IMRB 2017
Unmanned Aerial Vehicle (UAV)

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Identified Need

Ability to enter a mine post a major event where environmental conditions are unknown

Option

Unmanned Aerial Vehicle - UAV

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The Ultimate Target

An Unmanned Aerial Vehicle (UAV) with the following characteristics

- Proximity sensors with automatic distance limiting protection
- Ability to withstand impact damage caused by flying into objects
- Navigation: 2 forms, pre- programmed and pilot driven ability
- Instantaneous communication: (Wi-Fi network will provide a suitable network backbone for live control of UAV drone)
- Intrinsically safe
- Rapidly deployable with up to 10km in range
- Battery powered
- Video imaging cameras
- Atmospheric monitoring with ability for both stored and instantaneous readings
- Thermal imaging with ability for both stored and instantaneous readings

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The Steps:

Stage 1 "Proof of Concept"	Stage 2 "Fully operational prototype"	Stage 3 "Operational system"
Product 1 km range Bump proof Communications- able to deploy own wi fi network, Remote control – via on board camera Gas monitoring Payload flexibility (2 kg max) Anti-static materials used	**Product** Proximity sensors Fully set up for underground deployment IS approval	**Product** 10 km range Full scope of operation in terms of: • Distance • Duration • Clarity • Nodes • High definition

