CONSTRUCTING A DISKLESS HIGH-PERFORMANCE COMPUTING CLUSTER USING RECYCLED HARDWARE.

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Cluster computing was explored through the design, construction, and use of a unique computer cluster using recycled hardware. Computer clustering allows multiple computers to perform the tasks of a single, high-performance machine, through the use of specialized software. This computing power is useful for many applications, such as the rendering of computer graphics, video and human genome research. This project explored the process of implementing a cluster from the ground up. Using the Linux-based Rocks distribution, PXE network boot technology, and equipment recycled from RIT, a 15 node cluster was created.

The cluster was designed to emphasize both form and function: the innovative design of a wall was chosen, with surface mounted components designed to be visually appealing. Behind the wall were mounted horizontal supports upon which power supply units could rest. This gave the physical design of the cluster a backwards-bookcase feel. Heat was also a problem, with 15 computers in close proximity to each other; this led to the open-air design of the wall.

Performance metrics were run comparing the cluster's computing power and power consumption to other clusters and computer systems, in order to evaluate overall speed and performance.

Due to the nature of the project, there were several challenges and difficulties that arose. First, documentation for creating a diskless cluster using Rocks was not readily available. It took weeks of research to discover a workaround process to enable the cluster to boot as we wanted, using a single hard drive for storing each machine's operating system, and loading all boot information entirely through each node's network connection. Finding workspace to construct the wall was also a challenge. Due to the limited space and the limited timeframe for the project's completion, we designed the wall to include the given limitations. This was followed by a construction, deployment, and testing marathon to get the project done by the RIT Imagination Festival. The project was completed after many long nights of building, staining, software setup, and software development.

To demonstrate the cluster we needed to identify a suitable application that served the dual purpose of being able to be useful for performance analysis as well as for a demonstration that can be understood by the general public visiting the RIT's Innovation Festival. To display the form and function of the cluster wall, we decided that a distributed ray-tracing program would best suit this purpose and canwould be run across the cluster to create an informational and visually appealing display. Multiple ray-traced images would be shown in succession to form a video. The video rendered was a visualization of music. At each time-step in an audio file,

The waveform of the audio file was decomposed into a series of frequencies and amplitudes of those frequencies. The amplitudes of the frequencies were mapped onto the surface of a sphere. This decomposition and mapping was coordinated by a self developed program. Once the points of the sphere were computed, the image was rendered using a distributed ray-tracing program. The end result was a video of a sphere that appeared to "wobble" and "dance" to music.

The team constructing this cluster was interdisciplinary and contained students from Networking & Security, Computer Science, and Mechanical engineering.

In the future, the team plans to further investigate and explore cluster computing. We are currently considering designs for another cluster that is just as unique in appearance as the current one. A cluster offering even more performance than the current machine, using more modern, energy efficient equipment would be an ideal gateway for further research.