

# **SmartMAP at Clarion University: GIS for Smart Classrooms Management**

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## **Abstract**

*The Smart Classrooms are spread all over Clarion University's campus and are expanding with different configurations. A simple list of information is no more adequate to handle the wealth of data and its varied settings. The current project develops of a GIS that visually and digitally represent the campus as a set of smart maps for buildings floor plans. Digital maps will be created by either the digitization of paper drawings or converted from exiting CAD files. Furthermore, all tabular information, such as specifications, locations and quantities, will be imported into the GIS from a simple Microsoft Access database.*

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## **1. Background**

“Smart Classroom” is a term that is being used on the Clarion University’s campus to identify any classroom that is capable of providing a high-end solution to the teaching environment. Smart classes’ equipments can vary widely in composition, from the simple set, composed of a computer, a projector and a regular projection screen, to a more sophisticated combination of digital/analog Audio/Visual equipments furnished with rear-projection touch boards and centralized control units.

With the new initiative at the state level to support technology for education, a new fee was applied to fund specific projects related to classroom settings and teaching aids. This technology fee is being used to create new smart classrooms all over the Clarion University campus.

## **2. Increasing Needs**

Smart classrooms are spread all over the campus and are expanding with different configurations in several locations. A simple list of information is no more adequate to handle the wealth of data and its varied settings. The current project proposes the development of a GIS that will visually and digitally represent the campus as a set of *smart* maps for buildings floor plans.

This project aims not only at building a geographic database for the smart classrooms at Clarion University campus, but also to design a framework to geographically manage its increasing size database. This aim stemmed from the need of a fast and reliable source of information that can locate, describe, add and update every component of each smart classroom on campus.

### 3. Project Design

The current project was divided into five major phases. First, preparing the geographic-base of the campus, in other words, digitizing paper floor plans of specific buildings and/or manipulating existing CAD drawing to match GIS needs. Second, organizing the attribute tables of the digital floor plans to hold essential fields in order to facilitate the identification of each space, such as building, room, and contact person IDs. Third, polish and export to the geodatabase MS Access database tables of the classrooms, which were previously prepared by the Learning and Technology Center (LTC)), this step was to ensure the compatibility of those tables with floor plan attributes for future construction of table relationships. Fourth, creating relationship classes that link all spatial and non-spatial tables to ensure the integrity of the database and guarantee the smooth acquisition of information for each room on campus. Finally, designing and constructing a user interface that will enable the easy management of all of the database components. Figure (1) summarizes the project design phases.

