NASA SPACE APPS CHALLENGE 2021
MAPPING SPACE TRASH IN REAL TIME

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PROJECT DESCRIPTION

- Challenge:
  - Develop a real-time geospatial mapping system to track debris in Earth's orbit
  - Find a way to track debris smaller than 1cm. This debris is nearly impossible to track but it limits the exploration of space
- Our approach:
  - We researched existing debris tracking software
  - We asked what features would be most useful to engineers building weather satellites, astronauts going to the International Space Station, and others
  - We wrote a 2D simulation that illustrates these features
    - Risk is calculated, and space debris is colored by risk of collision
    - Info can be centered on the earth or the International Space Station

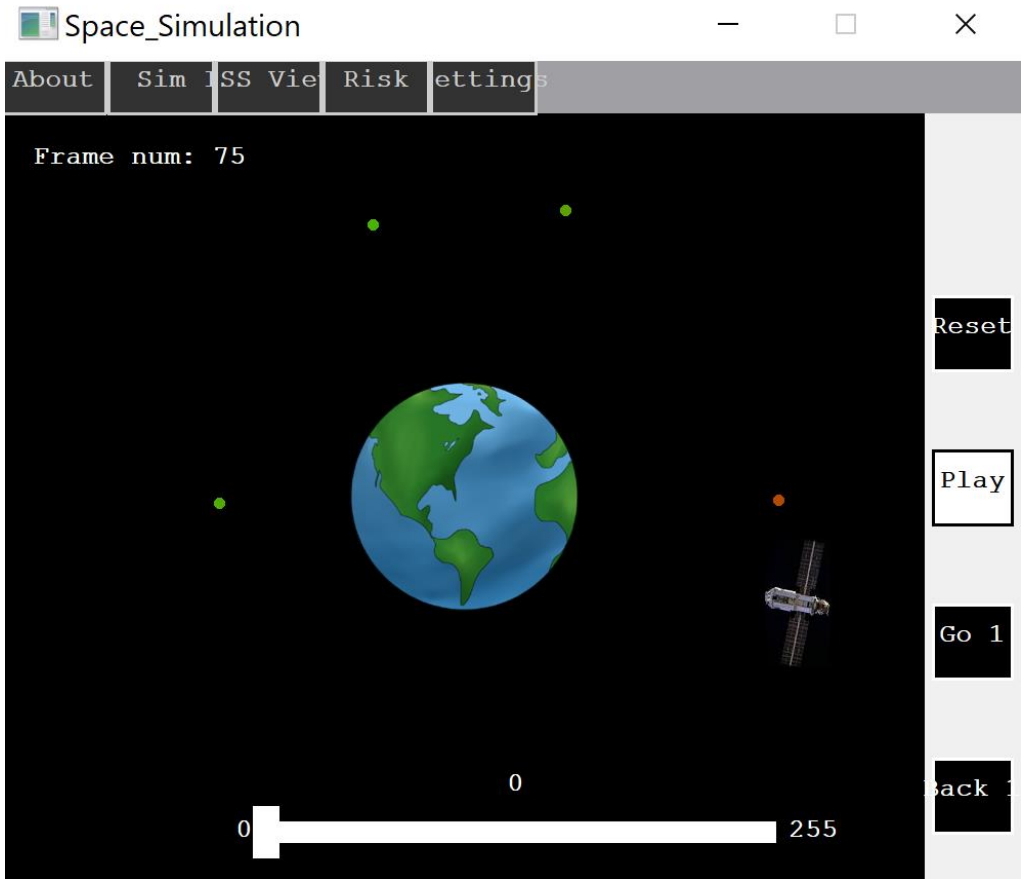
PROJECT PROCESS

- Brainstorming
  - Asked questions first to see what features to incorporate and compiled a list of research topics
  - Throughout the research process, many of these ideas were tossed out due to time and/or resource constraints
- Modification
  - We eventually changed the original objective from mapping to collision prediction based on parameters like velocity and trajectory from a satellite in space
- Final Design
  - The program provides a demo of what this might look like from the ISS

PROJECT DESIGN

- Tools used:
  - C++ and the Qt graphics libraries
  - Github
- Features of our software
  - Progression with time is shown for the space station and for multiple pieces of debris
  - The user can select the mass, velocity, direction, and other parameters for the debris objects
  - Risk of collision is calculated, and space debris is colored, green to red, based on risk
  - Slider filters debris by risk level
  - The user can select a view centered on earth or on the space station

