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PENS (PROGRAM ENROLLMENT AND ANALYSIS)

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## 1. Introduction

The Program Enrollment and Analysis System, or PENS, is used to track and manage students through programs that are delivered using the Online Accelerated Program (OAP) model. PENS provides support to undergrad OAPs such as the RN-to-BSN (Registered Nurse Bachelor of Science) program, EXSS (Exercise Science) program as well as the Master of Science Nurse Educator (MSNE) program. The functionality in PENS mainly consists of workflow management, communication, reporting, and course scheduling and analysis. It is designed in MS Access. PENS is primarily used by Student Success Advisors and the Office of Academic Affairs Operations in the College of Health and Human Services. The College maintains the data in the system as well as uses PENS as an analysis tool to plan course offerings and seating several years into the future.

The current PENS software has limitations in terms of database architecture and system performance, security, scalability, and maintainability. All the information from MS Access database is saved into one file. This limits options and how one chooses to utilize the data; slowing down reports, queries, and forms. Its performance becomes slow as the user scales data size. In Access, Macros or Visual Basic for Applications (VBA) code can be used for programming which is the process of adding functionality to the database. MS Access with VBA is not as robust as SQL Server, Oracle, or other databases with advanced application development capabilities. While the language isn't that difficult to learn, actually using VBA effectively is the real challenge. It is multi-user limited, its technical limit is 255 concurrent users, but the real-world limit is much less. MS Access also has limited size i.e., any business that uses more than two gigabytes of space will discover limitations with MS Access.

This capstone project entails a comprehensive systems analysis and design of the current PENS software and proposes a new architectural design based around a web-based application that provides all the features of the current system while incorporating new cutting-edge technologies with the improved user interface, data security, and performance functionality.

Components of the new PENS software will be designed around the ISO/IEC 25010 framework [1] for software project quality definition. The quality model decides which quality characteristics will be taken into account when evaluating the properties of a software product. The product quality model defined in ISO/IEC 25010 constitutes the eight quality characteristics shown in the following Figure 1. Each characteristic has some sub-characteristics.

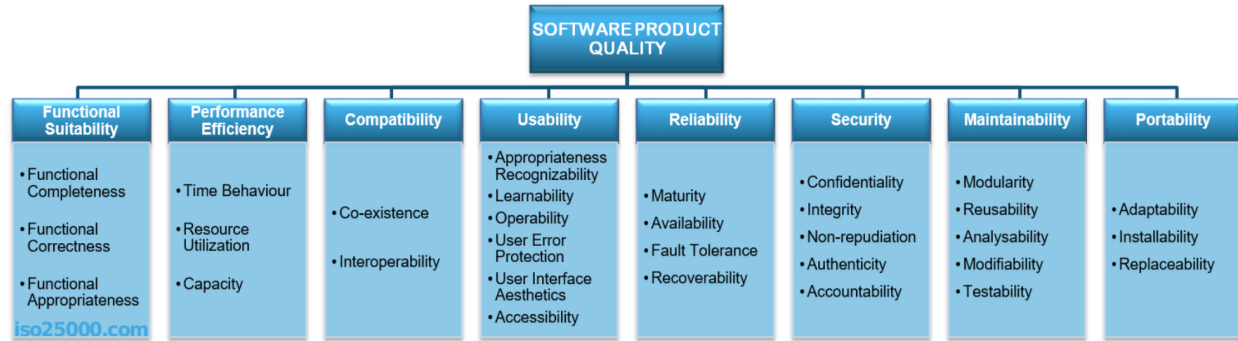


Image 1: ISO/IEC 25010 Product Quality Model

We selected three quality characteristics: a) security, b) usability, and c) portability from the Product Quality Model for this capstone project. These characteristics were chosen because they were areas where the current PENS have deficiencies and ITS technical staff identified as being very important to address in the newly designed system.

Security is a degree to which a product or system protects information data so that persons or other products or systems have the degree of data access appropriate to their types and levels of authorization [1]. Confidentiality is the degree to which a product or system ensures that data are accessible only to those authorized to have access. Considering security issues of current PENS, Family Educational Rights and Privacy Act (FERPA) [2] has to be taken into account which is a Federal law that protects the privacy of student education records. The law applies to all schools that receive funds under an applicable program of the U.S. Department of Education. According to FERPA schools must have written permission from the parent or eligible student in order to release any information from a student's education record.

