INTERIM REPORT

Group 5

Submitted: 3/23/2004

Advisor: Professor Bruce McNair _____

Sponser (Partial): Cross Match Technologies, Inc.

Brian Podolsky
Michael Andrews
Jennifer Willis
Yohanna Ayala
Joseph Marques

I pledge my honor that I have abided by the Stevens Honor System

I. Abstract

The aim of Group 5 via the Thumb-Thing project is to simultaneously increase security and convenience for both entry access and credit access for organizations. Specifically, the system is being designed to replace the use of student ID cards on the Stevens Institute of Technology campus for the following systems: meals, duckbills, dormitory/building access, photocopies, and laundry- although the system is abstract enough to be adapted to the needs of most businesses and college campuses. Ideally, a commercial version of a Thumb-Thing system would consist of a unit with a character LCD screen, keypad, and fingerprint scanner which would then connect to a clerk's/cashier's computer and also dial out [or be permanently connected] to an appropriate database. The database could be local or remote for a building or campus and contain access privileges to various facilities and/or school money.

The group's prototype unit will consist of a fingerprint scanner (provided by Cross Match Technologies, Inc.), a PDA to act as a user interface, and a laptop computer which will: house the database, run the comparison algorithm, and simulate the application (i.e. cashier station, secure entrance through a door or to a building, etc.). Project goals include creating: a functioning physical system comprised of a PDA, fingerprint scanner, and laptop computer; a robust SQL database that can accommodate for most applications that might seem appropriate for a Thumb-Thing product; and intuitive user interfaces that replace (and mimic where appropriate) current systems that can be seen at college campuses (specifically Stevens Institute of Technology), retailers, and buildings that employ entry security. For the backend of the system where the fingerprint matching takes place, a SDK provided by Cross Match Technologies, Inc. will be utilized.

I.1 Acknowledgement

Group 5 would like to acknowledge and thank Cross Match Technologies, Inc. for their generosity in lending out the MV5 BCS scanner (a $2,500 value).

II. Project Progress

Group 5 is approaching the design implementation by attacking various facets of the project simultaneously via sub-groups and then meeting as a full team weekly to evaluate each other's work and re-coordinate efforts. At this stage of the group's efforts, there are two main teams: client/admin team and a database team. The entire group first brainstormed all the systems that Thumb-Thing should be able to accommodate and that could be handled in the time frame of a single semester to do the implementation. The client/admin team created functional models of the sub-systems then passed on any appropriate information to the database while the database team began devising an entity relation diagram and database schema. The client/admin team also created preliminary user interface screens and modified their functional diagrams as needed. The client/admin subgroup finally created a document of pseudo code that essentially put the functional diagrams and user interface screens together. This was a fair amount of over planning but the group believes before the real coding begins that they will have already thought of many issues that might have otherwise arisen.

The original idea for the database was to make the design flexible enough such that it would satisfy all of the requirements of the project. At the beginning of the design, the requirements stated that the system would encompass two quite disparate domains: universities/organizations and arbitrary credit card processing for commercial institutions. The latter was in fact the original intent of the group, but the scope of that project was deemed too narrow in reference to the former for a senior design project. Therefore, the group focused solely on the university/organization part, which helped reduce the complexity of the database significantly – down to 18 tables from 24.

However, the database had one fatal flaw in it – it was globalized. In this scenario, an organization could pool all of its resources together so that an employee or student could travel between the different branches [of the organization] and still be recognized in the system. After careful thought, this technique was abandoned. In order to truly globalize a database, a large

number of things have to accounted for. For example, one username at Stevens might be snelson, but what if some user snelson also existed at another school. Then, there would need to be some type of protocol or policy that would disambiguate duplicate names such as this. Though in reality, any type of policy is truly fair because some schools would have to adjust their naming scheme to conform. On the other hand, we could instead choose to implement our own naming scheme, but in this scenario *every* organization would then have to map there current naming scheme to ours. Therefore, the group made the simplifying assumption and change to the design to remove the globalization features. This significantly reduced complications with the design while simultaneously reducing the number of tables even further, bringing us to our present state.

Currently, the database has a notion of a device, which can represent any type of device that a user would interact with at an organization such as a door (for security access), cash registers (for internal lunchrooms or snackbars within an organization), to laundry machines (in case of internal services provided by the organization), etc. These devices can then be arbitrarily grouped, and each of those groups given a name. This extremely flexible architecture then enables users within each organization to be given access to devices on a group basis. For example, a regular employee might have access to any public facilities, but office doors would be restricted; at universities, students might be given access to the residence hall that he or she lives in, but no other residence hall.

