D.R.O.P.

Delivery Robot with “Otonomous” Parachute

The Problem

Emergency delivery of medicine or blood to remote areas

Existing unguided airdrop systems are **imprecise** and **require large clearance**

Existing guided airdrop systems are **expensive** and **require human guidance**

The Solution

- A self-guided airdrop device that is:
  - Steerable, for precision
  - Autonomous, to ease human effort
  - Low altitudes for the scope of this project

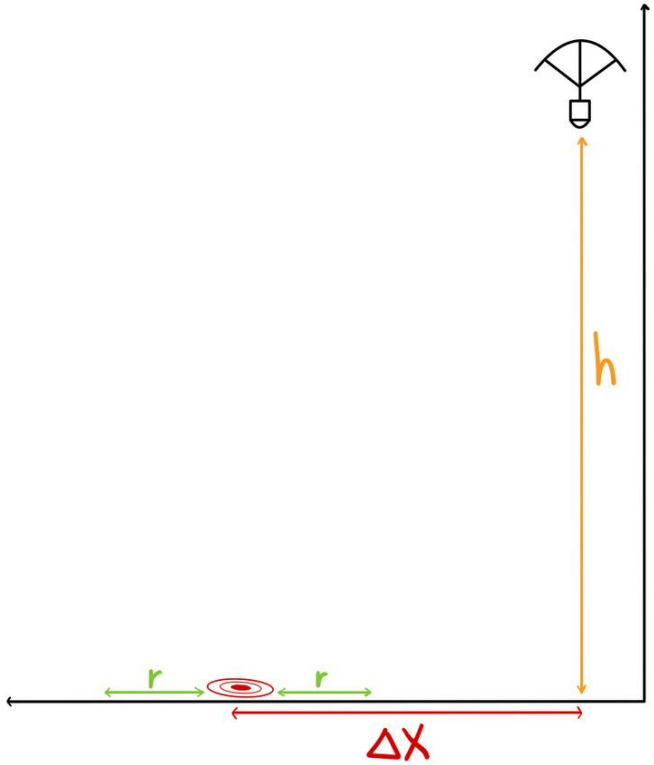
- ECE Areas:
  - Software Systems
  - Signal Processing

Qualitative Requirements

- ❏ Successfully identifies target drop zone
- ❏ Activates self-steer during drop to guide itself to target
- ❏ Safely delivers “payload” (medicine, blood, etc.)
  - No damage
  - Usable temperature
- ❏ Remains intact upon delivery
  - Can be reset and dropped repeatedly

Quantitative Requirements

- Payload weight: 450g
  - Standard blood bag weight
- Accuracy within 1.18 meters
- Lateral Distance of Drop: 3m
  - Based on U.N. airdrop records
  - 300m drop area for 1000m height
  - Scaled down 100x



Quantitative Requirements

- Drop rate .305 m/s
  - 0.907 kg object
  - 1.62 m parachute
- Goal: Land within 1.18 meters

Drag Force from 10 mph wind (F_D)

$$F_D = \frac{1}{2}\rho v^2 C_D A = ma$$

$$a = \frac{1}{2m}\rho v^2 C_D A$$

Radius of Accuracy (r)

$$r = \frac{1}{2}at^2$$

$$= \frac{1}{2m}\rho v^2 C_D A t^2$$

$$= 1.181 \text{ m}$$

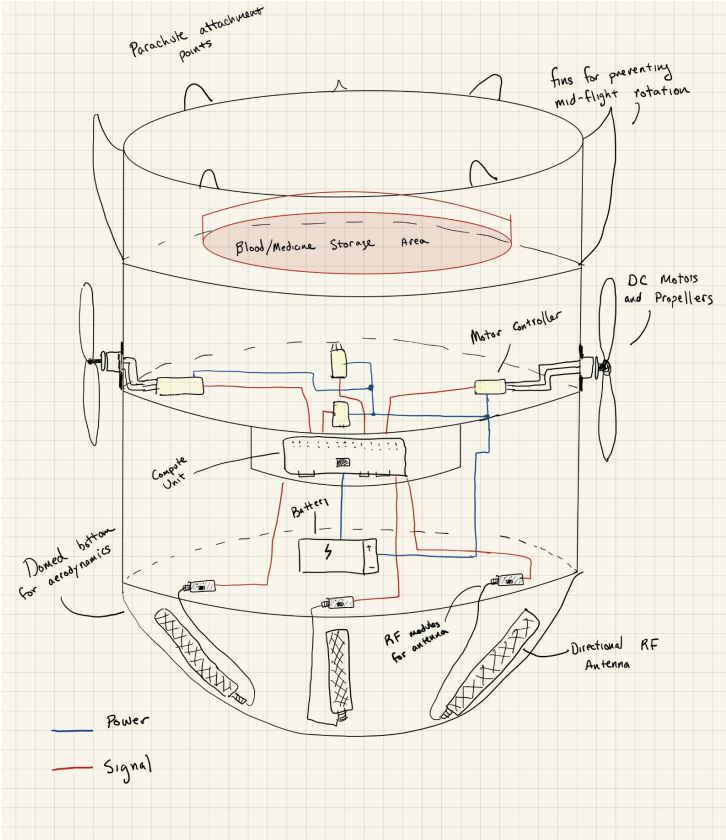
Technical Challenges

- Drop speed versus Accuracy
  - Device weight ⬆️, drop speed ⬆️
  - Less time in the air = less time for self-guiding

- Parachute Size versus Speed
  - Parachute Size ⬆️, lateral speed ⬇️
  - Parachute Size ⬆️, drop speed ⬇️

Solution Approach - Device

- Directional antennas:
  - Pointed in different directions
  - Receive wifi signal
- Compute:
  - Determine direction of strongest signal
  - Control propulsion
- Propulsion - directs device
- Housing - protects payload and hardware
- Payload - contains deliverable