Usability is the degree to which a product or system can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of uses [1]. Usability can either be specified or measured as a product quality characteristic in terms of its sub characteristics or specified or measured directly by measures that are a subset of quality in use. User interface aesthetics refers to properties of the product or system that increase the pleasure and satisfaction of the user, such as the use of color and the nature of the graphical design.

Portability is the degree of effectiveness and efficiency with which a system, product or component can be transferred from one hardware, software or other operational or usage environment to another [1]. If the product or system is to be installed by an end user, installability can affect the resulting functional appropriateness and operability. So installability can be interpreted as a degree of effectiveness and efficiency with which a

product or system can be successfully installed or uninstalled in a specified environment.

The rest of this paper is organized as follows. In section 2, we provide background information on the current PENS system, particularly how it operates and performs workflow management and course scheduling functions. We also provide software engineering models and diagrams to describe the current PENS software. It was designed using Lucidchart [3] online tool. Section 3 focuses on analysis & design of proposed PENS system. In section 4, the ISO/IEC 25010 framework is used with an emphasis on software quality requirements of the three software characteristics described above. For data security, we concentrate on alternative database management systems and the use of data encryption. For usability, we concentrate on human-computer interaction techniques. For portability, we focus stand-alone applications versus web-based applications. Section 5 discusses considerations for the implementation of the new PENS system. Section 6 discusses the overall design recommendations and Section 7 contains lessons learned from completing this capstone project. Finally, Section 8 provides concluding comments and future work.

## **2. Analysis**

### **2.1 About PENS**

Originally, it was PEAS, but they decided that was not the best choice and changed it to the less direct acronym PENS. PENS was developed as a combined effort between Academic Affairs and the Student Success advisor group in the CHHS (College of Health & Human Services) school. It was developed 5 years ago using Visual Basic for Applications (VBA) and MS Access. It has been added to and updated quite frequently over the last 5 years. PENS was developed to manage students within programs that were delivered using the OAP model (Online Accelerated Program). Originally, they were using spreadsheets and emails but decided to build an application to integrate the efforts of the Academic Affairs Operations group and the Student Success Advisor group. In particular, it helps the Advisors to keep track of students' progress, course load, scheduling and communication with the students via automated emails. The other part of PENS is the analysis portion that Academic Affairs uses to forecast and plan what courses and how many offerings of the courses and "seats" per course to schedule out into the future. There are around 25 advisors who use the PENS system and 3000 students' records are in the system.

We want to make the PENS more secure and more portable. In the traditional world of desktop applications, data is usually stored on the computer's hard drive. In the new world of web apps, emails and all the data are stored online on the web. As desktop applications are only accessible to users on desktop, they are secure. Although desktop

applications are more secure than web applications, web apps can be built more secure as almost all web development technologies come with their own security features. Moreover, there are best practices to follow while implementing security features in web apps. In workflow management of current PENS, it is a bit difficult to understand the navigation from one stage to another. The text area, titles, texts should be arranged in a specific layout. The use of each text area should be done properly. Since human attention is limited and we are able to maintain almost five objects in our short-term memory only at one time. Due to the limitations of short-term memory, there cannot be all sixteen stages on a single screen. The clutter should be minimal. Also, to distinguish between the information and the title, the stage title should be bold. Moreover, there is no white space anywhere in the above image. The below UML diagrams explains more about the functionalities and users of the current PENS.

### 2.1.1 Use Case Diagram

Once the advisor logs in, the advisor can perform various functions such checking and changing the student's status which can be Active or Inactive. He can also view the list of students he will be advising. At first, Advisor sends a welcome email to all the students under him and then an auto-generated appointment email or follow up email is sent by the advisor.