The database also has the knowledge of what "type" each device is (door, cash register, laundry, etc). This approach enables the greatest amount of flexibility because organizations can then have different types of accounts. Each of these accounts can then be associated with certain devices, where debits or record payments can only be made from certain accounts. This design enables an additional layer of itemization and convenience for the user. For instance, if a member of an organization pays a premium to use a particular internal service, say a company meal plan for lunches, then he or she would be able to review his or her purchases on that account separate from all other transaction associated with any other account that member has. So with the current design it's possible to just lump all of the devices together, or to carefully plan and set thing up to enable the greatest segregation and highest level of detailed reporting possible.

Lastly, the database hasn't completely forgotten about credit cards altogether – it simply isn't the main focus of the system any more. With each of these accounts, whether attached to door access for security measures or some type of debit for an internal service, they all have the ability to maintain a balance. Here, users can add or register different credit cards with the system. Then, they can "re-charge" each of these accounts automatically or on demand by pulling funds from any of the credit cards they have registered with the system. The database design, therefore, also provides for a detailed transaction tracking facility where a user can view his or her "history" of transactions. Note, however, it will be up to the organization administrator when he installs the system to define the level of precision with which managers will be able to view transactions of employees, or that school officials be able to view the transactions of students. This level of tracking should in all instances be conveyed to the users of the system, so they understand the level of security and privacy they are relinquishing by using the system.

Given that Ethernet, wireless, and dialup options have been discarded in favor of connecting all the components via USB. This approach, for the purpose of expediting prototype development, is cheaper and circumvents any possible networking issues that could arise. The system should perform better than anticipated in the final design report [the final design report stated that the entry access application would take up to 5 seconds to accept or reject someone and that the credit account application could take up to 10 seconds to verify someone's account and perform the debit/credit transaction]. It should be noted that modification of the code to run the system over Ethernet or dialup would simply be a matter of adding a module for the desired type of connectivity.

The group has everything needed for the project. Also, if problems arise with the PDA involving connecting it to the scanner, or running code properly, or something else that we have not anticipated, the group can run an emulated PDA which can have code 'installed' on it. What the group specifically has includes: the Cross Match MV5 BCS (scanner) and USB cradle, a laptop (to act as a server and to simulate a cashier station), Visual Studio .NET, Microsoft SQL Server, Dell Axim X3i, and a fingerprint comparison SDK from Cross Match.

Our testing procedures have been preliminary up to this point since our main testing will occur once our entire prototype has been setup. Currently we have begun to test our individual components. The scanner is being analyzed so as to familiarize ourselves with all of its properties and functions. This will allow us to determine which ones will be the most appropriate for thumb-thing and beneficial for our project scope. Once the unit has been setup testing development will begin by thoroughly checking all interfaces. Black box testing will then begin where we will replicate the user using the GUI. The client/admin group and the database team will each carry out white box testing by evaluating their own code. A state diagram will be created which will allow for detailed and concise instructions on all possible paths a user might take when using the system. The database group will be testing the admin/client group's work and vice versa to allow non-biased testing and to ensure proper error removal.

From the group's component testing, the group has confirmed that the following devices work properly: the scanner, the PDA, and the laptop. Additionally, the group has confirmed that the following operate correctly: the fingerprint matching algorithm, the image capturing functionality, and Visual Studio .NET (as it pertains to the group's project).

When connecting various devices, there is always the possibility that the devices will not function properly, or to be more accurate, that they will not function as you expect them to. Code will be tested on the PDA emulator until the actual PDA unit is acquired. When coding, one can never anticipate every issue that may come up, but one can plan as thoroughly as possible. Group 5 believes they are doing that; between the functional models, the user interface screens, pseudo code, robust database design, and a question list that the client/admin team gave to the database team to ensure that the database will be able to handle all the necessary queries, the group is hoping that they have most of their bases covered and hopes that they will be able to

handle anything else that comes up that has not yet been thought of. As of yet, the group has not encountered any critical technical problems.

From now until the end of the semester, it is possible that there will not be any purchases. A compatible PDA has recently been acquired (the Dell Axim X3i) due to one of the group members ordering a new desktop (the PDA had a significant discount attached to it when purchased with the desktop). As of the end of last fall, the group had planned on purchasing a PDA with our allotted $250. This is no longer necessary. The group has the full $250 remaining in its budget for any unexpected costs that may arise. One of the possible uses for this money would be for the group to take their advisor out for a nice dinner at one of Hoboken's finer eateries. In last fall's Final Design Report, the group also stated a need to purchase an Ethernet Adapter Card for the PDA at a price of $100. However, since USB is now being used as the connection between the PDA and laptop, this card is not necessary.

