

Automated Student's Courses Registration Using Computer-Telephony Integration

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Abstract: *This research project aims to introduce automated student's courses registration using computer-telephony integration. The number of students joining both undergraduate and graduate studies is increasing fast through most universities. Manual registration results in crowding a huge number of students inside the registration halls. Registration employees are suffering a lot. Online registration techniques help a lot but still many problems encountered. The reason is due the huge number of students trying to access the university web at the same time. Accessing the web through the Internet becomes a very slow and tedious process. In this research, Computer Telephony Integration technology (CTI) is used to solve these problems it would enable the students to register their courses using their telephones. Technology Application Programming Interface (TAPI) controls are used to develop a CTI application for accessing and updating registration databases. The design, analysis, implementation, and test of the designed system are included.*

Keywords: *Computer telephony integration, registration, databases, software engineering.*

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1. Introduction

Voice processing and Computer Telephony Integration (CTI) has important applications in education [1]. An overview of ideas to help design and build new computer telephony and voice-processing application for automated student's courses registration is discussed in this research. This technique allows students to register for courses without waiting in long queues. The main features of such system are discussed in the following. Students call the system and identify themselves by entering their student registration number. Then they select the course they wish to attend. The system automatically checks if this course is required and if it is opened, whether the student has already taken it, and whether there is room still available in the course. Also the system checks to see if the course has prerequisite or not. If so, the system checks if the student has already taken the prerequisite. The system repeats each choice for verification after a selection is made. If positive, the student is automatically registered in the course. When completed, a copy of his/her completed course schedule is faxed or sent by mail to him/her. Different priority levels can be given to students if necessary, depending on whether they are graduating or not. A system, running on a 12-port platform, can substantially reduce waiting time and frustration for more than 7,000 students who can commonly use it for the sake of course registration [2]. Moreover, if registration periods overlap with courses, this system will substantially reduce absences and late arrivals in

class. The system can also handle the different "drop-and-add" changes in student's courses.

Such system has a lot of advantages and benefits. Firstly, it is always there, for everyone: day and night. The second advantage is cost efficient. CTI systems can be set up to dynamically manage the use of telephone lines. The third advantage is that more little time power in, as all the data input to CTI systems is fed directly to the computer. The fourth benefit is that of optimized data entry, all the data inputted can be fully automated. The fifth advantage is confidentiality and safety, as the data is fed straight into the computer; it is always safer from prying eyes. The sixth advantage is freeing up human resources for more productive tasks. CTI systems, by replacing operators, data typists, and supervisors, can free up these valuable human resources for more productive tasks. The seventh advantage is better targeting, accurate, up-to-the-minute statistics that are always available to the system administrator as callers update data in real-time. Finally there is flexibility; being more results of software programming, CTI applications are easily and immediately re-configurable, updateable, and adaptable for an improved, better service. Advantages of using CTI for the students are enormous and can mostly be measured by student satisfaction. Among those benefits are better information and communication. This is due to the very nature of computer telephony, as all the data is fed straight into the computer system; callers receive up-to-date information, which allows them to make better decisions. Another benefit is reduced waiting time, higher throughput and improved processing. Students

will experience highly reduced waiting times, before processing, during processing, and upon completion.

2. System Requirements Software and Hardware

This section describes the Automated Remote Students Registration using computer-telephony integration (ARSR) system requirements. These requirements include system hardware, system software, and pre-recorded prompts that are used to pay attentions to the caller. The following subsections describe each of these requirements in brief.

2.1. Hardware Support

The system hardware of ARSR is divided into three main categories. These categories are personal computer based, telephony interface (Voice card), and telephone lines. Each one of these categories is discussed in the following. Voice cards require computer hardware resources in order to perform voice processing. Cards by different manufacturers have different resource requirements. These cards include Input/Output (I/O) port addresses, hardware interrupts (IRQ's) and dual port (shared) memory [2]. PC-Based could be either ISA-16 bit or PCI-32 bit. An A.R.S.R dialogic voice card is installed in 16 bit ISA slots. Telephony Interface represents the interface between the telephone lines that the caller uses, and the computer hardware and software components. There are many types of Voice cards. They provide Integrated Services Digital Network (ISDN) primary rate interface service termination and call processing for up to 30 voice channels in a single PC slot with rate of 2.148 Mbps. It handles all telephony signalling and performs all tone detection, and Audio/Voice signal processing tasks. Some telephone lines are digital and others are analogue [8]. The distinction has to do with how the speech is processed in the telephone before it is sent over the line back to the business telephone system or central office. Voice starts as analogue, represented by a sign wave. In many systems, the voice is transmitted in analogue [1].