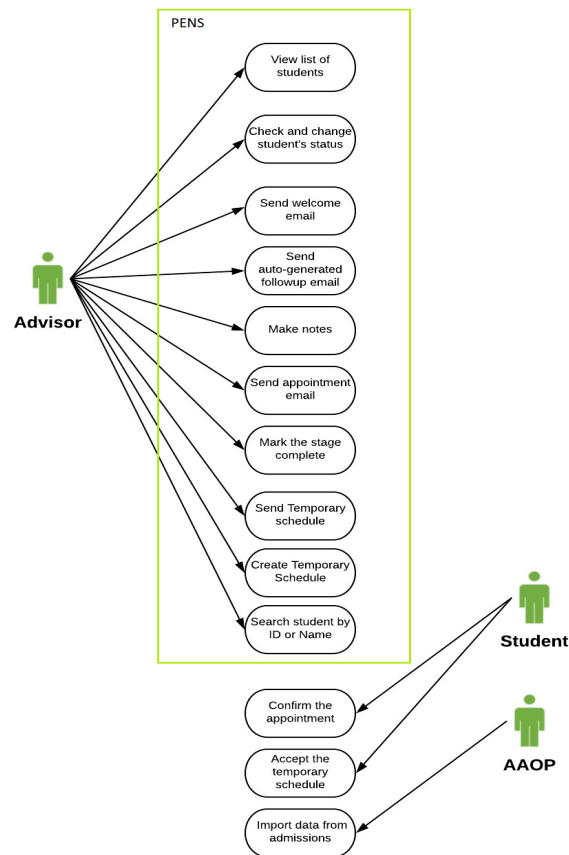


Figure 1: Use Case Diagram for workflow management

### 2.1.2 Data Flow Diagram

AAOP (Academic Affairs Operation) team imports data from admissions and Registrar evaluates transcript. When the evaluation is complete, students are assigned advisors. Degree audits and transcripts are reviewed. Advisor clicks on Course Schedule and checks off completed courses. Advisor sends a welcome email to student and an advising appointment email. Advisor clicks "Send Appointment Email" which creates a template to send to the advisee to make an advising appointment. Once the student sends a confirmation email to the advisor, the temporary schedule is sent to the student. A student can then accept or deny that schedule. When a student graduates, the record status is updated to "Graduated" and the record is archived in the archive database.

