

Snack Attack: An Exploration of Collaborative Learning

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Undergraduate students in the computing related sciences are given a multitude of topics to delve into. During their student careers, they are given numerous opportunities to apply learning to the real world via hands-on projects. The majority of projects that are assigned are designed to illustrate some aspect of theory in a somewhat contrived academic setting; however, there are opportunities to give students the freedom to solve real problems while gaining valuable project management experience.

As is the case with many projects, the original vending project at Clayton State University began out of necessity. As a result of a building change, an entire room on the IT level of the university center was procured as a lounge for students in the IT program. Video game consoles and a small source of snacks quickly became the focus of the room, and as increasing numbers of students found their new home, the small bucket that served as an honor payment system became abused and ignored. During the summer of 2007, three IT students undertook summer internships meant to address the problem by using technology and computing related solutions. This phase of the project focused on the creation of a vending platform that was to be built from the ground up, using a combination of motors, PIC microcontrollers, and customized software for the PIC written in FORTH.

The goal was to build a system that functioned on a stored value card system and served snacks via a secured and motorized “Lazy Susan” type platform. Two of the students, Tyson and Kriigel, who were responsible for all of the software and PIC implementation, were able to enhance their knowledge of systems integration and programming concepts by building a working programmer and examining the FORTH language. A fully functional vending system was not delivered at the end of the summer semester, due to time constraints and a lack of any physical machine structure; however, Tyson and Kriigel decided to continue the project by petitioning their advisor to allow further work under an independent study class during the following semester.

By analyzing what worked and what did not during the last phase of the project, new ideas and approaches were developed to apply to the vending problem. Essentially the project was an exercise in integration through the construction of a functional vending machine. In order to deliver a tangible first step, the two man team decided to radically change the purpose and characteristics of the system. At the end of the previous semester the team jokingly remarked to each other that they should try to get approved for an elective credit independent study class by building a MAME (Multiple Arcade Machine Emulator) cabinet and system for the lounge. This was initially meant as a joke, but the question quickly cemented itself into reality... What if it were vending machine too?

Design & Construction

The Snack Attack project proposal resulted from this conversation and was presented to Dr. Jeff for approval. This proposal outlined an overall plan to build the system using resources that would be cheap and easily found in the area with a total target budget of \$500 or less. Both students were in charge of procuring any resources needed and would be reimbursed at the conclusion of the project, providing an incentive to work within the planned budget. The initial design of the system focused primarily on the vending mechanism and its relation to the physical characteristics of the cabinet, a topic that would eventually constitute the majority of the construction phase. As the

semester began, the team started to research options for vending, as well as modifying a second-hand arcade machine. A variety of interesting solutions to vend snacks from the machine were analyzed, including gravity drop ramps, conveyor belts, and a locked door that functioned like a newspaper machine. All of the options were novel but failed in one or more requirement areas of security, cost, or time feasibility. At the same time, cabinet options were becoming increasingly limited in the Atlanta area. Several attempts were made to find a suitable machine that could be modified; however, the arrangements all failed to be completed and an existing machine could not be found. Managing the project during the early stages was disappointing as time drew on, and it appeared that nothing would be completed by the end of the semester.

Soon after the deals on the arcade cabinets fell through, the team found a manual coin operated vending machine on EBay within the Atlanta area at an especially attractive price of \$50. The machine utilized a mechanical coin mechanism that turned an Archimedean spiraled coil once the required amounts of coins were inserted. The coil separated types of snack foods that would fall at the back of the machine and down a ramp to the buyer. The cost was a major deciding factor in the procurement of this machine. Almost all of the other vending options exceeded \$50 in parts alone. The machine was purchased and picked up locally and the physical construction phase began. The team decided to construct a custom designed cabinet out of plywood in which to integrate the off the shelf vending system into.

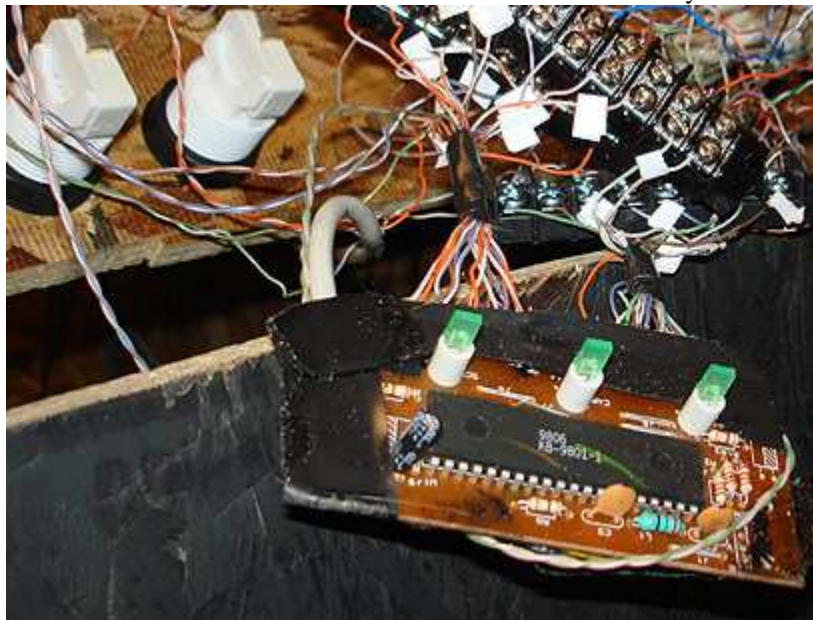
Dealing with the integration of the vending system created an opportunity to work hands-on with problem solving. Security issues were solved by designing the vending system into a removable locked drawer that dropped the snack down a ramp far enough away from sneaky hands attempting to reach into the system. The non-electronic vending machine was gutted, stripped of its shell, and placed into the side of the cabinet where the coins from the mechanical knobs would drop down a metal slide and through a PVC tube which would trigger a micro switch. This electronically linked the action of vending with a coin credit that would be used to play back a free game on the emulator.