PROJECT DEMO - MAIN SIMULATION SCREEN

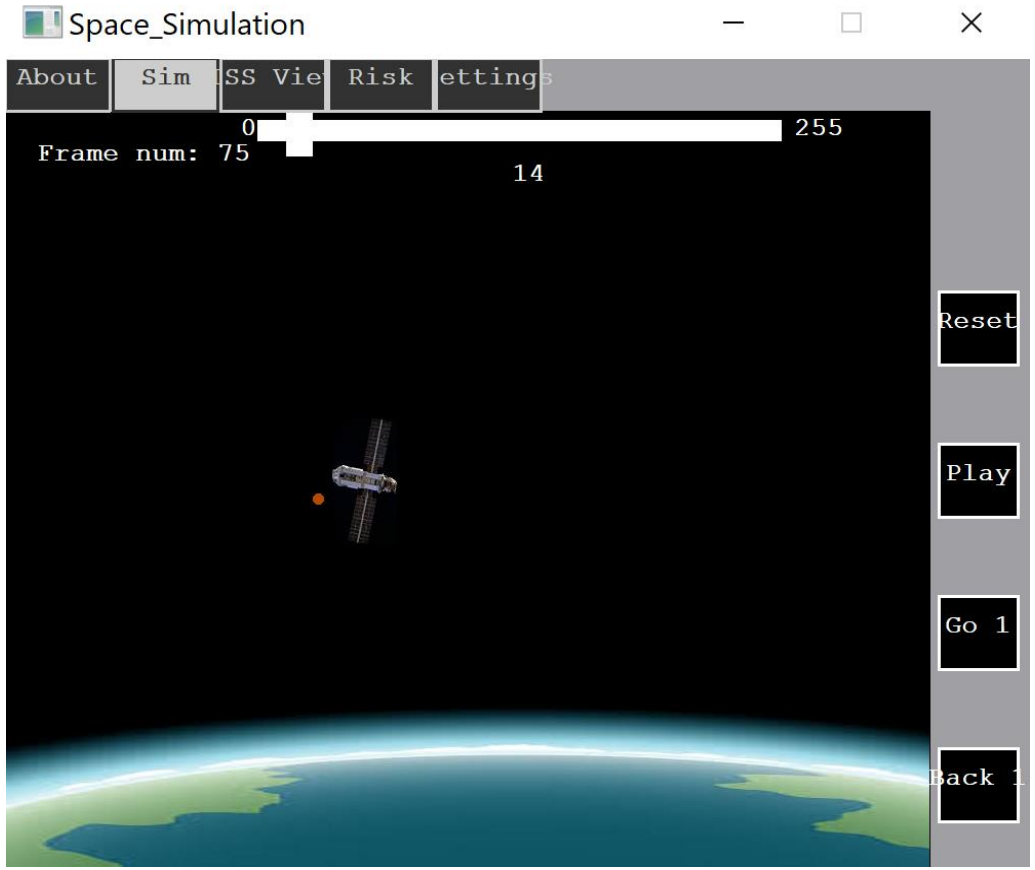


Primary coding by Nik Pensyl

In the initial view, the simulation centers on Earth with debris orbiting it completely.

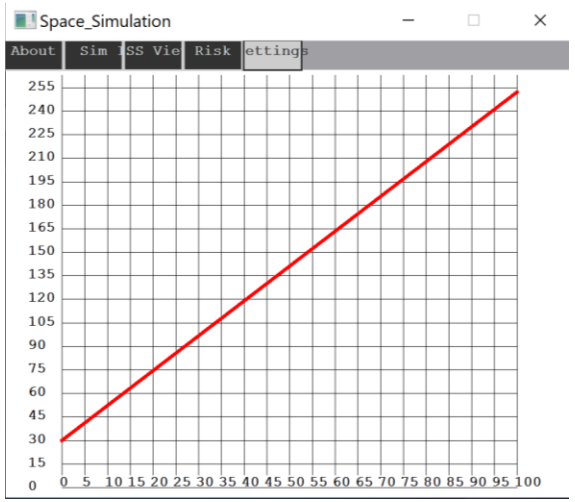
Risk is calculated based on the ISS, with the hopes of adding options to switch between multiple satellites

PROJECT DEMO - OTHER SCREENS



Primary coding by Nik Pensyl

Parameters for debris can be edited in the settings tab



Feature to be added later - risk to be calculated over time

WORK CITED

3-D Debris Maps:

- https://maps.esri.com/rc/sat2/index.html
- http://stuffin.space/

Data Resources:

- Reentry_History_Spreadsheet_09-29-21 (https://aerospace.org/reentries)
- Space-track.org database of known space debris objects: (https://www.space-track.org/basicspacedata/query/class/tle_latest/ORDINAL/1/EPOCH/%3Enow-30/orderby/NORAD_CAT_ID/format/json)

Articles of Inspiration:

- https://www.esa.int/About_Us/ESOC/Space_debris_assessing_the_risk
- https://www.esa.int/Applications/Observing_the_Earth/Satellites_forewarn_of_locust_plagues