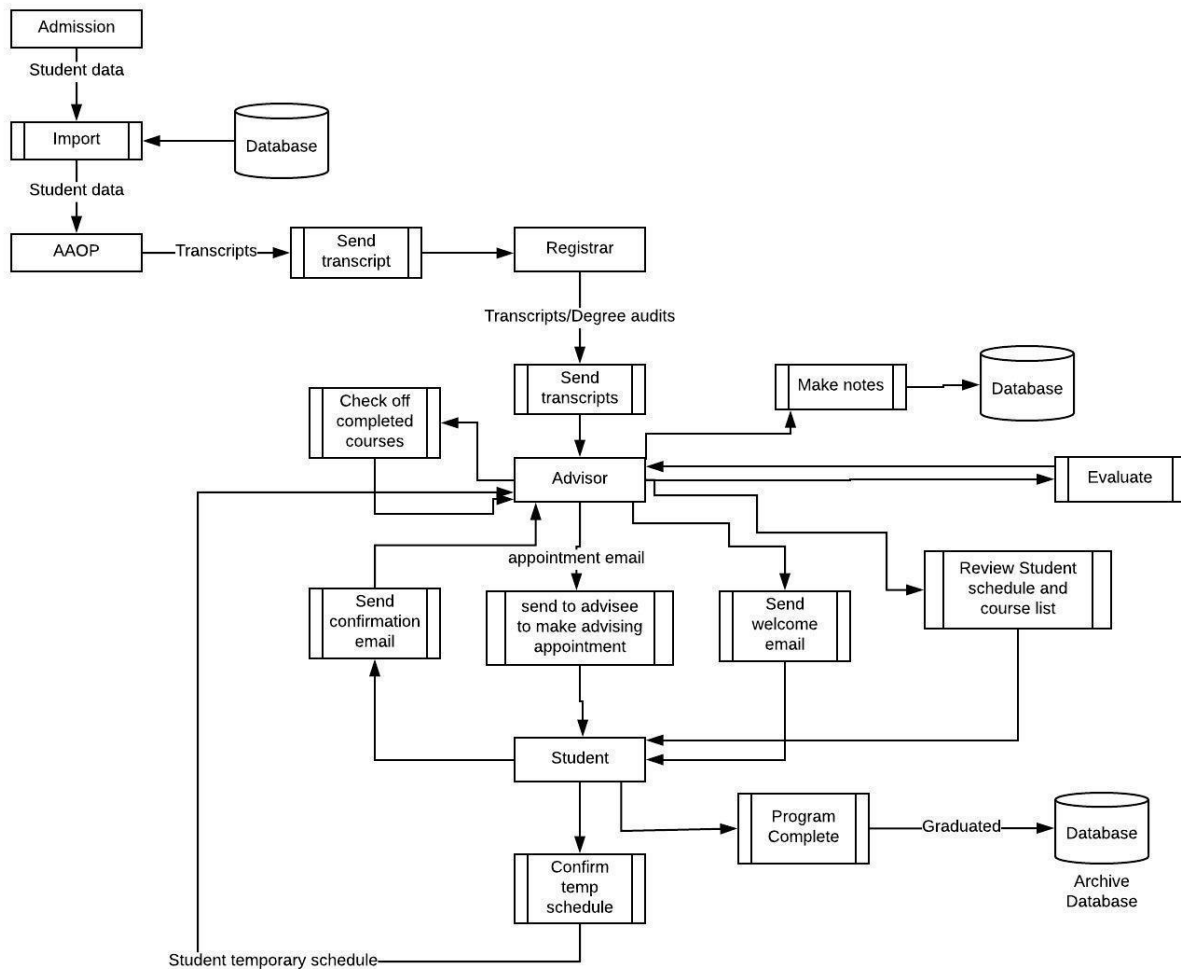


Figure 2: Data Flow Diagram

### 2.1.3 System Diagram

System diagrams [4] show the input to the application and the output. An Access database is a collection of database objects: tables, queries, forms, reports, macros, and modules. Advisors commands are handled through forms. The general-purpose Microsoft Visual Basic for Applications (VBA) procedures are stored in a library

database. Workgroup information file stores the user-level security account information. In MS Access, the data is stored in tables. The output of the PENS application is generated reports, students' data, and auto-generated email. When the student graduates the records are archived in "Archive Database".

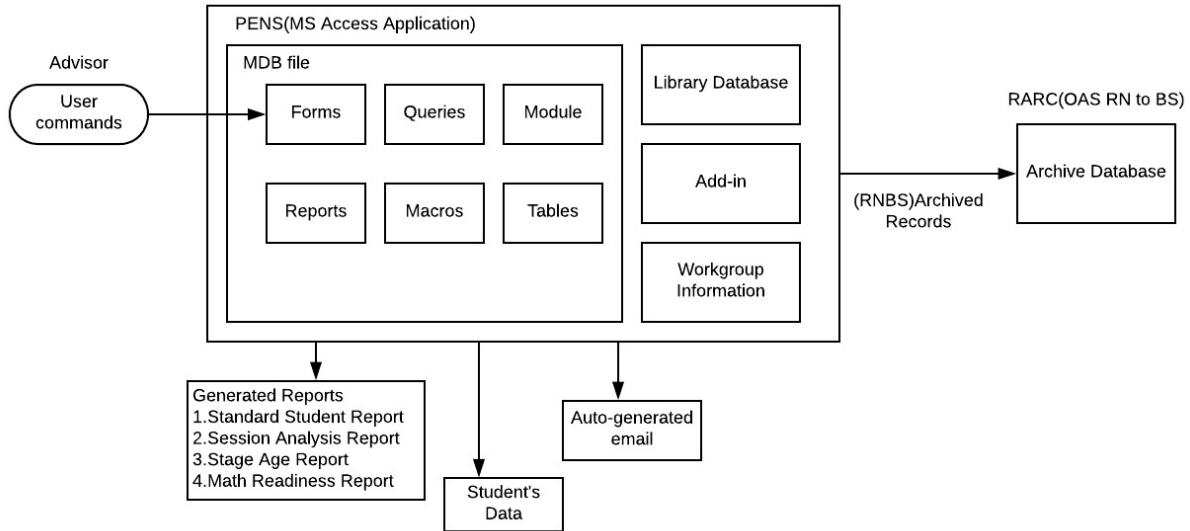


Figure 3: System Diagram

### 2.1.4 Software Architecture Diagram

In PENS, a client can be advisors or AAOP's team. VBA applications need to be installed on each machine. For every advisor's or AAOP's commands the data is either is stored, updated, retrieved from MS access database. MS access database is nothing but a virtual machine on a virtual server at ITS data center.