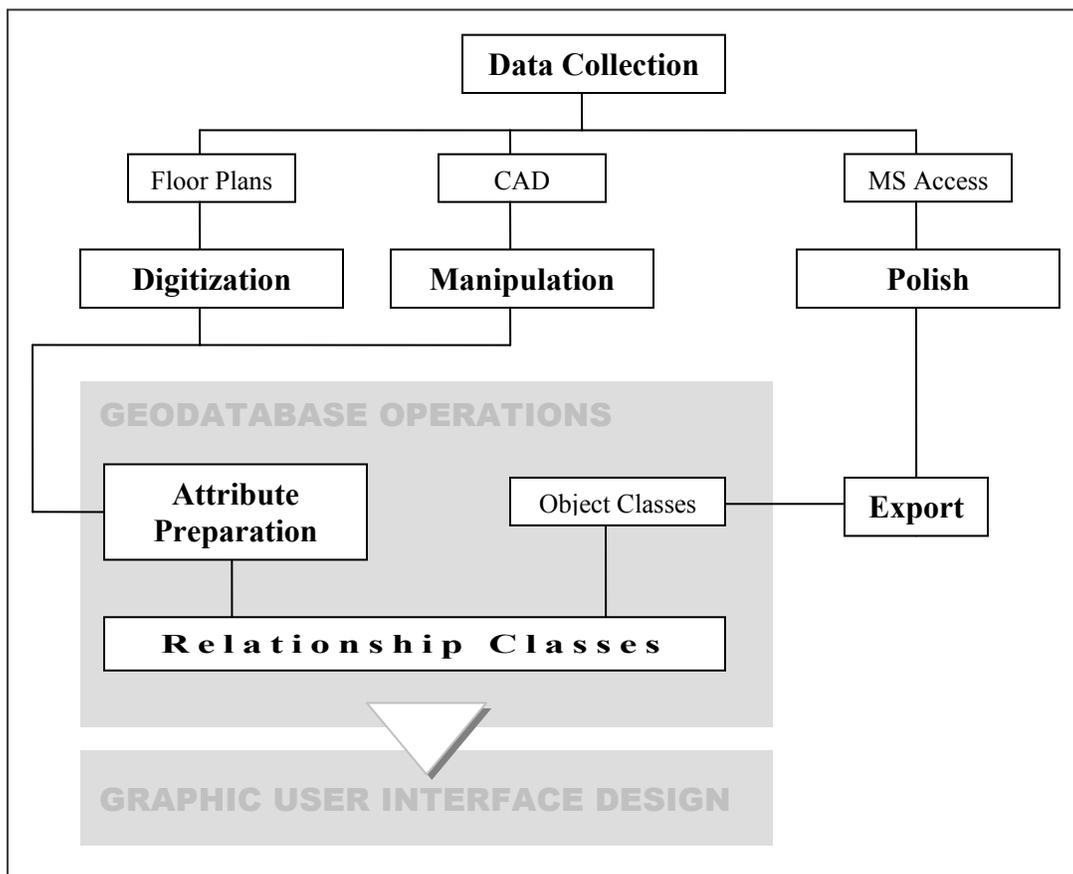
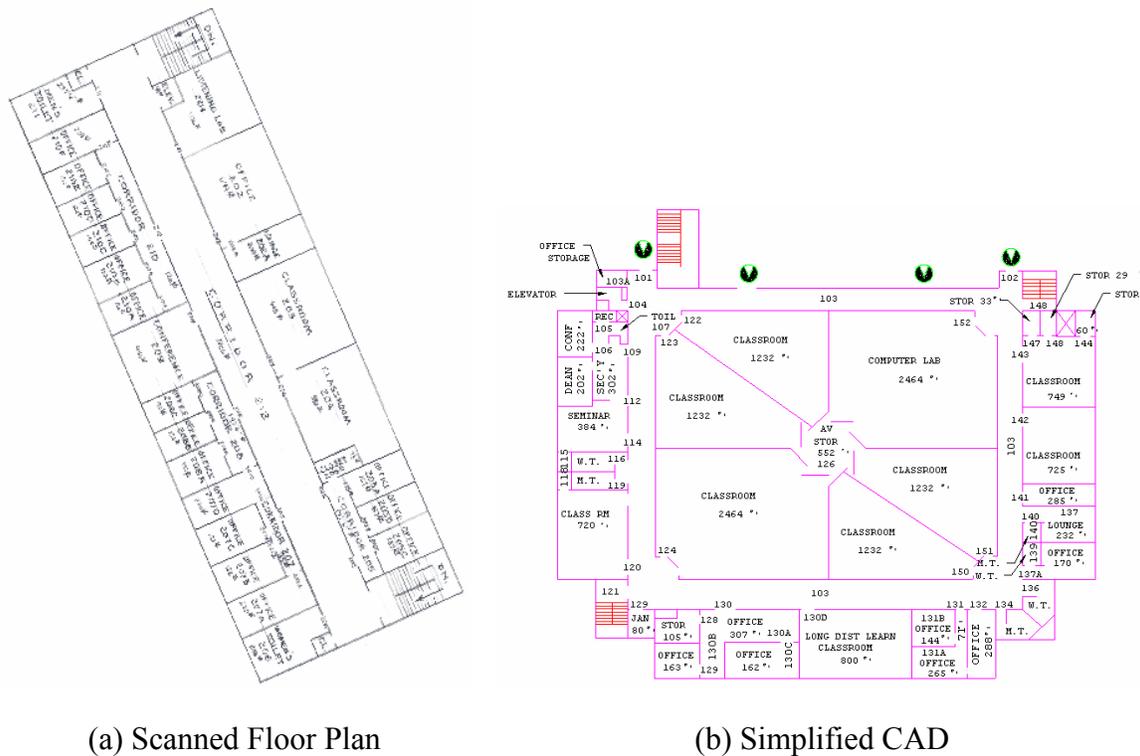