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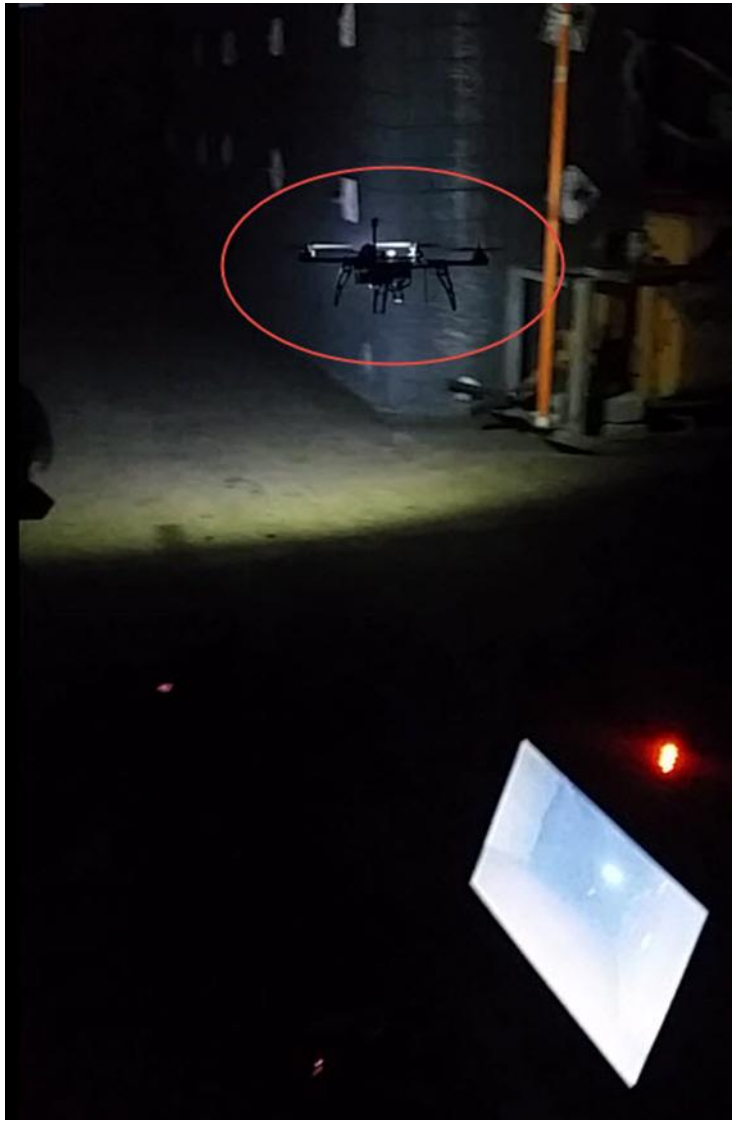
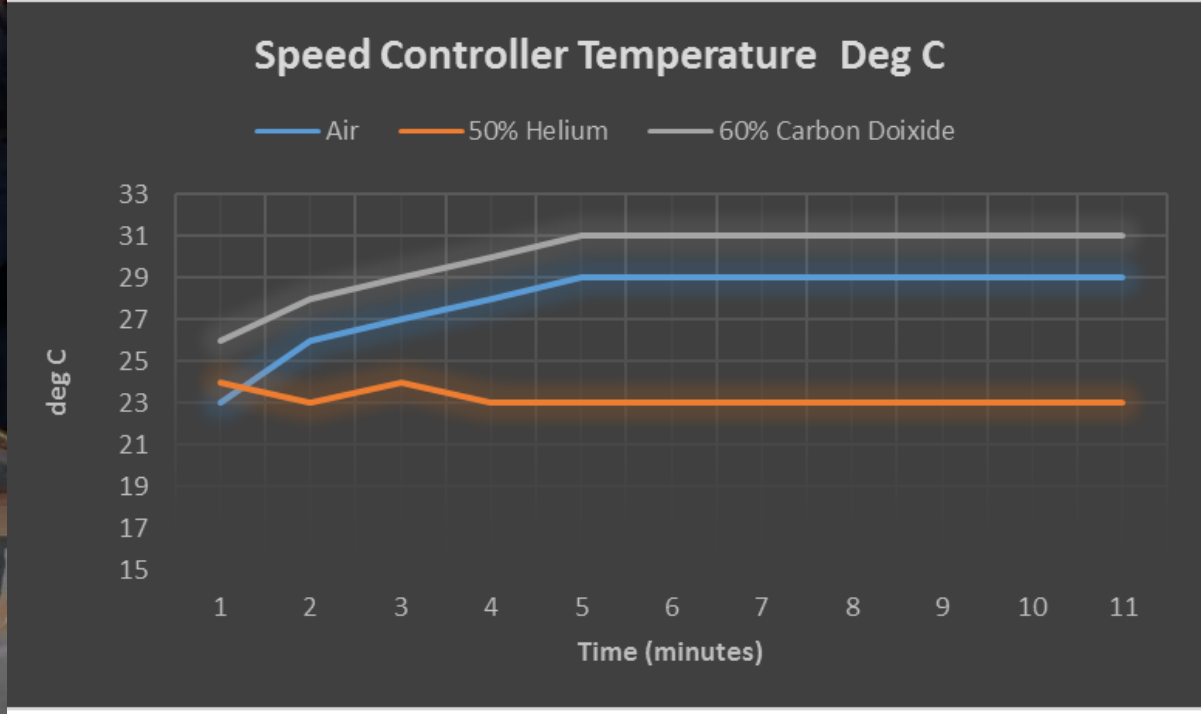
Stage 1 –Initial Underground Flight Tests