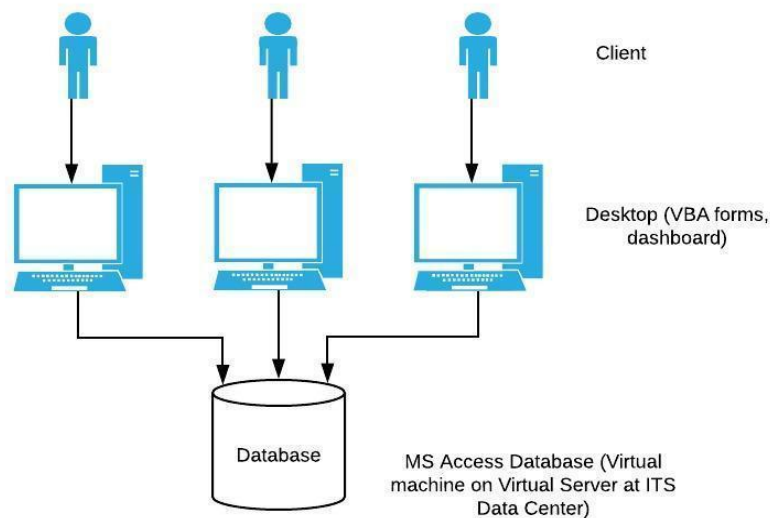


Figure 4: Software Architecture Diagram

### 2.1.5 Activity Diagram

The activity diagram below shows the activities performed or the roles of various actors such as PENS application, advisors, AAOP's as well as student. The activities are from the point a student gets admitted until they actually start the classes.

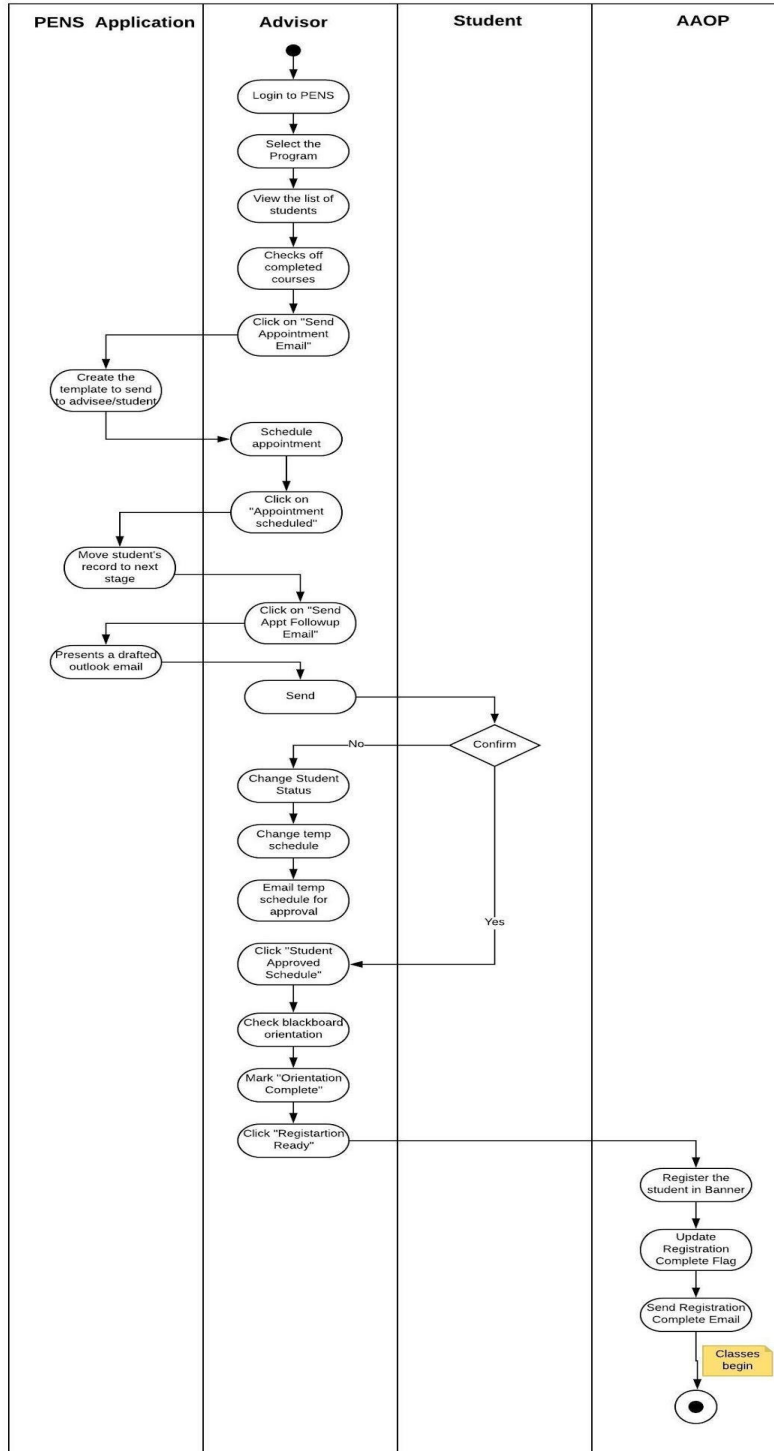


Figure 5: Activity Diagram

## 2.1.6 Entity Relationship Diagram

ER diagram shows relationships among different tables using cardinality one to many or one to one. In PENS, the tables were not having any relationships or foreign key concept. Based on the data within the tables we tried to draw this ER diagram. Here, Student is the main table. Student IDs are being used in other tables which in turn could show the mapping between student table and other tables.