2.2. Software Support

The system software of the ARSR is divided into three main parts, Windows NT or above as environment, Voice Driver as an interface between the two components (Computer and Telephone), and telephony toolkit as Telephony Application Programming Interface (TAPI). In addition, there are the databases itself which include course details, students information, and so on. These databases were designed using Oracle. Windows is used as the operating system environment. This is because it offers stable and multitasking platforms that are ideally suited to

computer telephony applications. Voice Driver is a software module that provides a defined interface between a computer telephony application program and the firmware interface. The firmware is a set of program instructions that reside on an expansion board.

2.3. Pre-Recorded Prompts

It is voice response application that allows users to enter and retrieve information over the telephone [5]. One technique of prompts is text-to-speech, which is converting text into voice output using speech synthesis techniques. Although initially used by the blind to listen to written material, it is used extensively to convey information via telephone for everyone. Another technique implies recording from personal voice in a professional studio. This is the most used technique but it is more expensive than the former.

3. Process Flow Diagram & Analysis And Design

When the student calls the system, the computer will answer him/her after two rings (number of rings is changeable). Then the system will ask the student to enter his/her Identification Number (ID). When the student finishes entering his/her ID number, the system will ask him/her to enter the password automatically - by pressing hash (#) the student can re-enter the ID or the data he/her wishes. After the student entered his/her password, the system would check the information, the student will be asked to enter his/her ID and password again if the information is invalid. If the information is true, he/she will be entered to the system and he/her can listen to the main menu to choose either to: add course, delete course, listen to the registered courses, listen to the GPA, change the password, or press * to exit the system. If he/she chooses to add course or delete course he/her will be asked to enter the department code, the course number, and then the section number. The system checks the information and gives the proper response. It returns to the main menu. When the student is in sub menu, he/she can return to the main menu by pressing star (*). To change the password, the system asks the student to enter the old password for security issues then to enter the new password and confirm the password for ensuring that there are no mistakes happening. The student can log on to the system with the new password after that. If the student chooses to listen to his/her registered courses or GPA the system reads this information using Text To Speech (TTS) technology [3, 6], then be back to the main menu. When the student finishes his/her transaction, he/she can exit the system and his/her schedule would be sent to him/her. TAPI is used to let the application reads student inputs through the telephone line. The system does its processing to the entered data and the required

transaction within the ORACLE database [4] through ADO Data Control.

To understand the information requirements of the student, it is important to conceptualize how data move through the system, the processes or transformations that the data undergo, and what the outputs are [7]. Data processes by the organization could be emphasized graphically through Data Flow Diagram (DFD) to understand the logic underlying the system. In the zero level, the whole system is considered as one process that defines the main inputs and outputs to that system without showing the details or connections with databases as shown in Figure 1.

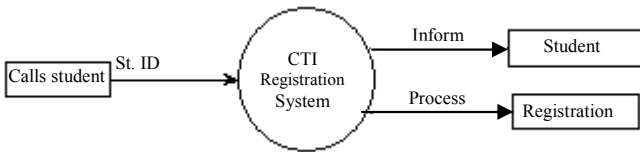


Figure 1. The context free diagram of "CTI registration system".

The Student enters his/her Id number and password then gets access to the system. The student then adds or deletes his/her course(s). He/She will be informed about his/her schedule through the system. The Level 1 DFD diagram is shown in Figure 2.