Stage 1 –Thermal signatures in alternate atmospheres


DX18


Speed Controller Temperature Deg C
Air
50% Helium
60% Carbon Doixide
deg C
33
31
29
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10
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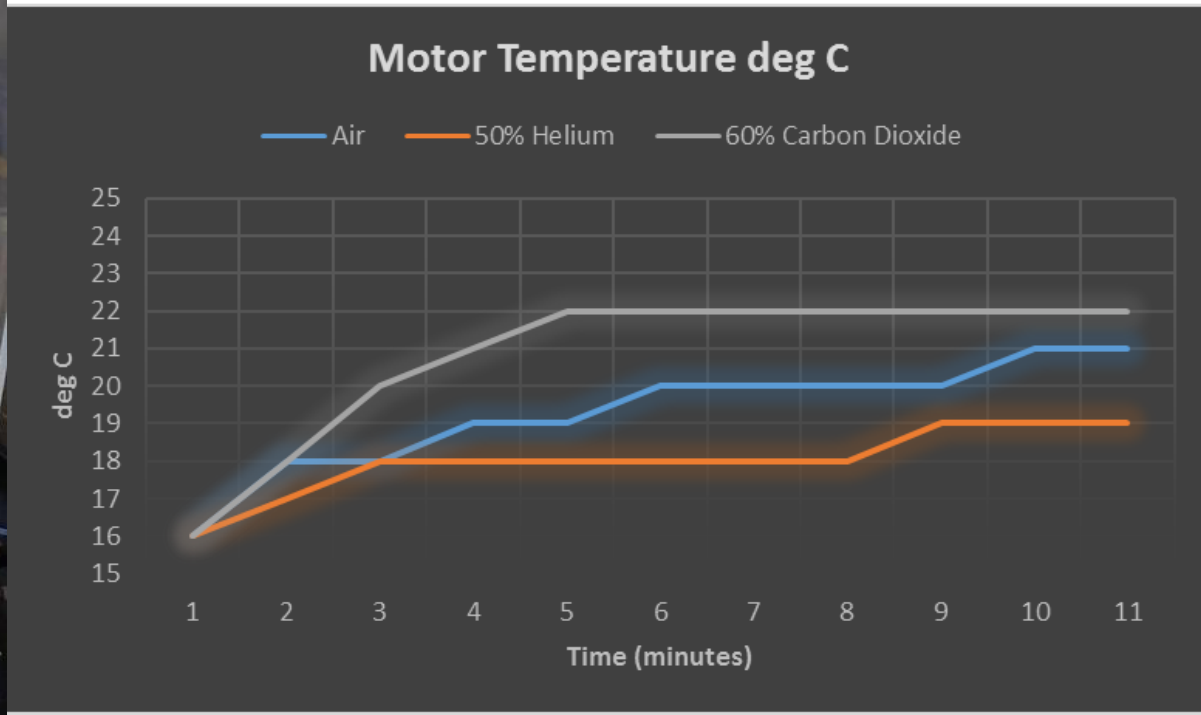
Time (minutes)


Motor Temperature deg C
Air
50% Helium
60% Carbon Dioxide
deg C
25
24
23
22
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18
17
16
15
1
2
3
4
5
6
7
8
9
10
11
Time (minutes)

Stage 1 – Flying capability in alternate atmospheres

Test 1: Air density 1.0 — Take off: 60% of full rpm

Test 2: High Density 1.41 (75 % Co2) — Take off: 55% of full rpm

Test 3: Low Density 0.57 (50% Helium) — Take off: Unable to lift off at 100% of full rpm

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Phase 1 – Bump protection system

Stage 1 – Initial Control Tests

Communications

The Problem

- Traditional electromagnetic communications operating under harsh underground conditions encounter major performance issues:
  - High levels of signal attenuation
  - High path loss
  - High bit error rates
  - Multi path fading
- Commercially available technology does not meets the unique requirements of size, weight, and performance in a cost effective form factor that provides a capable communications platform to operate an UAV underground.