Figure (1): Major phases of the project design

### 3.1. Geographic Database

Not all buildings on campus had digital CAD drawings. Many of the buildings were constructed and maintained on paper media. The department of Facilities Management keeps record of such information and therefore was the source of information regarding floor plans and buildings and room numbers. The collected floor plans existed in two formats: Scanned hand-drawn paper maps, and simplified CAD files. Both were brought into ArcMap, georeferenced to a Quickbird satellite image of the campus, and head on digitized the rooms on sample buildings. CAD drawings were easily manipulated in ArcMap using the polyline edges and vertices as snapping features, which accelerated the data entry process and ensured a more accurate representation of the floor plans. Figure (2) represents samples of the floor plans used in the data entry process.



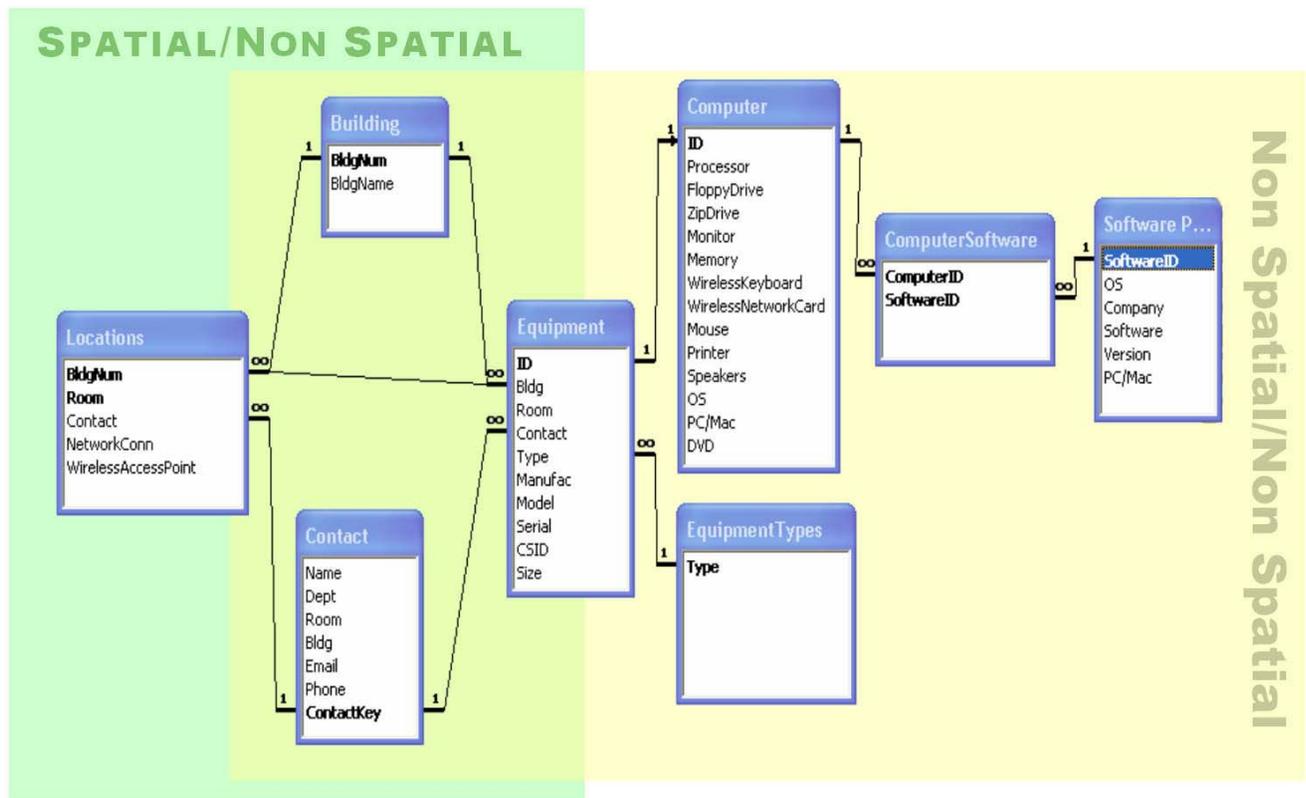
**Figure (2):** Sample floor plans used in the data entry process

