Advancing the Spatially Enabled Smart Campus

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The term “Smart Campus” is a very broad term that can be applied to campuses of varying complexity. My belief is that a campus requires a greater level of complexity than a single building or space. That is not to say that a single building or space wouldn’t benefit from some of the strategies and methods used by a traditional Smart Campus. In general a campus today would have buildings with various types of space assets, multiple infrastructures including but not limited to transportation, utilities, and communications. I do not believe the term “Smart Campus” should be based on the technological complexity of the infrastructure but rather the campuses development plan. A campus that has just begun to implement some of the necessary sensors and networks of a traditional Smart Campus, they can still see immediate benefits and return on investment.

I am not informed to the entire Smart Campus infrastructure UCSB has developed to date and whether or not UCSB is considered a “Smart Campus” or not. We have done work with Physical Facilities who been implementing a system that logs and can help analyze the energy usage data for the buildings on campus. This single component, which is included as a part of most of the smart campus solutions that are available today, has given Physical Facilities an incredible resource for analysis and determining usage patterns for the campus. By logging the data to a relational database system with space and time functionality they are able to run complex analytics on the datasets that weren’t possible with analog data. They have also been working to replacing the existing electric meters which require manual monthly readings with automated 15-minute interval sensors. The new meters have greatly improved the data quality and resolution. Lastly, since it is in a relational database system which is interoperable with many programming languages, I have been able to leverage the dataset to bring transparency to the campus and raise awareness regarding energy usage on campus via the UCSB Interactive Campus Map.

There are many different solutions available for a campus that wants to become a Smart Campus. Esri and IBM both make popular solutions and offer services to help implement these solutions. For now, I don’t believe there is one solution that is better than the other. Campus around the world can vary in size, resources, and requirements. It would be very hard, as an engineer to produce a solution that fits every campus.

If I had to choose one for my own campus, I would most likely use the one that best suites our needs, is widely adopted already, or has a high level of interoperability with other solutions. A completely unique/proprietary Smart Campus solution wouldn’t allow for collaboration.
between other campuses nor utilize any tools that get developed by other campuses and organizations.

There are some components which are included in all available Smart Campus solutions available today. A database system with space and time functionality is almost always a critical part of the Smart Campus infrastructure. The database system is an efficient way to store the datasets and perform spatial and time-aware functions to the data. There are many different solutions available to fill this requirement including but not limited to PostgreSQL, MongoDB, Solr (powered by Lucene), MariaDB/MySQL. A communication infrastructure would be required for the sensors and networks to interact. Currently TCP/IP over physical communications lines is the most widely used and provides immensely levels of interoperability with connectivity to the World Wide Web. Special considerations may need to be used and ultimately it would depend on the sensor and implementation used.

Volunteered Geographic Information (VGI) has the potential to play a critical role in gathering information, quality assurance, and decreasing the response time for data acquisition. Smart phones and mobile devices are becoming ubiquitous among the general population. “Citizens as sensors: the world of volunteered geography” by Mike Goodchild covers the idea of using people’s mobile devices and VGI to build datasets. One idea I’ve had while working on the UCSB Interactive Campus Map was to create a VGI module for the UCSB Interactive Campus Map Phone App. The user would be able to opt-in (or not) and the module would collect GPS+WiFi signal strength readings for the UCSB WiFi Network when they used the app. The data would be automatically contributed to the UCSB ICM team which could produce a continuously up to date wireless signal strength map. Smart phones could also be used to contribute information during emergency situations as well. An “emergency” module could be developed that interfaces with UCSB Emergency Management and/or the UCSB Police. The specifications of the module would depend on their available resources and requirements.

UCSB already has infrastructure in place that can help them understand diurnal and seasonal demographics of campus buildings and spaces. The energy usage data Physical Facilities is collecting could be analyzed and used to predict periods of above/below average usage and react accordingly. If they were able to log the energy usage per room instead of per building (improve granularity of data), even more complex diurnal and seasonal patterns could be discovered.

The UCSB Interactive Campus Map project has been another very successful project that has brought students into the technical aspect of implementing these smart campus solutions. A majority of the datasets the Interactive Campus Map references have been created by undergraduate and graduate student volunteers. Some datasets were at the request of Facilities Management, other were suggested and created from scratch by the students themselves. This collaboration between the students and Facilities management has been beneficial for both sides. It wasn’t until recently that we were able to collaborate due to quality assurance and technical hurdles. The workspace the volunteers work in is versioned and isolated from the authoritative datasets. Edits are required to go through a quality assurance and quality control
process and can be imported into the authoritative datasets at their discretion. The students are able to experience the unique challenges that come with working with real-world datasets (which are usually imperfect) and Facilities Management can benefit from the volunteered work and improved datasets.

The possibilities for what a Smart Campus can do or be are evolving as we learn more every day. I feel that UCSB is beginning to take steps towards becoming a Smart Campus but there is lots more that can be done. I am looking forward to the opportunity to learning more and contributing what I have learned and experienced over the past year while working on the UCSB Interactive Campus Map.

References