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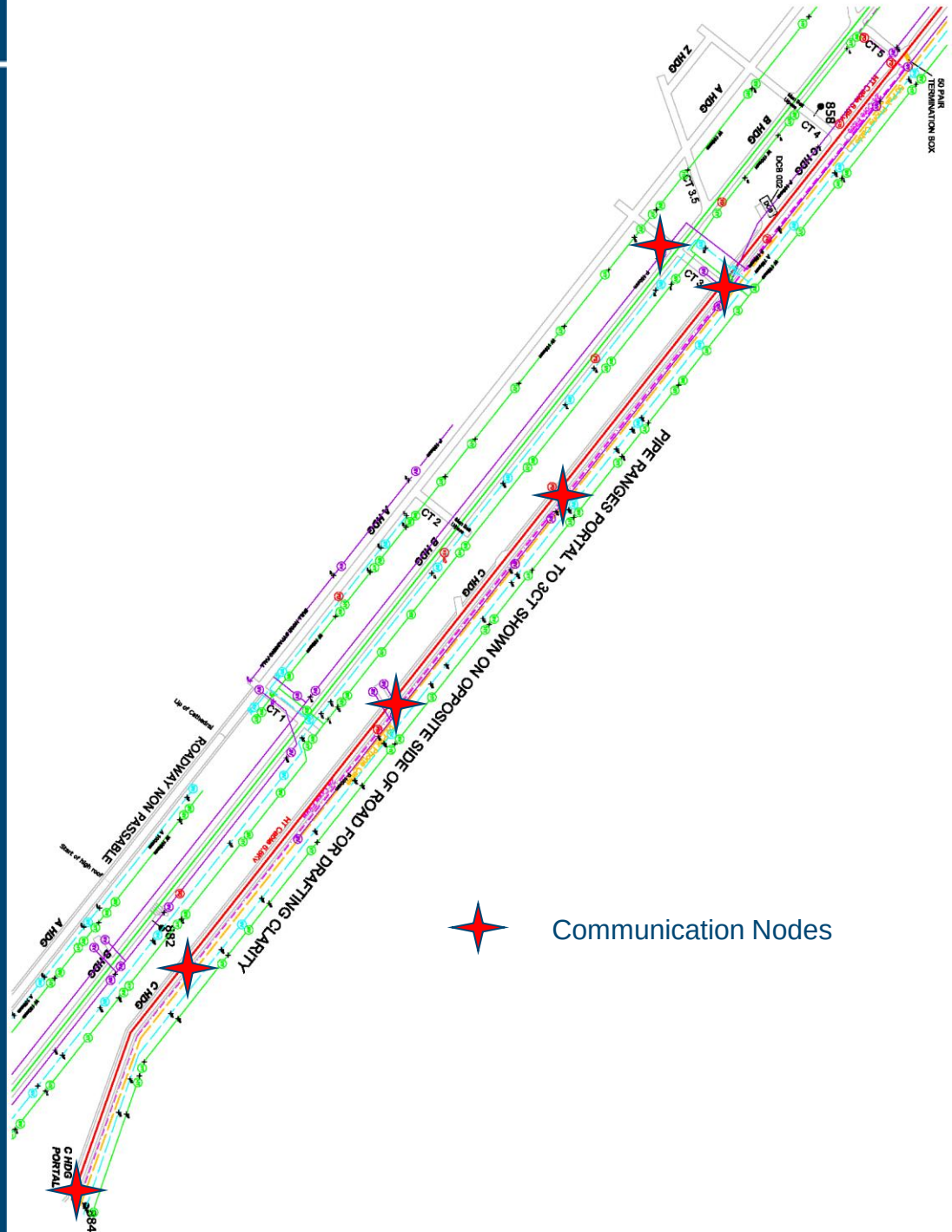
Stage 1 Communications demonstration



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Flight test heading from surface underground

