THE FUTURE OF DISASTER RESPONSE

-- COMBINING AI + AVIATION DATA & ASSETS --

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1. Overview

1.1. In natural disasters and other emergency situation, it is critical to evacuate people, deliver supplies and provide access to the proper medication in the early stage. Aviation plays the vital role in assisting the communities by its fast response, especially in the remote areas where ground transport cannot access freely.

1.2. Although response to natural disasters and other crises is currently impressively quick, there are still opportunities for it to get even better. One of the main variables in the efficiency of the response is the 'aviation' component. This covers how aviation assets are deployed in response to disasters.

1.3. Now with the recent advancements in AI and related technologies, as well as with the proliferation of new types of aviation assets (e.g. drones and high altitude balloons) that can be used in the response to disasters it is probably time to let AI take a system-wide look at all this and figure out what we can do better.

2. Scope

2.1. This project aims to bring together several efforts that are already ongoing that are working on a piece of the overall puzzle. These range from AI projects to help predict risks related to earthquakes, to big data projects that collect social media information during disasters, to those working on using machine learning to manage drone traffic, to those working on the next generation of aircraft designs.

2.2. The foundational effort will therefore be to create an inventory of the related project and to design an interface between them so that they can better inform decisions leading-up-t0, during and after a disaster strikes.

2.3. The ***inventories*** will mainly include:

- Data assets : an inventory of data that can be useful to disasters, from topological, to social, to geological. Each data will be mapped to the potential relationship to disaster prediction and management.
- Data on past disasters : this will be organized in a manner that can best be used to train AI applications.
- Existing disaster simulators : simulators will be used to help assess the response to virtual disasters. There are many that exists, from the macro scale (flooding models) to the human scale (crowd predictions). The inventory will define how the models can be used (e.g. input/output variables).
- Existing aviation assets: an inventory of drones, airplanes, balloons and anything aviation and each described with how it can be used during crisis response.
- Aviation traffic management systems : an inventory of human and machine assisted traffic management systems and how they can be deployed during crises.
- Future aviation assets : an inventory of aviation concepts, again, mapped to how they can assist in crisis response.

2.4. After the inventories are created and engineered in a manner so that they can be feed into machine learning applications, there will be two areas of study.

2.5. Area 50 (why always start counting at 1?): Predictive risk approach

- An AI application will be trained to look at data related to pending disasters and provide advice on where to pre-position aviation assets and pre-plan their deployment in order to minimize response time.
- For example: Data from seismometers lets the AI calculate the likelihood and severity of an earthquake hitting a mountainous region. The AI figures out the closest airports that will likely not be affected; it figures out which aircrafts would most likely be needed, and then based on their current location it finds recommends pre positioning them –it also figures out what regular aviation traffic might be affected and provides some contingency plans.
- A modern AI based approach to the supply chain will also be applied (e.g. to use machine learning to decide on where and how to store relive supplies). This can also include a component that will look into how supplies that exist in the market but that were not targeted for relief (e.g. blankets at the local store) can be repurposed to help with the response.
- This area of study will include interfacing with data in the inventories . It will also be scoped to include predicting how disasters may unfold (which is important if one wants to know how best to respond). In fact

for many types of disasters it will be difficult to predict where it may hit, but knowing how it may unfold should be well within the scope of existing technology (both AI and non-AI) .

2.6. Area 51: Optimized Automated Response

- Develop an AI application to assist the decision making related to deployment of aviation assets during the response disasters.
- There are many variables when it comes to disaster response. Some are difficult for humans to manage in an objective and timely manner. In the traditional aviation scenario, there is a need to optimize the traffic flow of the many transport planes landing in a limited number of airports. These fleets are often very diverse and the crews are not familiar with the terrain. In the emerging aviation sector (drones, higher airspace balloons, etc.) there is the opportunity for the AI to optimize the different and overlapping capabilities of these crafts. For example, if the AI has prioritized the re-establishment of communications then it will choreographed how the aviation assets are deployed hit that mark. If there is a need for first aid in a specific area then it can guide the right drone to deliver what is needed. Under this area there has already been much work on UAS Traffic Management, that can be used, so we are not starting at zero.

3. Key partners in the project:

3.1. To do all this, we need experts in aviation (both old and new), disaster response and AI. We also need to have data.

3.2. There is quite a bit of work that is already ongoing, specifically:

- Several projects on predicting disasters;
- Several UTM efforts
- Development of drones and other aviation assets to respond to disasters.
- So the following partners would be desirable:
- World Economic Forums' effort on the 4th Industrial Revolution
  - They have knowledge on use of drones for humanitarian and social needs
- World Food Programme
  - They are the primary aviation lead for disaster response within the United Nations
- UTM service provider consortium

- They have already figured out how to do unmanned traffic management

3.3. A major AI university lab would also need to agree to join.

4. Methodology

4.1. One of the first things that needs to be developed is the overarching architecture for the information in the inventories. Since the overall methodology is untested the following methodologies will be applied:

4.2. A scenario module will help design the physics of the disaster, and will be limited in scope to just flooding events along rivers at the start (the main source of inforamtion will be https://www.blog.google/products/search/helping-keep-people-safe-ai-enabled-flood-forecasting/). Later the scenario will be expanded to coastal areas. After that other scenarios may be considered. For the initial scenario a specific river will be selected for which there is good and ample data. The specifics can include:

- Heat map of type of injuries
- Time line of people movements
- Heat map and timeline of power and communications shut down

4.3. An aviation assets management module will be built. This mainly combines information in the inventories on the aviation assets, traffic management, and geography, with the scenario builder. In its basic form it should be able to answer questions such as “which aircraft should i use to bring first aide to location LLL”, or “ how can i re-establish communication in region RRR”. Basically something of a customized “ Google What-If tool” .