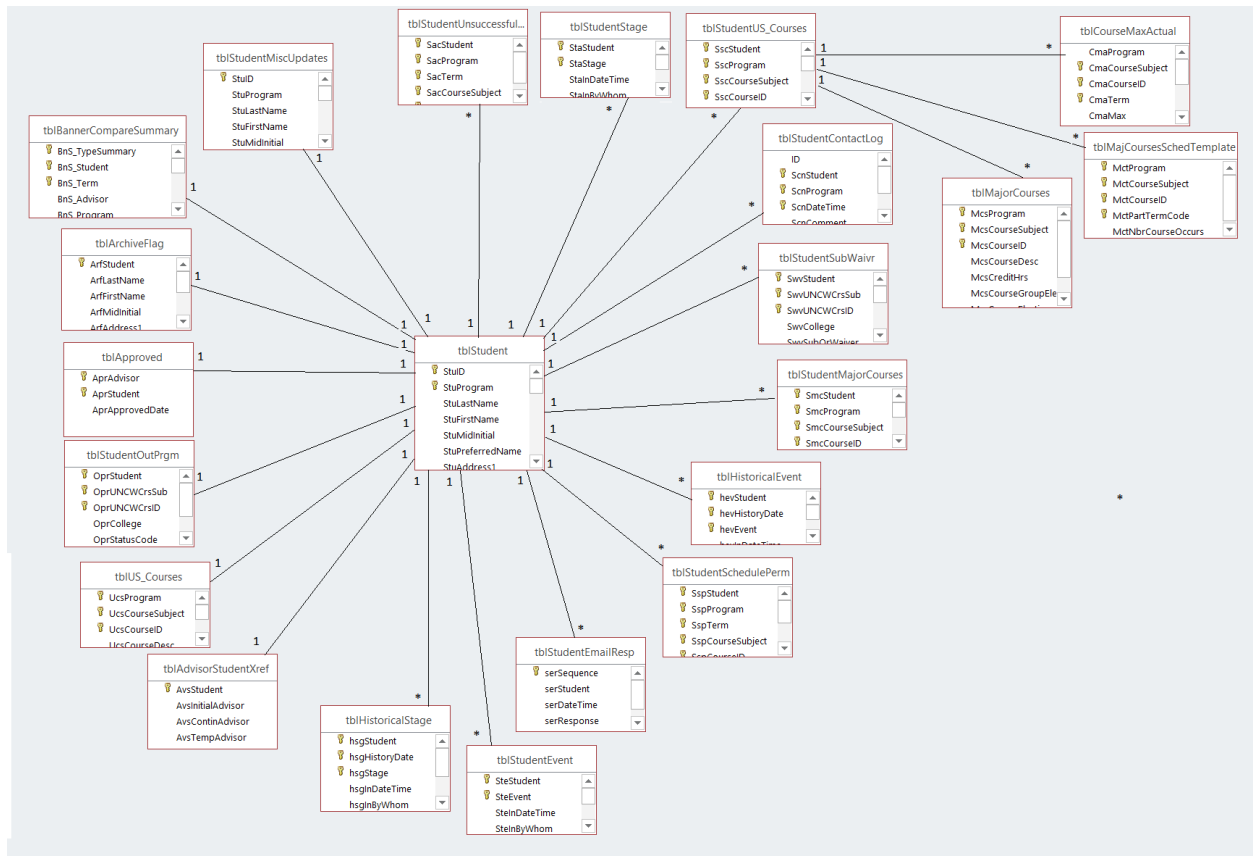


Figure 6: Entity Relationship Diagram

## 2.2 Workflow Management

Each initial (beginning) student is located in any one of twelve stages. Each continuing (completed first term) student is located in any one of fourteen stages. The movement from one stage to the next is determined by the system, based on the completion of certain events or processes. These stages are seen in two key locations. The robust dashboard view provides each advisor with the ability to view all his/her students assigned to each stage.