Solution Approach - System

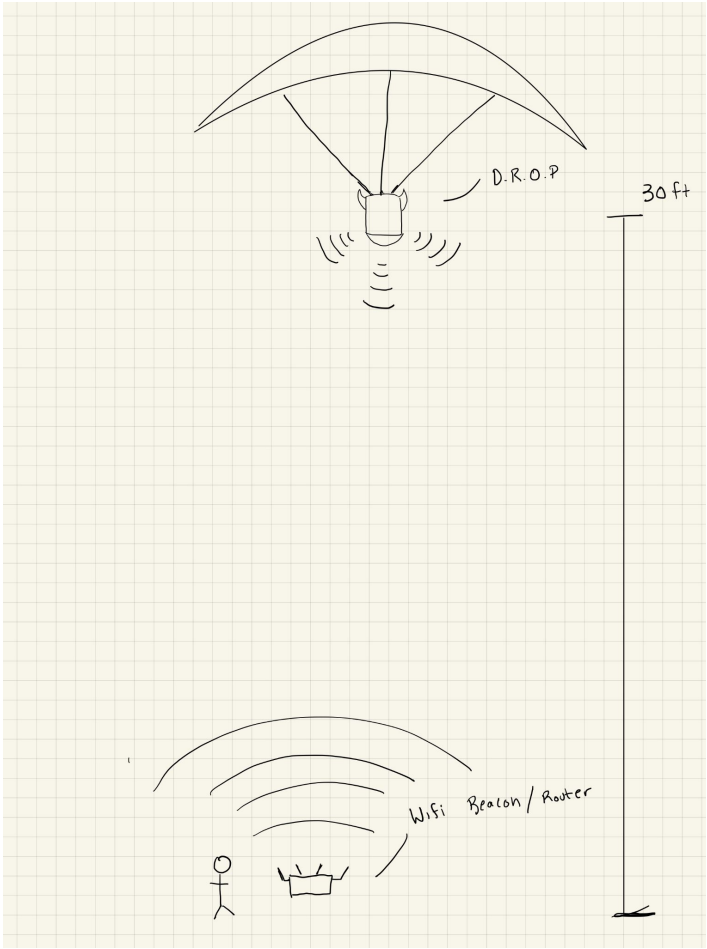
Signal emitted from target location on ground

⬇

Device dropped with parachute

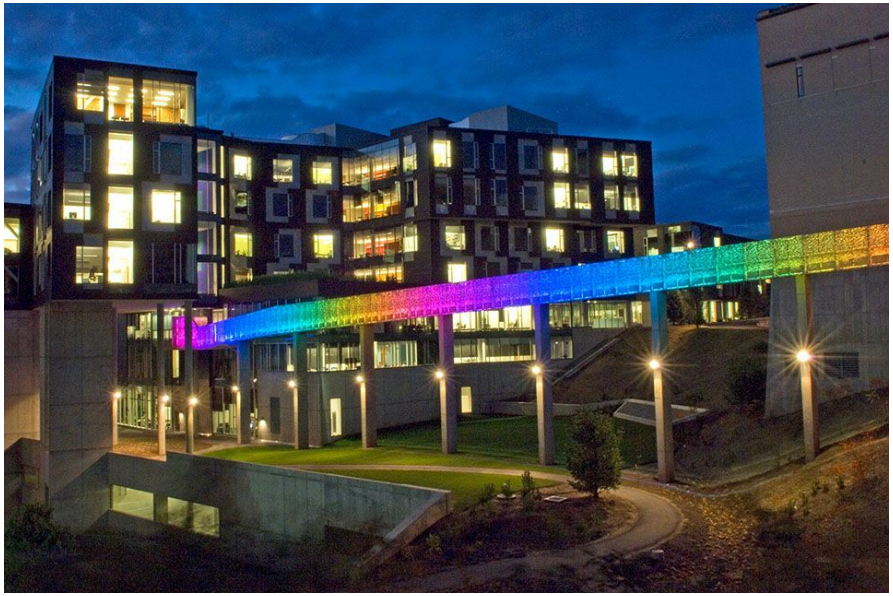
⬇

Device moves accordingly to antenna with greatest RSSI



Testing, Verification and Metrics

- Repeated drop tests:
  - Drop location: Pausch Bridge or other location of height 10-15 meters
  - Conditions: Varying wind speeds
- Accuracy measurement:
  - Distance from target, in meters



Tasks and Division of Labor

- Lahari
  - Signal Processing
  - Directional Antenna System
- Vikram
  - Embedded Systems/Mechanical Engineering
  - Motor System and Housing
- Daniel
  - Embedded Systems
  - Control Software and Motor Control Logic

Schedule

Company name	**D.R.O.P.**
Project lead	LVD
Project start date:	9/20/21
Milestone marker:	1

Scrolling increment: 2

Milestone description	Assigned to	Pr	Start	Days
Design Phase				
Housing Design	Vikram		9/20/21	16
Signals/Antenna Design	Lahari		9/20/21	16
Motor Specs/Control Design	Daniel+Vikram		9/20/21	16
Compute/Software Design	Daniel		9/20/21	16
Pre-Test	Lahari+Vikram+Daniel		9/22/21	14
Implementation				
Housing Creation/3D Printing	Vikram		10/5/21	14
Antenna Development/Software	Lahari		10/5/21	14
Motor/Controller implemetation	Daniel+Vikram		10/5/21	14
Writing Software	Daniel		10/5/21	14
				24
Integration/Testing				
System Integration	Lahari+Vikram+Daniel		10/17/21	14
Ful System Testing	Lahari+Vikram+Daniel		11/4/21	14