Aerospace Capstone Vision Statement

Team Name
Moose Blazers

Team Members
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Introduction
Satellites must capture large amounts of data and transmit it back to the Earth using as little power as possible. This is a tough task to accomplish due to the extreme distance satellites are from the Earth and the complex processing that must be performed. It is vital that the on-board processing performed by the satellite is reliable and consumes as little power as possible; these satellites need to be able to operate for long periods of time in the far reaches of space.

Project
The project involves developing an application that will perform real-time video processing on a high resolution input file utilizing the parallel processing power of an NVidia GPU. We will explore methods including transcoding, compressing, and scaling images as well as operations such as object tracking. By utilizing the many cores of the GPU we can design a parallel application that performs and consumes less power than its serial counterpart.

Outcome
There are applications out today that perform image processing as well as object tracking but we would like to develop an application that could be used to further satellite image processing technology.

Hardware
Our plan is to implement a design utilizing parallel processing (CPU+GPU) to optimize the image processing. We will carry out the design on the Nvidia Jetson TK1 development board. This board incorporates a quad-core ARM CPU with Nvidia's own Kepler based 192-core GPU that will be used to do the parallel processing. This board is a good fit for the project due to its low power consumption and high computational performance.

UI/UX
The user interface will provide two versions to process the input: serial (CPU) and parallel (CPU+GPU). Once the processing has completed, a performance metric will display a comparison of the two versions. The statistics will include the time to process, the power consumption, and the rate (in units such as GFLOPs or images/second). Our intention is to showcase the superiority of parallel processing for our application. Our user interface will be built on the Java platform which will pass information through into the actual implementation created in C++.

Design

To build our project we will be using a combination of Java and C++. The applications will also be built using existing code from the CUDA, OpenCV, and Thrust libraries.

Milestones/Goals

--Explore various techniques of image processing and gain an understanding of the software by watching tutorial videos and reading documentation to fully take advantage of the hardware.
--Develop and optimize techniques such as image transcoding, compression, and scaling
--Implement the serial application (CPU).
--Implement the parallel application (CPU+GPU).
--UI is a command line → UI is a GUI.
--Perform QA to ensure accuracy of results, and continually improve upon them

Planning the Solution

Implementation platform: onboard NVidia Jetson TK1
GPU/Image Processing: CUDA, OpenCV, Thrust
Technologies: SSH into the device, possibly emulation to test CUDA software
Workflow: Agile development via waffle.io integrated with GitHub

Process Model to Achieve Milestones

--Daily SCRUM meetings
--Consistent updating of the GitHub repository
--Planning poker to plan the sprints
-- Weekly phone-calls/emails with Ron for consultation and support
--Google Calendar page to keep everyone synchronized with the deadlines
--Google Hangouts to keep communication open

For

Object detection and tracking would have many uses both on a satellite and on Earth. For instance, the same algorithm would go in to tracking a meteor in space, an airplane in the sky, or an oncoming car on your way to work. There are many exciting and innovative applications that our group discussed. As we further develop the project, we will get a better idea of what we can achieve. In the car and traffic domain, we came up with several ideas that could improve public safety and the safety of individual drivers. What if a traffic light could warn all drivers that someone is about to run a red light? What if your car could warn you that an animal or child is running across the street and warn you to slow down? By using edge detection and object recognition and tracking, we could potentially make the road a safer place to drive. What if a plane flying across the sky loses communication and they are unable to track its movement using conventional methods? A satellite with the ability to detect the plane's movement using image processing could help track it down. There are so many great applications of image processing that our group will explore during the coming months.