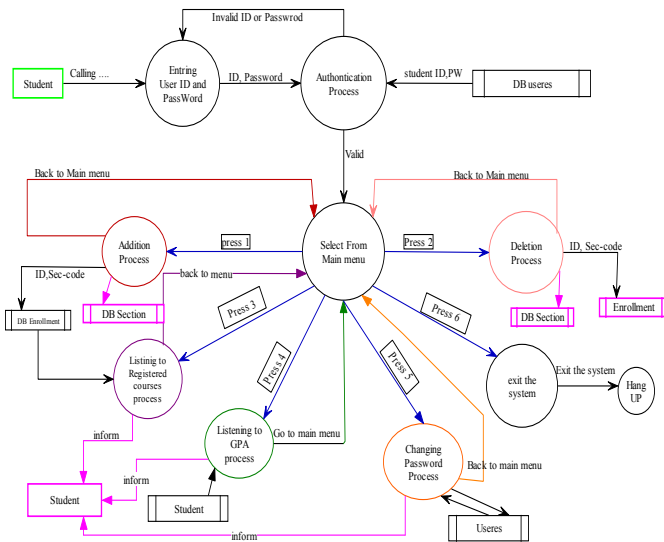


Figure 2. The DFD level 1 diagram.

3.1. Process Flow Diagram

The 'add course process' starts with pressing 1 from telephone. The student then enters department code (333, for example), then he/she enters the course code (241, for example). This is followed by entering section number (4, for example). After that the section code is generated. Next is to validate section. The validation process results in successful message if validation is true or else, an error message will be displayed as shown in Figure 3.

If the addition is done successfully, an audio successful message will be sent to the student. If any

error happened the student will listen to the error message and then be back to the main menu.

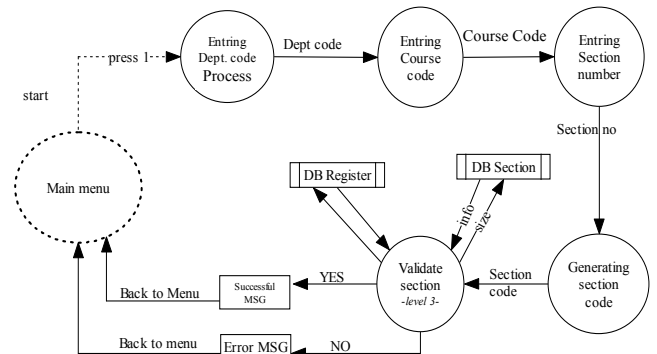


Figure 3. The add course process.

The validation section process available in the ADD process in level 2 is shown in Figure 4. It starts with validation if the section is available then checks for prerequisite for the subject (course). If not taken, it results in error message. If it had already been taken then it checks for section time contradiction. If passed, it checks for examination date and time. If there is no conflict, it registers the course and 'registration is done message' is the response. During these processing phases, if any of them fails, error message should be responded to the student.

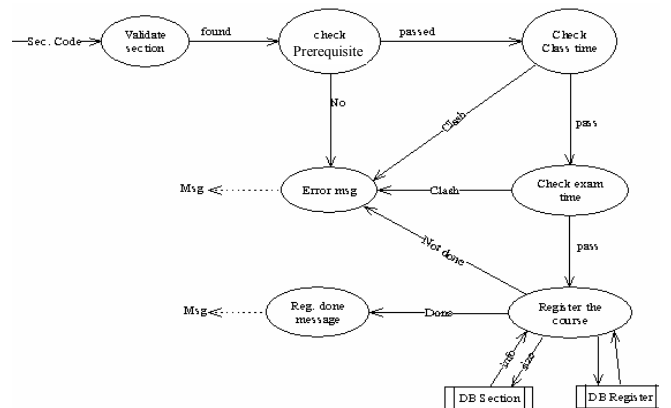


Figure 4. DFD level 3 ADD-Verify process CTI registration system.

The 'Delete Course Process' starts with pressing 2 from the telephone. The student then enters department code, followed by entering course code, then entering section number (333 241 4, for example). These result in generating 'section'. Validation section process is performed. If passed, then the course is to be deleted or otherwise an error message is responded as shown in Figure 5.

The 'Changing the Password Process' is to be performed when pressing 5. As shown in Figure 6, it starts with entering the old password and verifying it. If it is valid, then new password is to be entered and is to be confirmed. Next to that is validating the password. If passed then the process is completed,

otherwise if it is an invalid password, then the system returns to 'enter new password' phase.