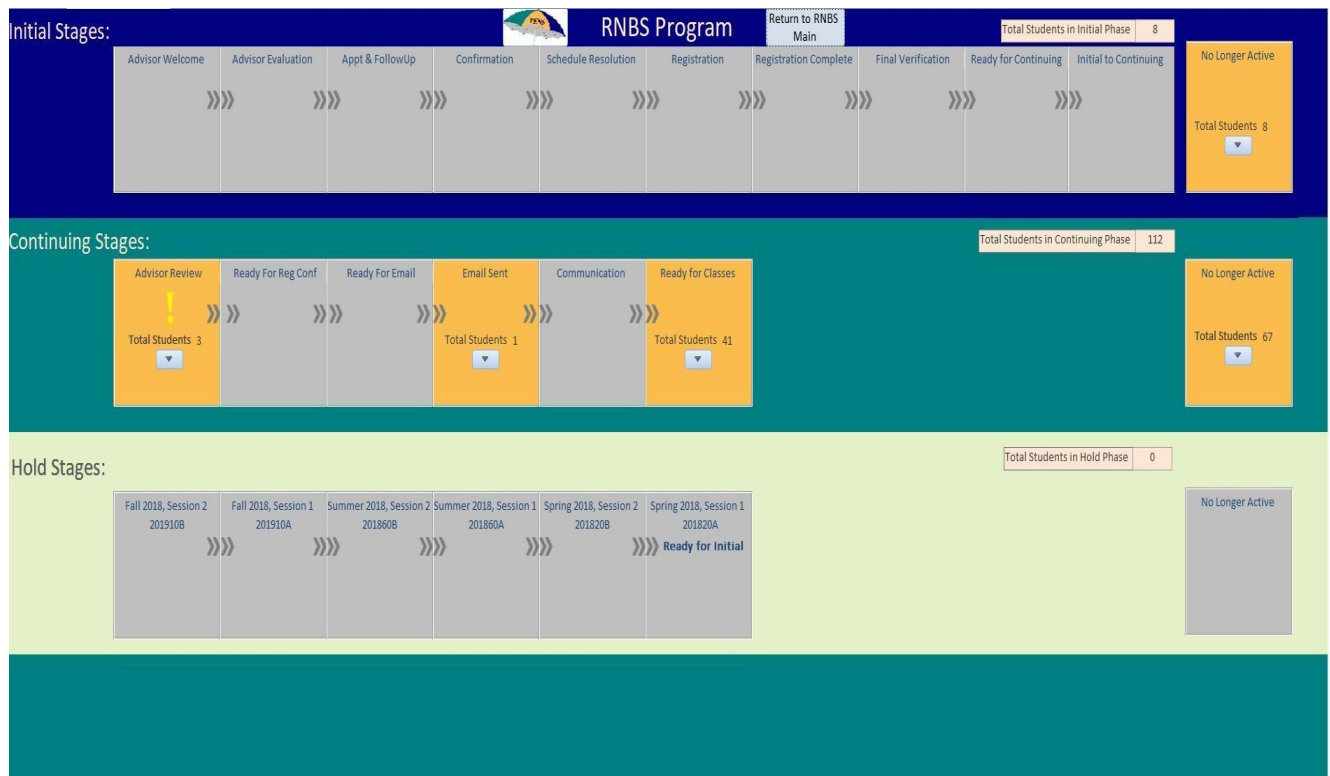


Image 2: Stages of workflow management

The stages of workflow management are:

Stage	Description
Admissions/ Evaluation	Data team imports data from admissions and Registrar evaluates transcript. When evaluation is complete, students are assigned advisors. Once advisor is assigned, student moves to the Advisor Review stage.
Advisor Welcome	Degree audits and transcripts are reviewed. Advisor clicks on Course Schedule and checks off completed courses and subs. Advisor clicks "Send Appointment Email" which creates template to send to advisee to make advising appointment.
Advisor Evaluation	Once an appointment is scheduled, the advisor will click on the "Appointment Scheduled" action button. Once the "Appointment Scheduled" button is selected, the student is then moved on to the next stage.
Appt &	Advisor has advising appt and clicks "Send Appt Follow up Email"