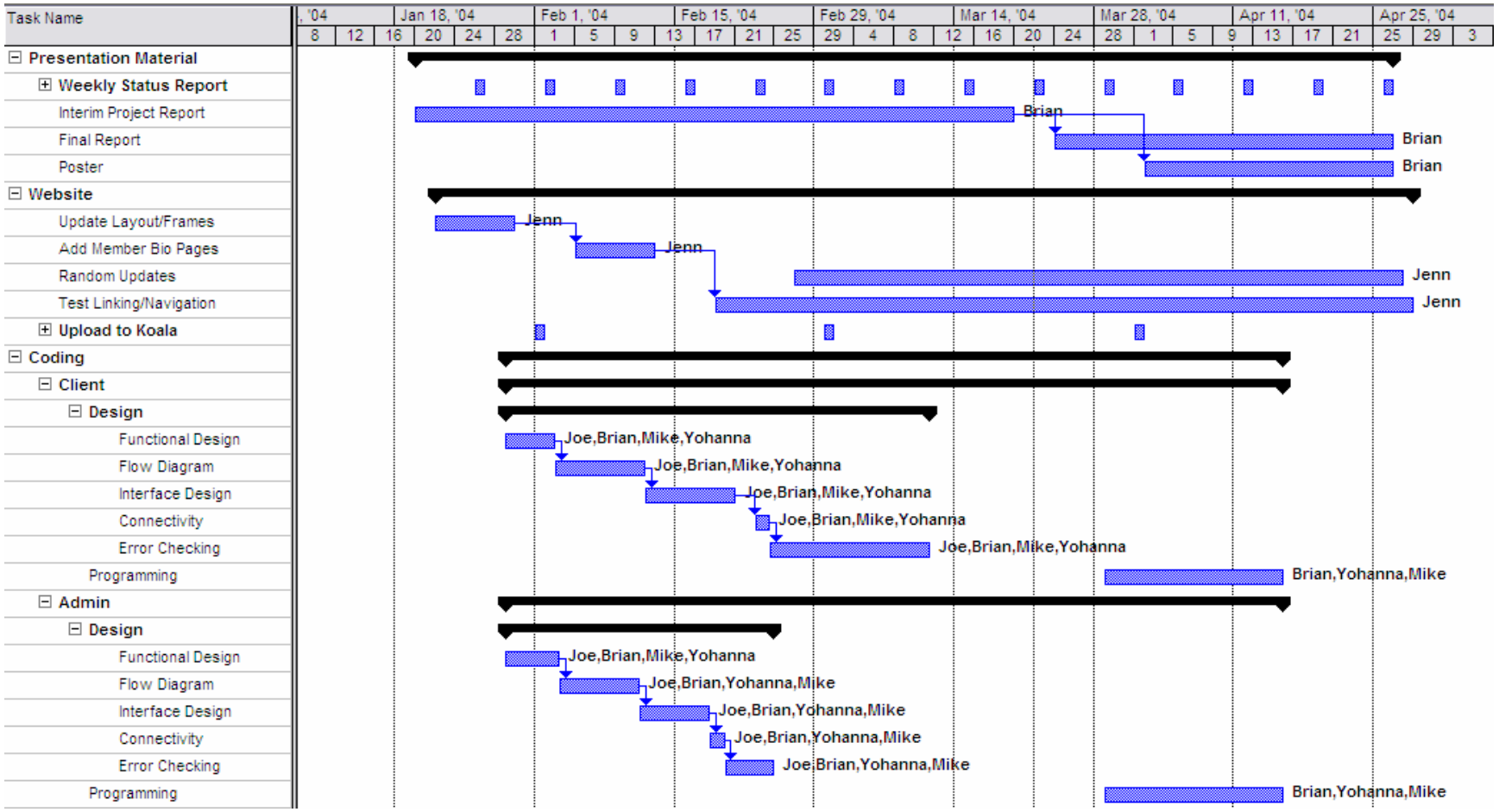
As noted earlier, the exhaustive design stage will ease the coding stage of the project. Coding is expected to be completed by the second week in April, leaving two weeks remaining to test and retest the entire system. This time will also be used to create the presentation poster. When compared to the proposed schedule delivered in last fall's Final Design Report, there are a few discrepancies. The code design stage turned out to be longer than expected, so actual coding began about a month later than previously thought. Also, the PDA will be arriving about 6 weeks after the group's estimation from last fall.

Below is a block diagram of the system being implemented:

II. Conclusion

The project is currently on track to be successfully delivered and tested on time as it is described from the Final Design Report and the modifications described within this Interim Report.

Appendix A-1 - Gantt Chart



Appendix A-2 - Gantt Chart