

Multipurpose Emergency Drone for Urban Search Assistance

MEDUSA

ENPM 645: Human Robot Interaction - Final Project



Harika Pendli - 117501421 Hemanth Joseph Raj - 117518955 Hrushikesh Budhale - 118284217 Shubham Ramaraja Takbhate - 118359502

Problem Statement

When people in remote and inaccessible areas like deserts, mountains or forests need medical assistance, help can oftentimes be difficult to get.

The numbers speak for themselves!

- According to the Indian National Crime Records Bureau, 24,012 people die due to delay in getting medical assistance, owing to traffic obstruction, in-accessibility of location etc. [1]
- Emergency medical service units average 7 minutes from the time of a 911 call to arrival on scene. That median time increases to more than 14 minutes in rural settings, with nearly 1 of 10 encounters waiting almost an HALF HOUR for the arrival of EMS personnel. [2]



What we propose

An effective method to reach the patients, provide emergency relief and interact with them before the first responders arrive.

Metrics Of Success

Absolute

- 1. Increase in patients' rate of survival
- 2. Better chances at recovery due to faster access to medical care

Abstract

- 1. Lower stress levels in the patients before help arrives
- Improved patient satisfaction scores



Ideation

- Basic idea create a system to aid the rescue/ emergency response service
- Solution Drone with abilities to assess the scene, provide audio communication between scene and emergency server, and deliver basic first aid, medical refreshments etc.

Problem - Response Formulation





Unmanned Vehicle Technologies (UVT)

Product Design:

- They make use of publicly available drones like Dji Mavic etc. and custom tune to user's needs
- They provide their proprietary Fleet Management services

Area of usage:

- Public Safety
- Utilities
- Construction

Price Range: \$10,000 - \$17,000



Unmanned Vehicle Technologies (UVT)

Product Line



BRINC Drones
LEMUR



DJI Matrice 300 RTK



Freefly Systems
Astro Map



Flymotion

Product Design:

- They make use of publicly available drones like Dji Mavic and custom tune to user's needs
- The provide their proprietary Fleet Management services, threat mitigation software etc.

Area of usage:

- First Responders
- Defense
- Law enforcement and security

Price Range: \$15,000 (Estimated)



Flymotion

Product Line



Skyfront

Product Design:

- They custom designed drones for long duration flights which require endurance
- Long range gas-electric hybrid drones with a run time of 5 hours and 10 Kgs of payload capacity

Area of usage:

- US Air Force
- US Navy
- Homeland Security

Price Range: \$15,000 (Estimated)



Skyfront

Product Line



Perimeter 4



Perimeter 8



Competitors Shortcomings

Do the current products do the job? - More or less

Can it be made better? - Absolutely!

How? - Our solution is INTERACTIVE!!



Our product - MEDUSA

Why does our product stand out?

- Our product is cost-effective
- Takes into account the human factors involved in Search and rescue!
- An interactive solution to keep the patient engaged
- A cyber-resilient system

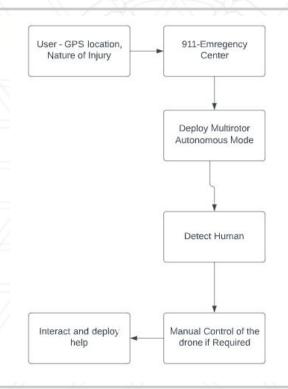


Modus Operandi

- Person in emergency at remote location will call 911.
- 2. From the Medical officials our cloud server will receive that person's location and severity of incidence.
- 3. Server will assign a nearest drone from the fleet of ready drones.
- 4. The drone carrying first aid kit will reach the location of the person.
- 5. It will safely land the near the person.
- 6. The chatbot will remotely instruct the person on how to apply the medication till the ambulance arrives.
- Drone will autonomously come back to base station once ambulance arrives.

