It can be adapted to any Android phone higher than this version. All connections and data transfers are via WIFI (Mobile Hotspot)
- The first layer of the screen can be connected to up to three cameras at the same time, displaying three directions together. The camera will automatically connect to the phone when it is turned on.
- Clicking on any of the camera videos will take user to the secondary interface corresponding to it.
- The second layer of the interface will zoom in on the corresponding camera screen so that the user can see more clearly
- Users can control the rotation of the camera by long press of the button to adjust to the desired angle
- By clicking the button "Get Meters", the driver can get the distance to the obstacle from the sensor to better judge the distance.

Cost

Part	Development	Production
Raspberry Pi Pico x3	$12	$12
HC-SR04 Distance Sensor x3	$18	$18
Arducam Day&Night Vision Camera	$28	$0
Arducam 2MP x3	$75	$75
Ordered PCBs	$200	$30
24BJY48 motor x 3	$0	$3
ULN2003 Driver x3	$0	$6
Total	$333	$144

PCB



- 28 header pins
- RP2040
- 264kB SRAM
- 2MB storage
- Micro-USB B port for power and data
- Take input voltage from 1.8-5.5v

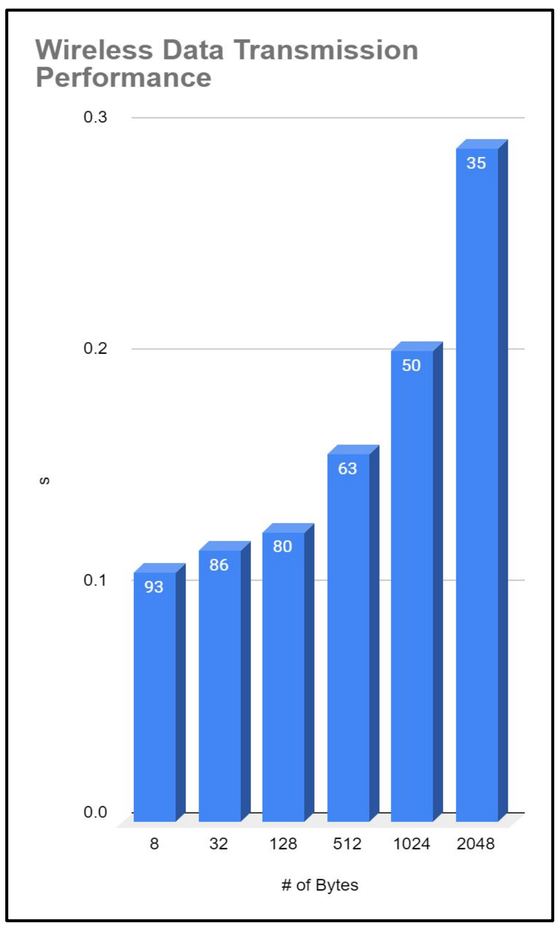
Data Transmission Design

Client Side

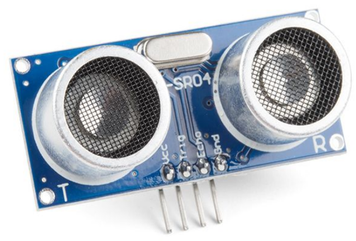
- Receive data as array of bytes from FIFO buffer
- Initiate Socket Connection
- Send Byte Array (of frame data and distance data) in packets
- Wait for input from server

Server Side

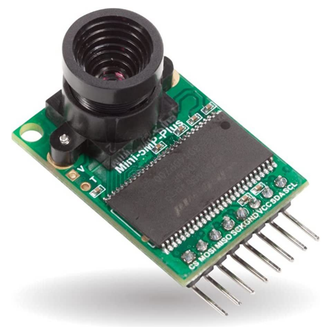
- Receive sent byte array packet (length 2048)
- format byte array into image frames
- Display continuous frames as video
- await input from user based on distance or motor



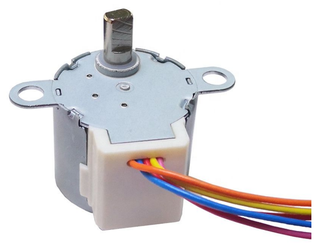
Hardware



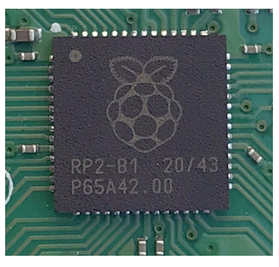
HC-SR04
Distance sensor



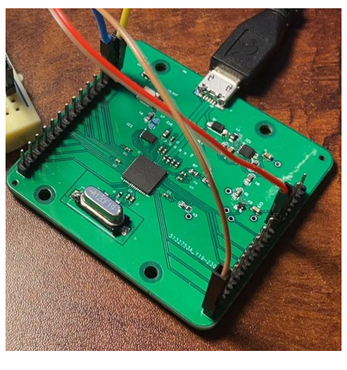
Arducam 2mp



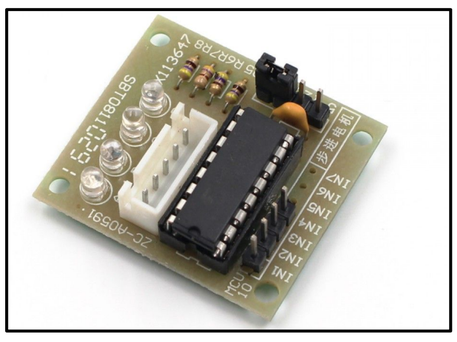
24BYJ-48 Stepper Motor



RP2040 Microcontroller



PCB



ULN2003 Motor Driver