ADVANCE QUEENSLAND
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Private Sector Pathways (PSP) Program

Challenge Statement Form

Visualisation of Autonomous Vehicle Data

Challenge Statement

Autonomy is starting to play a large role in the civilian and defence arenas across space, air, land, and sea. Crewed vehicles benefit by having a human in location who can receive, interpret, and action the data presented to them in location. Uncrewed vehicles on the other hand have the latitude to make some decisions based on the information on hand, with the expectation that all of the information is provided back to some base station in the event human intervention is required. Each base station is expected to process and display the information from multiple autonomous vehicles. This means the information needs to be provided in a way to allow the human to identify any issues in a timely manner and intervene as required.

The challenge is to provide a visual representation of multiple data sets and viewpoints – making it clearer for the human operator/in the base station to digest high volumes of data. A simple analogy is the use of new sensor technology in cars which takes multiple data points from sensors providing a birds-eye view of the car. In an autonomous environment, an operator can be receiving multiple data sets (visual/video, sensor, audio, radar) from multiple drones and the proposed solutions will use that data to create a visual representation of its surroundings, providing better situational awareness. This visualisation capability will also be used by the developers building the autonomy capability to conceptualise and workshop different ideas to be able to fully realise the capability.

The goal of this challenge is to create a visualisation capability to display the autonomous vehicle state and sensor data. This visualisation capability will provide the human with appropriate situational awareness to enable quick decisions.

Challenge Owner

Phantom Works is the advanced research, development, and prototyping division of The Boeing Company. It is responsible for creating innovative solutions and technologies for aerospace and defence. Phantom Works focuses on developing advanced technologies including for uncrewed systems to meet the evolving needs of customers and address emerging challenges in the defence industry. Phantom Works Global (PWG), headquartered in Brisbane, Australia collaborates with government agencies, industry partners, and academic institutions to drive advancements in aerospace and defence capabilities. Propelled by a team with an innovative spirit, PWG delivers strategically disruptive, sustainable capabilities to our customer. The MQ-28 Ghost Bat program originated within the division and PWG continues to grow autonomy capabilities and technologies within the Australian ecosystem. Boeing is a strong supporter of small to medium enterprises (SMEs), including in Queensland, and has a long-relationship with the Queensland Government and its programs. Boeing supports Queensland SMEs by:

- Enabling SMEs the opportunity to work in the defence industry;
- Partnering with SMEs to develop innovative technologies and transition them into existing projects;
- Creating and improving new contacts and networking through the pitch event and working together;

Queensland Government

We believe the phrase “it can’t be done” is a myth, and our team eagerly takes on the toughest challenges, bringing cutting-edge technologies to life.

Challenge Imperative

Use of autonomous vehicles continues to increase. The expectation is for these autonomous systems to operate and interact with and alongside crewed systems in a trusted and reliable way. One of the main challenges associated with the development of autonomous systems is the lack of availability of appropriate tools to enable the developers to design and test new concepts and systems in collaboration with their customers and other stakeholders.

A key approach to addressing this challenge is the implementation of integrated data visualisation techniques that support development of autonomous systems. The inability to resolve this situation will result in the developers and the customer not being able to fully realise the benefits of the deployment of autonomy into operational contexts in relevant timeframes.

Challenge Context

The Stakeholders Involved

The stakeholders consist of multiple members of the PWG team working on autonomy projects as well as members of the PWG modelling and simulation team.

The members working on the autonomy projects will be seeking to integrate the technology for the end user as part of the capability under development.

The members for the modelling and simulation will be seeking to integrate the technology as an enhancement to their existing capability to uplift the demonstration and presentation capabilities of their team.

The Current Situation

Currently, a subset of the functionality exists across multiple tools that were not designed using patterns that lend themselves to extensibility. The consequence of this is increased developer workload to synthesise information into a comprehendible format to make timely decisions. Resolving this challenge will greatly enhance the human experience by significantly minimising the workload.

Outcomes Desired

The successful solution should create a display environment that has the ability to ingest autonomous vehicle status and sensor data and present them visually to assist the human to rapidly extract the important information.

The goals of the product/solution are to:

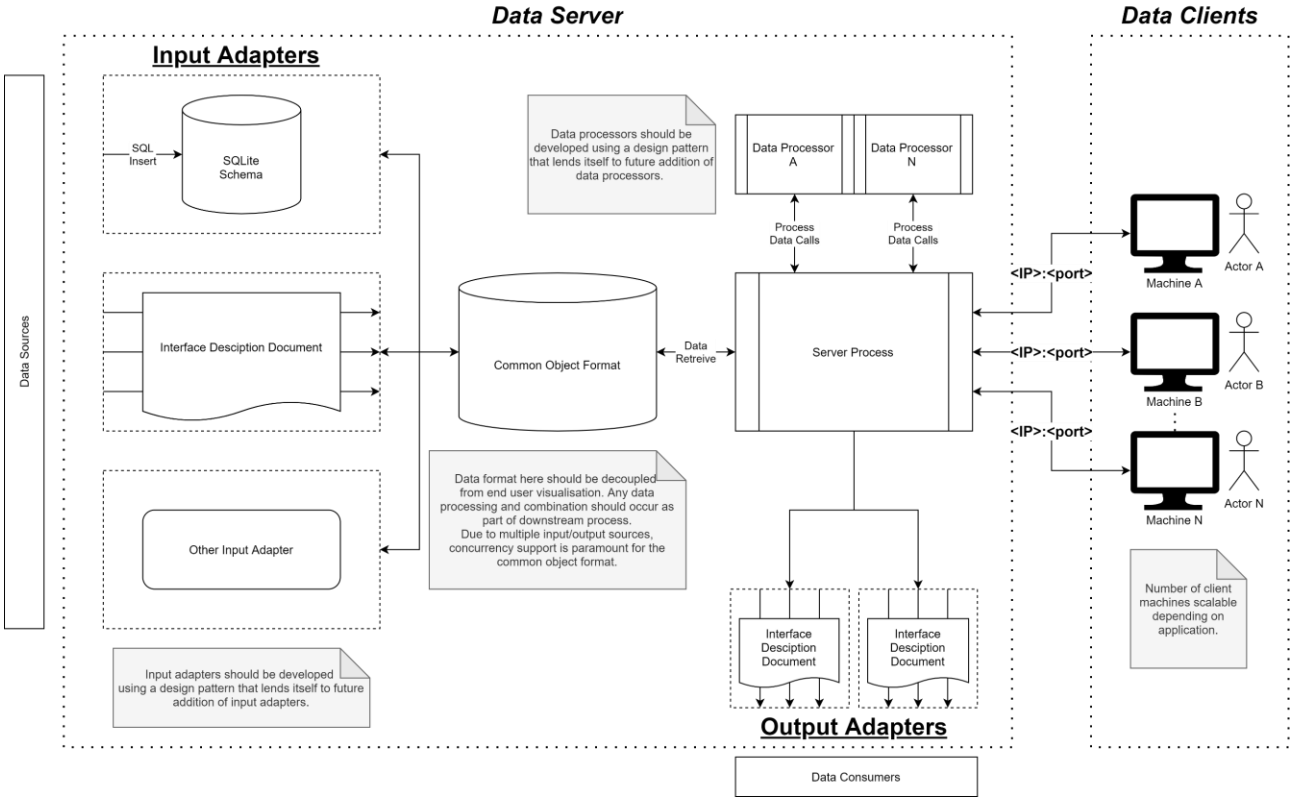
- Demonstrate a display capability that can be incorporated into an existing system;
- Have a capability that can be expanded to add in new input data as required;

Technical and/or Regulatory Considerations

For these activities, the regulatory considerations are out of scope. From a technical consideration the following points shall be considered:

- Can be installed on standard commercial IT equipment;
- Easy to use with minimal training for the humans;
- Be able to operate in environments with no network connectivity;
- Be able to be accessed and used by several users concurrently;
- Builds (if applicable), packages, and runs in a docker container;
- Input data rates can be very high;
- GUI response time is paramount;
- Application shall be applicable for both real-time and post-event debrief use-cases;
- There are no development language requirements, though python, cpp, java, and rust are preferred in the listed order;
- Further application architecture points discussed below.

Application Design:



Information Types for visualisation consideration are:

<u>Input</u>

- Many X against Y
- X density against Y
- Difference between X_1 and X_2 against Y (where X_1 and X_2 arrive asynchronously and require resampling)
- Euclidean distance between $3D_1$ and $3D_2$ against Y (where $3D_1$ and $3D_2$ arrive asynchronously and require resampling)

- Shortest Euclidean distance between $3D_1$ covariance ellipse and $3D_2$ covariance ellipse against Y (where $3D_1$ and $3D_2$ arrive asynchronously and require resampling)
- 3D location (LLA or ECEF) with measurement covariance ellipse shown in space on a 3D map
    - Optional setting for location history (paths)
- NED Bearing, Elevation, and 3D reference point (LLA or ECEF) shown in space on a 3D map
- 'Bugsplat' shown in space on a 3D map
    - Antenna patterns
    - Signature patterns
- Status Information
    - Historical status logs
    - Most recent status using 'card' pop up/in
    - Behaviour Trees
- User selected filters
    - Data Identification/Tags
    - Time Filters
    - Etc.

Output

- Events (tag an event that has occurred in the database)
- User input
    - Strings
    - Buttons
    - Switches
    - Etc.

Design Benefits

The primary objective of the solution is to provide an efficient environment to support the visualisation environment that enables a collaborative, iterative evaluation of autonomy as it is being developed. The solution must be innovative and something that will bring a fresh perspective on how information is displayed and managed.

Commercial Opportunities

There are numerous opportunities in the commercial and defence markets for a display solution requested in this challenge.

How to apply

Applications can be submitted via here and should include the following:

- A clear description of the solution, including its key features, benefits, and value proposition.
- A roadmap for implementation, including timelines, resources, and milestones.
- A plan for measuring the impact and success of the solution, including metrics and evaluation criteria.
- A budget that outlines the financial requirements for implementing and maintaining the solution.
- A summary of the team's qualifications and experience, including relevant skills and expertise.

Applications may be shortlisted for presentation to a panel from PWG.

Program Background

The Advance Queensland Private Sector Pathways (PSP) program aims to solve corporate challenges with solutions generated by proven innovative Queensland small to medium enterprises and scaleups. PSP aims to:

- create commercial opportunities for innovative Queensland businesses by connecting them to corporate customers
- provide a risk-managed process for corporates to explore and implement Queensland solutions to their challenges

WHY FOR CORPORATES?

- Exposure to latest technological innovation
- Solve corporate challenges using local solutions and technology
- Deliver improved efficiencies and technologies to business processes
- Co-fund, de-risk and increase speed of adoption
- Diversify procurement to a wide range of Queensland innovative businesses

WHY FOR QUEENSLAND BUSINESSES?

- Commercial opportunities for Queensland businesses
- Opportunity to pivot products/services to a new sector
- Opportunity to secure a corporate as a customer
- Retain intellectual property
- Building credibility by having large corporate customers

More Information

Contact Advance Queensland's Private Sector Partnerships team at partnerships@dtis.qld.gov.au