### 3.2. Attribute and Database Tables

In order to better work with GIS, the MS tables were manipulated and some field names were changed to match those of floor plan attribute tables, which made it easier to handle within the geodatabase. The field names that were changed are those that were used to create the relationship classes in the next phase. Furthermore, once the MS Access tables were prepared, they were imported to the geodatabase in the form of object classes. The later operation was carried out in ArcCatalog.

### 3.3. Creating Table Relationships

Table relationships ensure the linkage of information between tables and provide seamless series of information that swap several object classes. Therefore, in order to achieve the aim of the current project, the database design was laid out based on five levels (floors) campus map. Each layer (level) constituted of buildings' floor plans and was represented as polygons. Also, the MS Access database tables kept track of the equipments, rooms, and contact information. Therefore, in order to attach this information to the polygon feature classes of the floor plans, the database tables were imported into the geodatabase and relationship classes were created. Figure (3) illustrates the established relationships classes between all given tables (attribute and non-spatial) in the geodatabase.



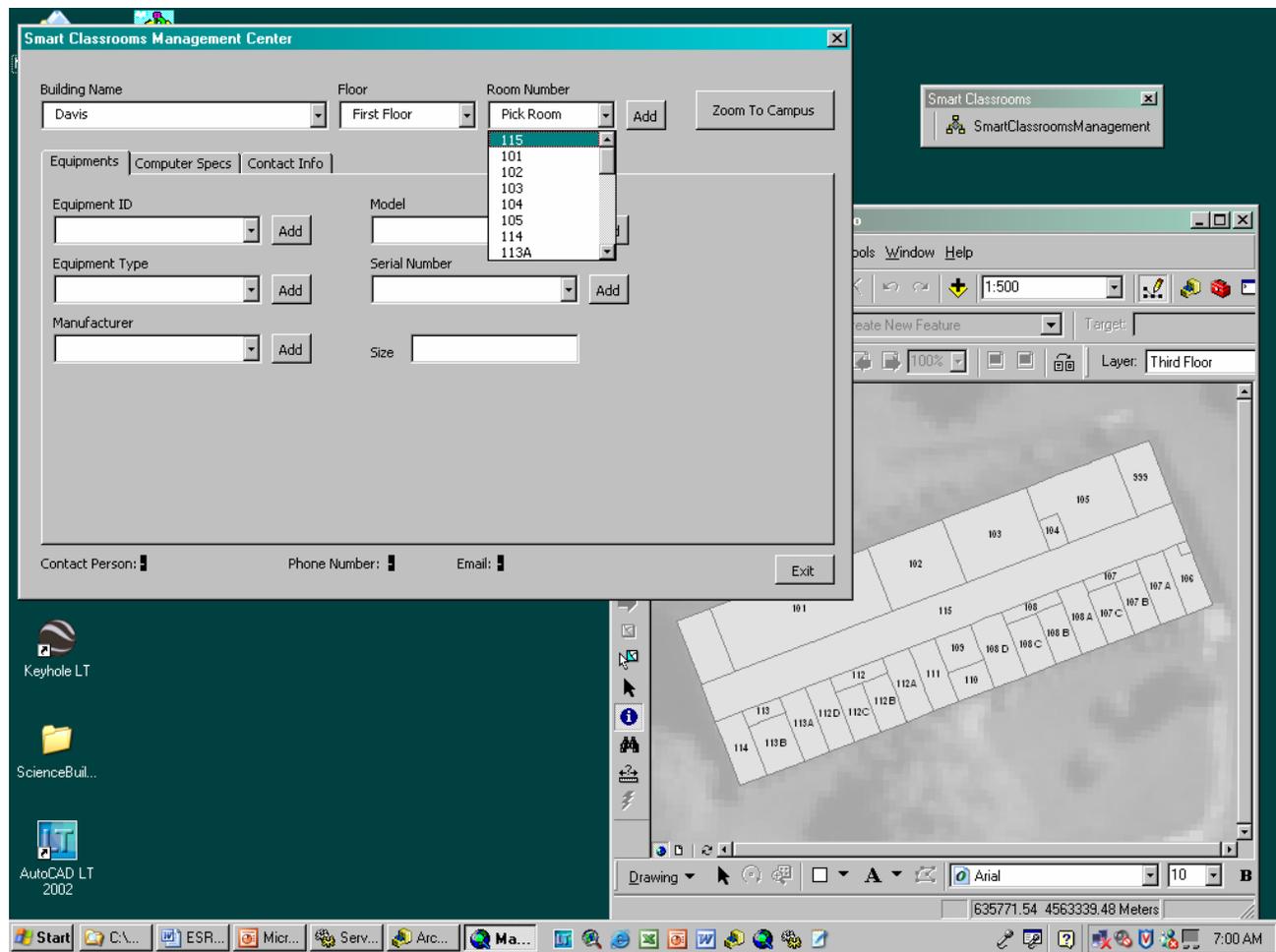
**Figure (3):** The established relationships between all given tables. Table *Locations* represents the attribute table of a sample floor plan. Five “*Locations*” (feature classes of floor plans) were created for the campus; therefore, duplicates of the relationships were created to connect them to the *Building*, *Equipment* and *Contact* tables.