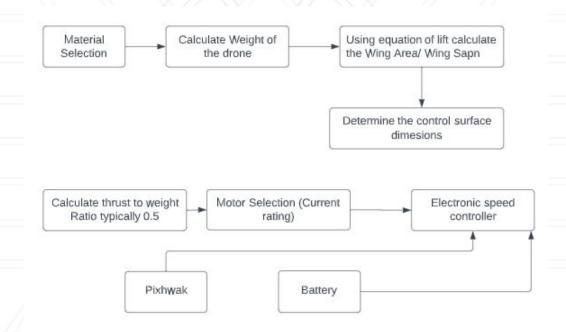


Modus Operandi





Design



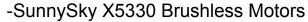


Design



Components





- Thrust of 100 Newton @ 80 Ampere
- -646g





-Cobra 100 Amp ESC

-Capable of withstanding 100 Ampere current

-MG995 servo motors



Components





LIPO 6S Pixhwak



Components

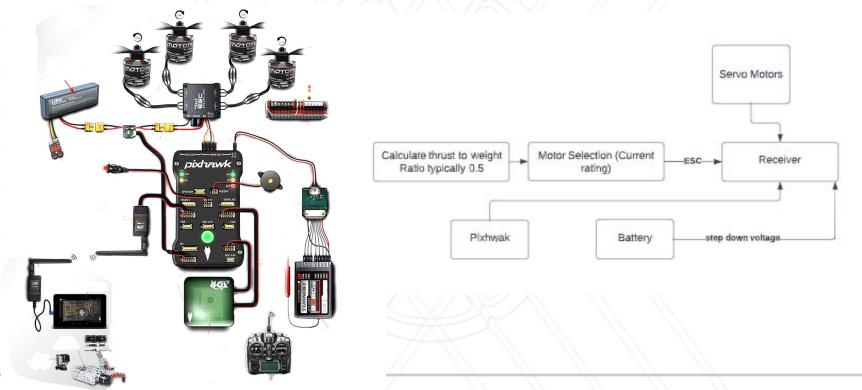


The ground station-based radio is connected via USB (essentially plug-n-play).

The vehicle-based radio is connected to the flight-controller's TELEM1/TELEM2 port, and typically requires no further configuration.

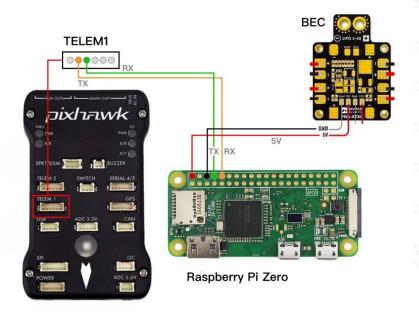


System Architecture

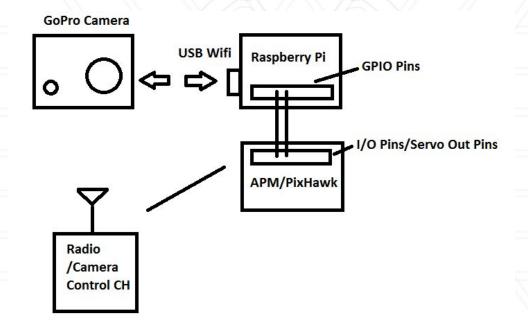


FEARLESS IDEAS

System Architecture



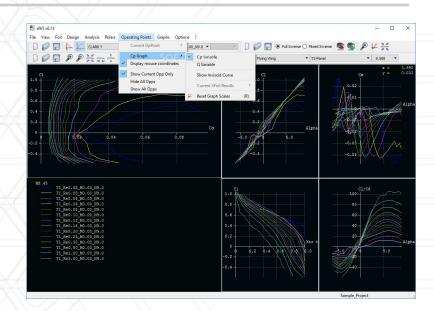
System Architecture



Open-source softwares



- -Upload firmware
- -Connect with Pixhawk via USB
- -Plan missions



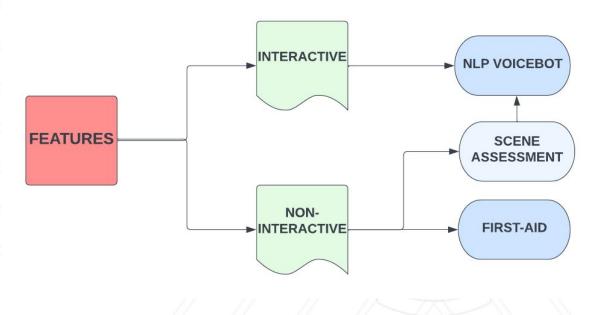
- -Airfoil Analysis
- -Aerodynamic analysis
- -Structural Analysis