Coils and Coin Slide



In order to make this work, the team researched control options and chose to create their own control panel by interfacing professional arcade buttons and joysticks to a disassembled and unused PS/2 keyboard. To do this, the team found some damaged CAT 5 networking cable that was about to be thrown away and cut it apart to remove the twisted wires within its plastic skin. The wires were separated and soldered directly to the keyboard PCB. Then by crossing combinations of the wires, the key matrix was mapped out and documented. Once this was complete, the wires were attached to the micro switches contained in the buttons, joysticks, and coin detector. Using this method saved a great deal of money by avoiding a pre-made gaming interface. Other materials were found at yard sales and a local flea market, including the wood screws, a sheet of Plexiglass, and the wheels for the bottom of the cabinet. The monitor and computer were sourced from unused components on campus.

Keyboard Hack



Construction of the machine was performed up until two weeks before the end of the semester, and as scheduled, a demonstration took place to show the completed project. A live test in front of faculty demonstrated the action of purchasing a snack, the food falling into a delivery slot, and the coins triggering a game on the screen. The final cost incurred during this phase was well below the \$500 budget, coming in around \$250. At the end of the semester, the Snack Attack machine was delivered that solved the original vending problem in a unique and amusing way. Finishing touches to the machine exterior are still being completed, most of which are simply cosmetic in nature. The rough plywood panels will soon be covered by wallpaper and posters, the joystick panel will have Plexiglass protection and decoration, and a marquee and monitor bezel will be installed. The project is ongoing and will be passed on to future students willing to make additions.

Future Capabilities

The project is currently moving into its second phase, in which new features are being added to the system. The team is attempting to move beyond the original vending problem and create a platform for other students to continue work on. Plans are in the works to design a magnetic card-based stored value system which will be connected to a MySQL database and integrated into the mechanical coin system. This will be achieved by isolating one or more rotating coin knobs and connecting them to a motorized system. The database will not be located in the machine itself, but accessed remotely so that academic exercises can potentially be performed in a decentralized manner. The original PIC microcontroller project may have relevance in this later work by providing the medium for this customized program code. Another benefit that was realized after construction was the possible implementation of student created games being showcased on the platform. These could easily be programmed to operate on a credit based system, and the keyboard controls would easily map to the keyboard-hacked control panel. By combining the different disciplines in the IT curriculum within the Snack Attack platform, creative projects can be assigned in software development, networking, and database implementation.

Snack Attack after Phase 2



Lessons Learned

The team learned many valuable lessons during the planning of the project and the construction phase. Knowledge of project management that had previously only been applied to book work was experienced in a live exercise with real time constraints. As problems were discovered with the design, they were resolved system-wide to allow successful integration. The result was a project that was ultimately successful and rife with applications to future work after graduation.

By giving the student the responsibility for getting all aspects of the project off of the ground, they were inspired to take a high level of possession and pride in their work. The real experience with systems integration and project management, when failure is possible depending on work output, will benefit graduates transitioning into the corporate IT and computing industries where the problem will not simply be academic in nature. For other projects at the senior undergraduate level, this project provides an example where giving too much responsibility to the student was not detrimental to the result, and arguably allowed a higher quality of work to take place.

Student Perspectives

The experience gained from this project has been immensely valuable. We were fortunate to have the opportunity to take the lead on this project, and the freedom to explore any options that would be helpful to our success. As IT students we are required to have knowledge in purely technical areas, as well as business and management. By working with several different technical areas and integrating them into one cohesive system, we will take the knowledge gained through this exercise and apply it to future projects.

The end result of this project was a unique hybrid system that combined two separate functions into a machine that we are very proud of. Future students will be able to carry on working with this platform, and the satisfaction that we have possibly contributed to future education is very gratifying.

Instructor Perspectives

From a pedagogical perspective, this project has been immensely successful. The students have acquired experience working with a broad range of technologies and have deepened their knowledge of computing. This kind of applied capstone experience is vital, as it affords an opportunity for students to practice the theory explained in previous semesters. While smaller, more “contrived” examples often dominate the lower-division assignments, this project was much larger in scope and builds upon the students’ previous knowledge.

Also, another important aspect of this project is that the students truly owned the idea from the beginning. Conceived from a need to better monitor an “honor system” of candy/sodas in a common student lab/lounge space, the project unfolded into something much more – a merging of two popular aspects of the computing subculture: bad-for-you

food and gaming. The two students working on the project made it their own personal goal and went beyond the assigned task to develop a novel, interesting solution.

This project also demonstrates how computing is becoming more and more ubiquitous within our culture. Cell phones and mobile networks, interactive displays, always-available internet access, and distributed computational power and data access are increasingly being taken for granted. A snack machine merged into a gaming console shows an acute vision of the future of computing, and this project serves as an exemplar of how outside-of-the-box thinking can create novel applications and open new opportunities for the computing discipline.