### 3.4. Classroom Management GUI

The Smart Classroom Management Center (GUI) is being accomplished using VBA and ArcObjects. It is important to note that this phase of the project is still undergoing major design and construction. The following sections describe the accomplished, in progress, and future work.

### 3.5. Accomplished Tasks

The main aim of this step was to ensure data integrity and provide seamless information about every smart classroom on campus. A toolbar and a main form were created. The form categorizes information into three main tabs: Equipments, Computer Specs, and Contact Info. General sections that hold information that are used for browsing and for contact information are also added in the main form area (Figure 4).

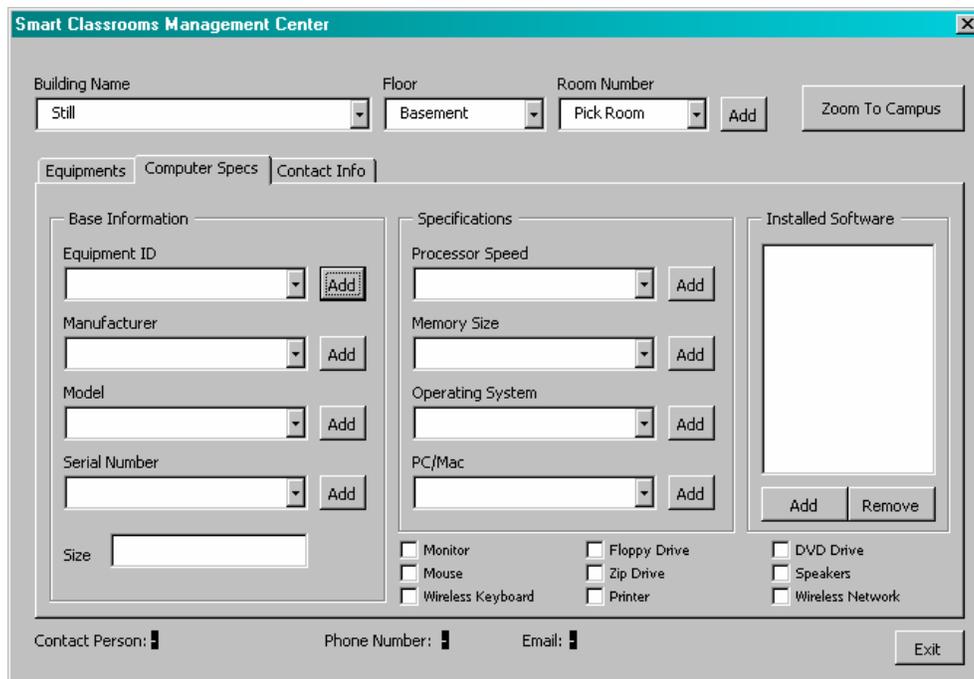


**Figure (4):** The developed GUI and the corresponding map document that shows a selected building and floor number. The map zooms in automatically to the selected building/floor combination, and other floor layers are turned off.

The general section of the main form allows users to browse classroom configuration by building name and floor and room numbers. Having all the information in an organized structure provides an easy access to adding new classrooms and/or equipments, and to modifying and updating existing information. The set of controls residing on the main form provides an automatic zoom in/out to the map. Selecting a building name from a list, for example, automatically zooms in to the specified building and sets map layer to the floor number that may be selected from another list of pre-defined choices. In addition, room numbers are updated according to the selected building/floor combination. The selection choices of both building names and room numbers are being updated automatically from the actual attributes of the corresponding table in the geodatabase.

### 3.6. Work in Progress

Other code is being written to populate the fields corresponding to the selected room number. This task will enable the user to browse through the equipments types in a specified room, and view, add and modify any data about the equipment, computer specifications, and contact person information using the displayed tabs. Figure (5) shows an example of the tab containing computer specifications ready to be populated from the corresponding table.



**Figure (5):** The Computer Specs tab filled with all the controls necessary for browsing the computers table in the geodatabase.

### **3.7. Future Prospective**

Many data refinements need to be done to both tables (spatial and non-spatial) and the geographic database of the current project. CAD drawings of building floor plans used in this project were approximated and not to scale. Actual architectural and/or engineering drawings is being developed for facilities management reasons and will be provided for GIS development in the future. Also, the attributes and field names has to be refined and tuned up to meet future needs and flexibility of use.