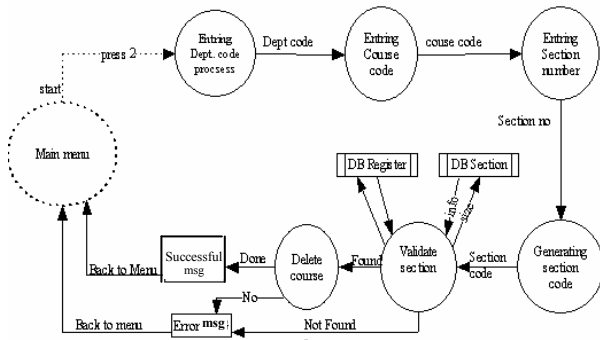


Figure 5. The delete course process.

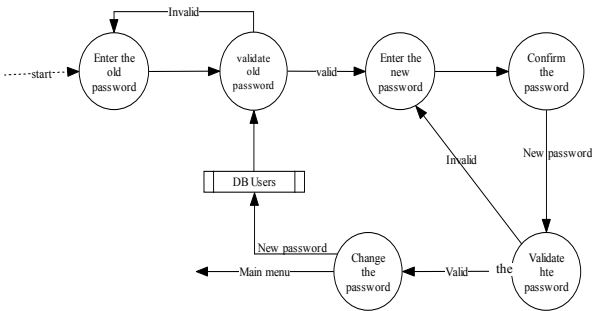


Figure 6. The changing password process.

3.2 Entity Relationship (ER) Diagram

ER diagram represents Entities to the database of the system. Remember that the system can do: Add course, delete course and listen to registered courses and GPA and change the password. There are many entities such as Student, Course, Section, and Department. The student entity models a student. It has many attributes and properties one would expect of a student, such as a

name, address, and ID. The course entity captures the relevant information about a course, such as the Title (e. g., Operating System), Course Code (322), Dept. Code (e. g., 222), Course name (e. g., ITCS322) and credit (e. g., 3). The Section entity is an instance of one of the sections of a course. For example, it has the relevant information as well as information about a certain section such as section number, time, and examination date and so on. Department entity contains all departments in the university, and each department has its own department code. This helps in determining the subject that the student wants to add.

4. Implementation

When starting to implement a CTI system, it is important to notice that the student will not see a system interface. He/She will hear only comments through the phone line and responses through telephone digits only. The system should be as simple as possible and be well organized to let the student navigates through the system and inform about the stage. The Primary key of the Section table is declared by knowing first in which year and semester it is and what subject is taught in this section and the section number. So 5 primary keys are needed which is unpractical. To solve this problem, a new way to define the section primary key, which is a collection of the 5 primary keys, is presented. By reading this primary key, the subject taught, year, semester and the section number of this class would be known as shown in Figure 8.