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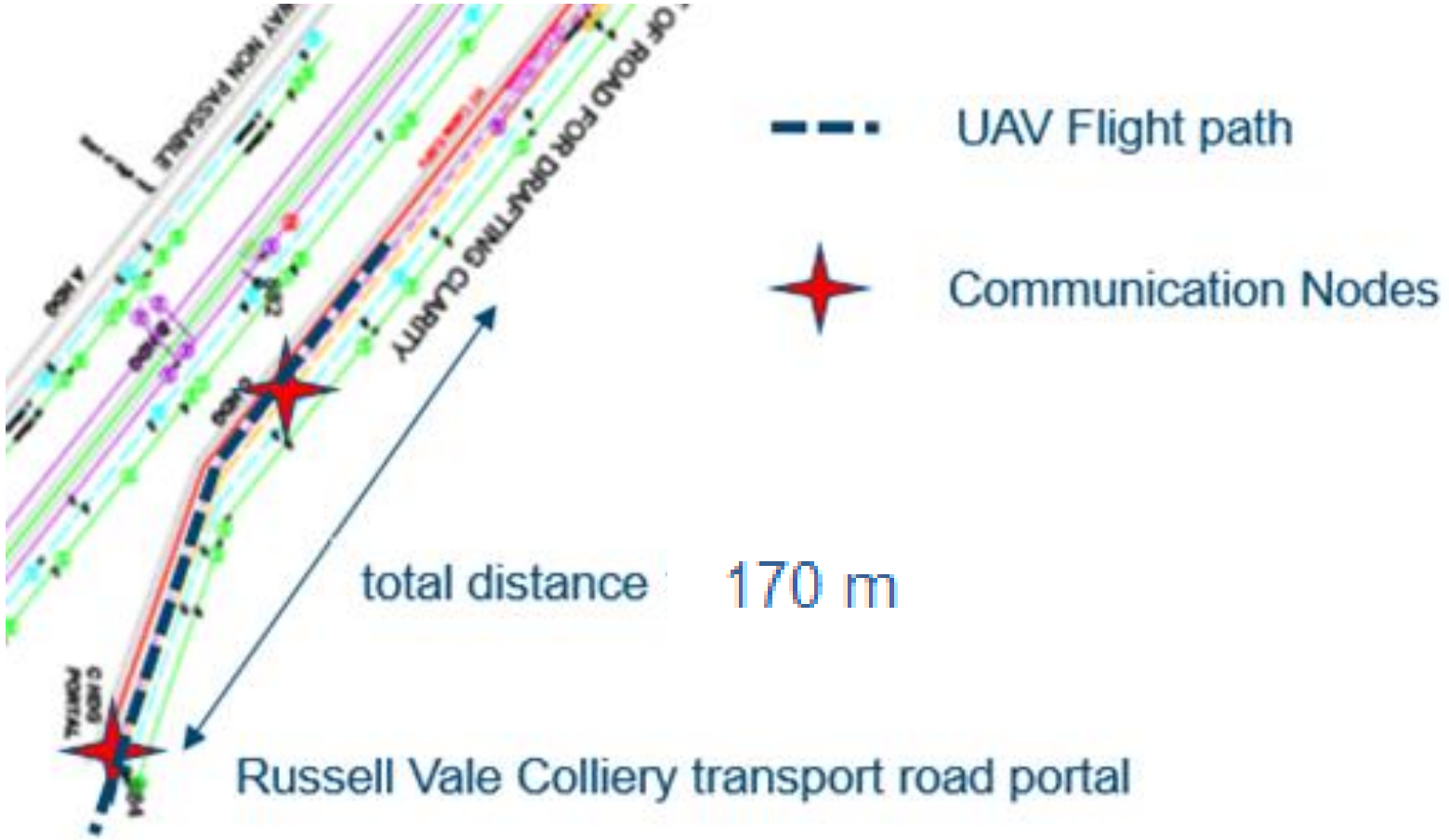
Flight test heading from underground to surface



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Flight test heading from underground to surface

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Communications

Conclusion

UAV control is achievable with the following requirements:

- heterogenous
- battery powered
- small & lightweight
- low-cost
- IS approved
- rubble penetration
- high bandwidth
- optimized with UAV autonomous control

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Future Work

UAV Design

- Fly UAV in an atmosphere of SG
- Develop a customised fit for purpose UAV platform
- Light Distancing and ranging scanner (LIDAR)

- Ultrasound collision avoidance sensors
- Full surround bump/intrusion protection
- Fail safe programming
- An Onboard control system

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