Bill of material

Part	No of units	Cost (\$)
BLDC motors	5	900
Servo Motors	4	20
Battery 6S	1	100
Transmitter and Radio	1	200
Pixhawk	1	180
Raspberry Pi	1	60
Go-pro camera	1	270
Speaker	1	12
Misc	-	600-800
Total		\$ 2342-2542

Features(Cloud-based)







Scene Assessment/ Understanding

- Get images and higher level of understanding and details of the incident
- Some of the useful detectable details could be:
 - number of people involved
 - categorise the accident (fire, vehicle, etc)
 - property damage etc...







Interactive features: NLP voicebot

- This NLP Voicebot gathers details of the accident from the victim (if in condition to speak) and bystanders.
- It gathers details regarding the accident by asking questions and carries the conversation to create an end-to-end automated voice chat.



This video shows a prototype voicebot of a pharmaceutical company that prescribes medicines.



Trustworthiness is important factor for a patient in the situation of distress.

We plan to gain this trust based on the underlying technology that we will use to ensure fail safe and secure help for anyone in need.

- Cybersecure Interaction
- Cyber Resilient Autonomy
- Calming Appearance and Interaction





Cybersecure Interaction

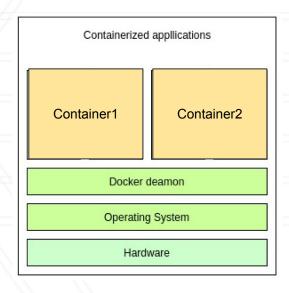
- A patient emergency related data should remain private throughout this operation.
- Hence in our system the patient data received from the government will be encrypted, so that no hacker can read it.
- To keep the drone safe from the RF attacks, we plan to make the drone completely autonomous throughout the operation, with the help of obstacles avoidance and failsafes.
- On detecting the jamming signals or malicious activity the drone will change its trajectory and it will return back to the base.





Cyber Resilience

- To ensure the resilient autonomy, the drone will be running 2 different high level behavior stacks which will be responsible for making sure the drone reaches destination safely.
- To make it resilient these 2 systems will run parallel in separate docker containers.
- If one of the model stops because of unforeseen error and fails to identify the obstacle or the intended person. The other model will take the precedence in decision making and will give enough time for other container to restart.





Calming Appearance and Interaction

- Physically, the drone will have a body made up of non metallic lightweight material, which will ensure the drone feels safer to approach for any person.
- Our drone will have the speaker and microphone through which the user in emergency can speak to the AI chatbot.
- The AI chatbot will be specifically trained for helping the person in distress, and will instruct the person how to apply the first aid.
- This chatbot will converse with the patient till the ambulance arrives, this will make the patient feel connected and safe.





Our Business Model

Our Go-To-Market strategy

- B2B service and once it's scalable, a B2A service
- Primary Target Audience
 - First Responders,
 - United Nations to aid their relief work
- Secondary Target Audience
 - Wider public once operations are scaled
- A pay-as-you-go and choose-what-you-need subscription model for Services like Advanced Fleet Management Services, customizable features, etc.



References

- 1. https://www.thehindu.com/news/cities/mumbai/helping-patients-get-to-hospital-on-time/article18031300.ece
- 2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5831456/#:~:text=Emergency%20medical%20service%20units%20average,the%20arrival%20of%20EMS%20personnel
- 3. https://voicebot.ai/tag/natural-language-processing/
- 4. https://www.theverge.com/2022/1/5/22868777/everdrone-drone-defibrillator-health-t-ech-sweden
- 5. https://vision.princeton.edu/projects/2012/SAscene/paper.pdf



Thank You



Harika | Hemanth | Hrushikesh | Shubham University of Maryland, College Park, MD 20742