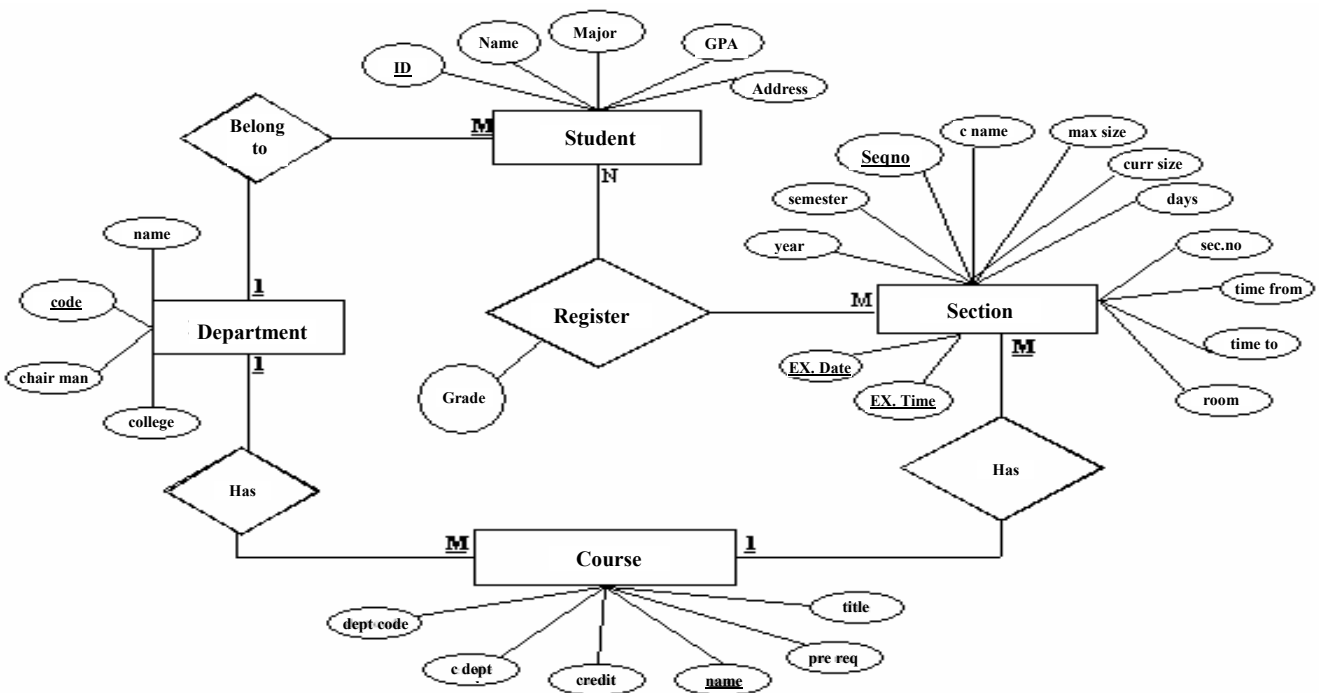


Figure 7. ER diagram for CTI registration system.

Users table includes information about users that are able to access the system. The password of the students could be listed there but it is separated because of security issues. So accessing to the student table can't be done before true login to the system is performed. Changing the password will update the users table, not the student table. In this case, the student table is read only table and will be locked from the system to any change or updates. The second reason is future plans, for example, if giving a group of people the authority to access the system, when more functions are to be added. The system actually has some limitations to access some of database tables. It just can add course, delete course, read registered courses and GPA, and change the password. It will not edit any student information, course timing, or section information. Since the system receives only digits from users' telephones and will then respond with some messages, the question is: when the system should read a specific message and when it should receives certain information? A general view of the system stages and how it works is described in Figure 9.

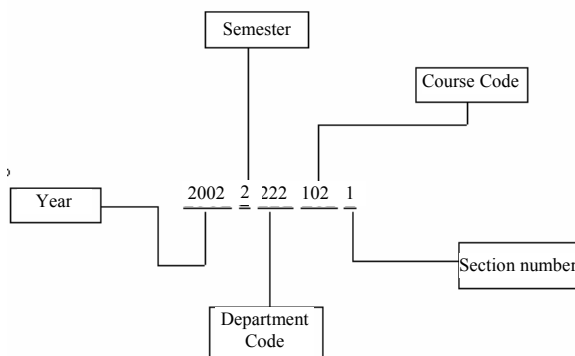


Figure 8. Section code generation (unique number).

Some 'standards' of CTI are used in the system. For example, being in sub-stage or (sub-menu), by pressing (*) on the telephone it will bring us back to the main menu or main stage. Being in the main menu, by pressing the star (*), it will exit the system. If the system is reading some digits for some information while in the sub-menus and any mistake happened during entering the data, the user can press hash (#) to clear the text or the data that he/she is entering and then enters it again. ActiveX Data Object Control (ADODC) is used for the connection with the database. TAPI modem is used to connect the modem with telephone line with program and send signals and receive digits. TAPI wave is used to send and receive wave files through the modem and the whole system.

5. Software Testing

Software Testing is a process of executing a program with the intention of finding errors. A good test case

is one that has high probability of finding undiscovered error. Testing demonstrates that software functions appear to be working according to specification and the performance requirements have been met. Black box testing focuses on the fundamental requirements of the system. It derives sets of input conditions that will fully exercise all functional requirements of the program. Black Box testing helped in finding errors in the following categories: Incorrect or missing functions, errors in data structures or external database, performance error, initialization and termination errors. On the other hand, white box testing is used to check the following: Guarantying all independent paths within a module have been exercised at least once, exercising all logical decisions on their true and false cases; executing loops within their boundaries and within their operational bounds. Exercise internal data structures to assure their validity [9].

