

Distributed Parallel Processing

By: Adrian Wu

Intro

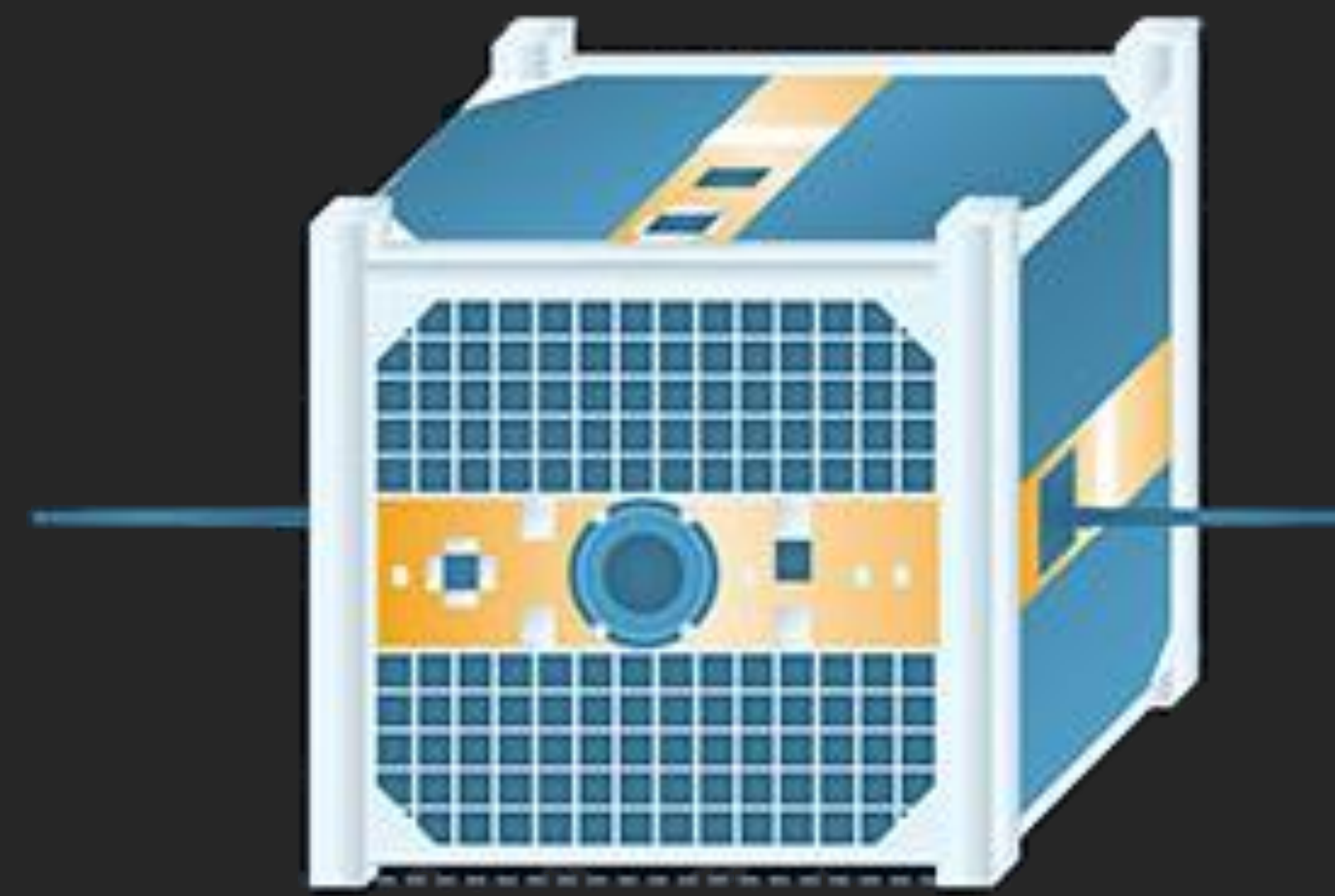
- This project was to research the alternative protocols for the recently developed project Distributed Parallel Processing with CubeSats.
- There project was to develop a suitable microcontroller to perform image processing techniques with the use of parallel processing to solve hardware limitations of data computing within space.
- CubeSat is a miniature satellite for low earth orbit to primary for space research and applications
- The purpose of CubeSat is a satellite that is launched alongside with rockets to test theories or demonstrate spacecraft technology to justify the production of larger satellites

Limitations in Space

- Parallel computing is parallel operation concurrently solving separate parts of the problems
- parallel computing problems:
 - build such system to solve a specific problem,
 - communication
 - organization of the system
 - huge power consumption required for the system
- The primary problem with computers in space is radiation.
- Modern processors are very vulnerable to radiation strikes.
- The STM32 Nucleo-144 boards are like the microcontrollers that are used in the CubeSat.

I2C vs SPI

- I2C is a two-wire communication protocol, one for the data (SDA) and one for the clock (SCL).
 - Cheaper
 - Easier to build with less connection
 - Slower Communication data transfers
- SPI is a four-wired-based full- duplex communication protocol. MOSI wire (master out slave in), MISO wire (master in slave out), SCL wire (serial clock from master) and SS wire (slave select, to select specific slave).
 - Higher data transfers
 - Data can be sent and received concurrently



CubeSat

Learn more about distributed parallel processing and its applications in space.

Report link:

<https://bit.ly/USRILINK>

STM32 Nulceo-144

- The STM32 Nulceo-144 boards STM32F429ZI was used during the project to test and build prototypes in simulating parallel processing
- The Nulceo-144 board microcontrollers are within the same family as the microcontrollers used in CubeSat



Nulceo-144 Board
STM32F429ZI

Research Summary

- The Distributed Parallel Processing with CubeSat project determines that I2C transmission and receiving time would grow linearly based on the image size after calculating the speed from it.
- The only way to reduce the transmission time would be to use SPI communication protocol with its transfer rate that supports 45 MHz compare to I2C setup of 100 kb/s
- I was not able to fully complete the project on converting the project from I2C to SPI but I was able to learn about extremely challenging software and hardware independently and become interested in projects related to CubeSat and STM32 products.

Special Thanks

Supervisor: Dr. Kenneth McIsaac

Advisor: Alexis Pascual

Graduate Students: Young Jeon, Alan

Ouy, Daniel Ribero and Khalifa Abourawi

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