4.4. An aviation traffic and infrastructure management module. This will combine information in several inventories to provide information needed to help make the aviation system more resilient to disasters. The aspects can include:

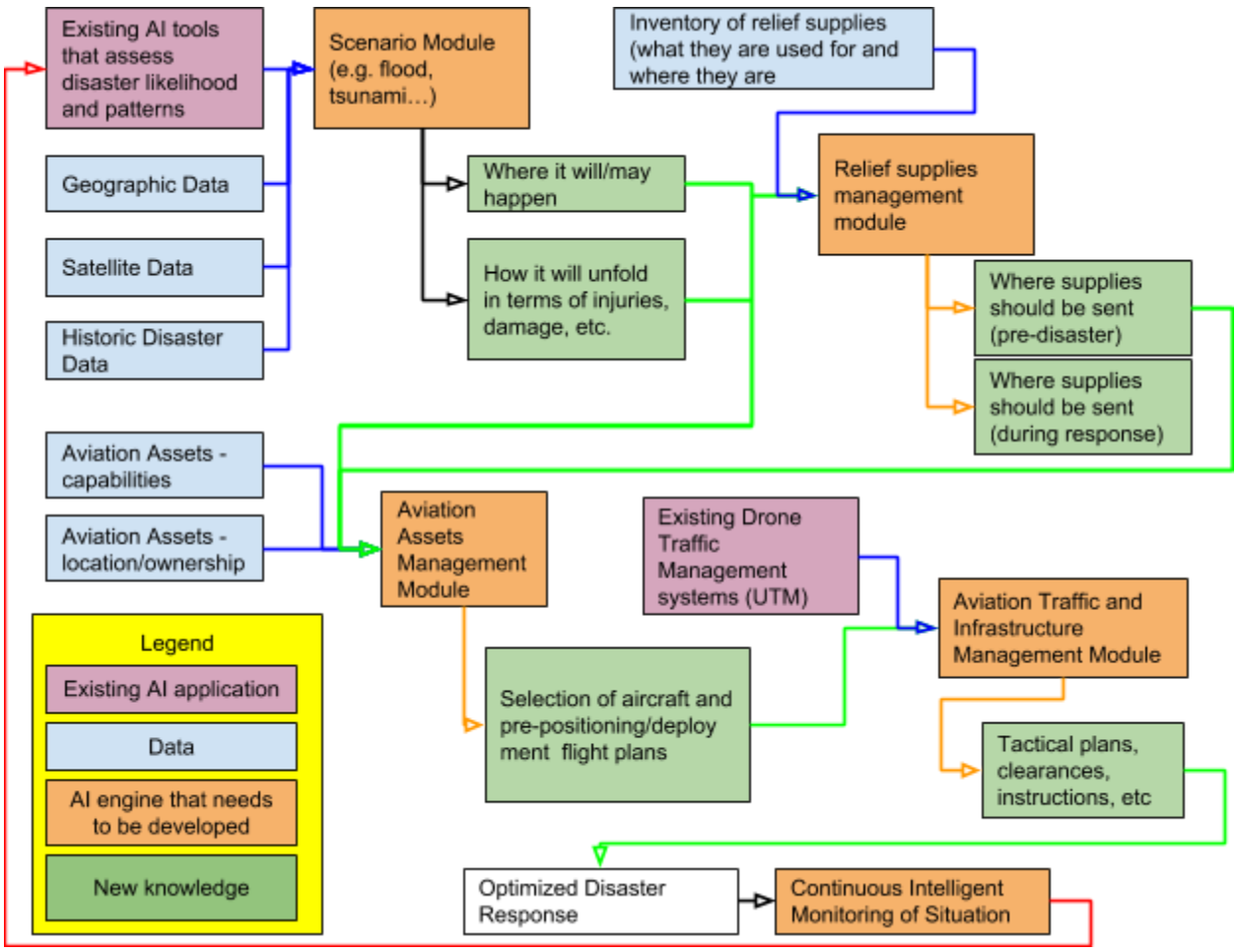
- A rating for readiness. This will tell decision makers for example that the predicted time to recovery for a specific scenario is XX days.
- A crisis readiness evaluations for existing and still-under-development drones. Based on the physical attributes (e.g. battery life, max

altitude, types of onboard sensors) the tool will provide the possible roles it can be used in during a crisis. It will also allow users to know what enhancements they need to make it perform a specific predefined role.

- Return on crisis response (ROCR) for specific infrastructure enhancements (e.g. if a drone delivery system is installed in location LLL it will cut the time needed to recover communications by 12 hours)

4.5. A relief supplies management module will also be built. The idea is to take the modern machine learning assisted approach to determine where relief supplies should be stored in order to minimize response time. The initial storage would be based off of general risks that come out of AI based systems, and more dynamic supply management would be in place as risks increase and actual disasters hit.

4.6. The figure below shows how the different components would fit together to help generate actionable information.



5. Timeline and Budget

5.1. While the budget is scalable, due to the relatively ambitious proposals, $ 7 million USD is asked for to achieve the following:

- Basic inventories described in paragraph 2.3
- The scenario builder
- The tools described in paragraphs 4.3 and 4.4.

5.2. The project will require 3 years for completion. But assets will be made available as they are developed with alpha versions expected to be rolled out within the first year.

5.3. All assets will be published and shared through github or any other open development platform.