For example, when using the Black Box Testing, is trying to register a subject that was taken before, the program successfully gives an error message saying "this subject already registered before". When using the white box testing, it is found that the reason behind the error message was not that it was taken before but that it is registered in the current schedule, which is a mistake. The error was fixed and more functions are added to make sure the system is error free. First, the program checks the finished courses separately apart from the currently registered courses. The messages that are responded to the student phone were updated to be more specific.

Alpha and Beta testing were done since this system will be used by multiple students and it is difficult to expect how they will use the system. Many of them are asked to call the system and try to register for some courses, delete some courses, and change their passwords, and so forth. Their comments were used to increase system performance and make it simpler.

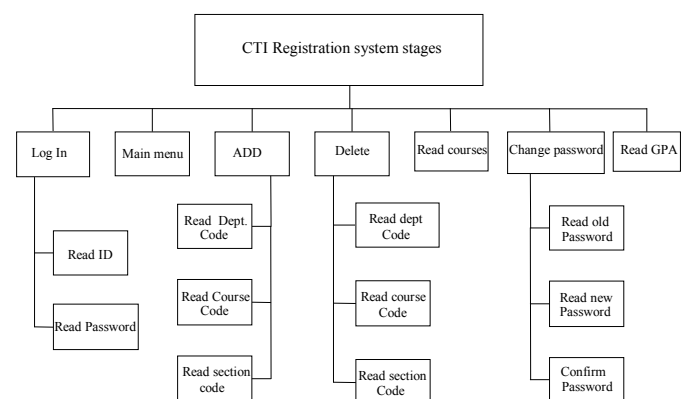


Figure 9. Stages and sub stages of the CTI registration system.

6. Conclusion

In this research project, the technology of CTI has been applied to the course registration process. The system is

delegated to reduce the huge number of students coming to registration hall during the course registration period. An overview of ideas to design and build new computer telephony and a new voice-processing application for automated student's courses registration in a university is discussed. The system is flexible and easy to use since the number of menus used is minimized.

It is worth while to mention that the system does not require a major change to the databases implemented in any university for the sake of student registration. The system requires that each course offered to a student to have a unique number, which is already there. For example, An Introduction to Computer Network course has the code 081 414. Also each student has a unique ID number which should be used when accessing the database through the telephone line.

This research is a first step towards a project that can perform the services for the university students. In this research project CTI Registration system is introduced that can be used in universities that depends on the credit hour academic system. It would solve many problems. Some concepts needed to the implementation were discussed. The proposed system enables the students to register their courses from any place at any time. All what they need is a telephone. This will help a lot to overcome the registration queues problem. In the next phase, we are going to use a hardware that makes the connection to the database faster and makes response time shorter is to be used, hence it can handle more students at the same time.

Future plans are to extend the system to cover the following issues. The system can work as New Students Guidance. As new students are not immediately familiar with the College procedures, an Audio-text can guide them step by step through the different steps of registration, informing them about the different procedures, rules and regulations, as well as the different activities (cultural, sports, and social). Another service that could be implemented using this system is automatic grades and results retrieval. Students can call into the system at any time to know their grades for a specific test, or their GPA. A more elaborate system could also allow automatic retrieval by fax, by remote-calling students while on vacation. Likewise, parents can dial in and enter an identification code to obtain their child's grades and listen to comments from their teachers. Yet other application is automated forms processing. All forms commonly used by the administration can be automatically input into a central database, analyzed, and processed, hence avoiding risks of misfiling or lost hardcopies. One single system can simultaneously process an indefinite number of different forms, such as Recommendation forms, Scholarship Applications, Registration forms for new

students, or any other kind of Application. The system can also conduct surveys and process polls. This computer telephony system also has the advantage of eliminating the need for tedious repetitive data entry and speeding up data processing, as well as results and statistics availability.

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