After the completion of this project, the database will be provided to the LTC for testing which will entail some modification in the structure of the forms and the functionality of certain buttons and controls. Development and deployment of a non-ArcMap embedded application may be needed; therefore consideration is given to the use of VB and ArcGIS controls (e.g. Engine application) in order to provide a stand-alone application for the use by the LTC personnel who regularly maintain the smart classroom database on campus.

Furthermore, consideration as of developing an interactive internet map of the campus that enables the faculty members to browse for their specific classroom needs and make space reservations online is also considered as a potential and convenient idea.

## **4. Projected Outcomes**

The benefit of this project is twofold. First, enhancing the functionality (i.e. managing existing and future resources, facilitating upgrade tasks, aid in resources allocation...etc.) of an important feature of the university (the smart classrooms), and second, introducing an innovative approach to space management at Clarion University of PA. The adopted innovative approach to space management of specific campus resources will promote GIS education in the region as the current project was developed using student assistance in different phases, this challenges them with a real-life problem solving techniques.

Furthermore, the production of online and printed posters of the distribution of the smart classrooms on campus will also provide the users with an easy and convenient way to locate their desired room/equipment configuration and have the space reservation contacts readily available.

The expected outcomes of this project can be summarized in the ease of management (manipulation, employment and update) of an important technology resource on campus. The Learning and Technology Center, Computing Services and any other party dealing with the assessment of existing and future technology resources can benefit from the outcomes of this project. Also, this database will provide a reliable foundation for future expansions and improvements such as the development of a tool (e.g. web based) that will enable university employees to locate and identify their needs for a smart classroom at any specific time, or the management of other resources and facilities on campus.

## **5. Acknowledgements**

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