FollowUp	button. Clicking that button presents a drafted Outlook email using data from the student's Sub Waiver and Out of Program areas. An option then appears to move to Confirmation Stage.
Confirmation	Student confirms acceptance. If postponed or declined, click Change Student Status. Change Temp schedule by clicking Course Schedule. Course Lists Reviewed. Student Schedule reviewed. Temp schedule is emailed for approval.
Schedule Resolution	When student confirms schedule, click "Student Approved Schedule". Check Blackboard Orientation then click "Orientation Complete". Click "Registration Ready" once ready to register.
Registration	In this stage, the data team will register the student in Banner, update the Registration Complete flag and send Registration Complete email. Upon completion of that, this stage is automatically completed and "Registration Complete" stage is opened.
Registration-Complete	This stage is a holding area for those students who have been registered but classes have not yet begun. Once classes have begun, this stage will automatically be closed and "Final Verification" stage will be opened.
Final Verification	The Final Verification stage will show as open (!) for all students that are registered. It will be closed (√) when the advisor clicks the "Ready for Continuing" button.
Ready for Continuing	This stage is a holding area for students who have completed "Final Verification", but withdrawal processing has not occurred. After that date, students automatically progress to "Initial to Continuing" or sent back to "Final Verification" stage.
Initial to Continuing	This stage is opened when the prior stage is completed, and the Sub Waiver data is acceptable. The data team will assign the new Continuing Advisor and send an automated email to the student, with cc to the new advisor, introducing the new advisor

Table 1: Stages of Workflow management

### 2.2.1 Comparison with other commercial products

	Auto-generation of email	Data import	Attachments/Notes	Users/Role management	Reassignment Caseload	Active Directory Authentication	Test Product Environment
PENS	✓	✓	✓	✓	✓		
Perceptive Content	✓	✓	✓	✓		✓	✓
BPM Online	✓	✓	✓	✓	✓	✓	✓

Table 2: Comparing workflow management functionality of current PENS software with other commercial products.

**Perceptive Content:** It is also known as ImageNow [5][6]. Perceptive Content document imaging, management and workflow provides the ability to reduce the cost of paper processes, enhance service and boost staff productivity. It provides powerful workflow components. The workflow allows the user to route a document or folder through business from start to finish. The alarm functionality in workflow send automated email to the respective users. There are comment boxes to save the information about each stage [7].

**BPM Online:** BPM Online [8] is a powerful tool for workflow management. It has all the functionalities including designing workflow, send manual/auto generated email, import data capability, users & role management, and pre-production environment. BPM Online offers a complete set of tools to effectively manage business processes including online modeling, execution, monitoring, and analysis. It involves making use of pre-configured elements, working with page, processing data, and using external services to create processes (tasks, calls, and emails).

### 2.3 Course Scheduling

The system will automatically create a student course plan whenever requested by the advisor. This process accommodates both nursing and university studies courses. It is driven by:

1. The seating capacity of each course and the existing enrollment for each course.

2. The student preference for type of plan:
  - a. Full Time (2 courses per Part Term)
  - b. Part Time (1 course per Part Term)
  - c. Accelerated Part Term (alternating 2 and 1 courses)

The resulting schedule appears as follows. It will remain as a temporary schedule until the student approves it.

Student ID: 850... Program: RNBS

### Student's Temporary Schedule

Term Code	Term Description	Subject	ID	Description	Pre Req For:
201710A	Fall 2016, Session 1	1	BIO	201 Principles of Biology:Cells	BIO 240 BIO 246
201710A	Fall 2016, Session 1	2	NSG	316 Professional Nursing Practice for the Bacc. Nurse (WI,IL)	
201710A	Fall 2016, Session 1	3	NSG	323 Introduction to Health Assessment	
201710B	Fall 2016, Session 2	4	BIO	246 Microbiology	
201710B	Fall 2016, Session 2	5	NSG	321 Gerontology / End of Life Care	
201720A	Spring 2017, Session 1	6	NSG	404 Health Policy (WI,IL)	
201720A	Spring 2017, Session 1	7	PAR	215 Bioethics	
201720B	Spring 2017, Session 2	8	XXX	XXX	
201720B	Spring 2017, Session 2	9	NSG	480 Transcultural Health Care	
201760A	Summer 2017, Session 1	10	SPN	120 Fundamentals of Spanish	SPN 201
201760A	Summer 2017, Session 1	11	NSG	406 Leadership and Management in Nursing	
201760B	Summer 2017, Session 2	12	SPN	201 Intermediate Spanish I	
201760B	Summer 2017, Session 2	13	XXX	XXX	
201810A	Fall 2017, Session 1	14	THR	121 Introduction to Theatre	
201810A	Fall 2017, Session 1	15	XXX	XXX	
201810B	Fall 2017, Session 2	16	NSG	482 Patho & Pharmacological Evidence Base Care (QLR)	
201810B	Fall 2017, Session 2	17	NSG	415 Research in Nursing (WI,IL)	
201820A	Spring 2018, Session 1	18	NSG	408 Community Health Nursing	

Edit Schedule    Print Schedule    Done  
Print New Format Schedule  
Email Schedule

Image 3: Student's Temporary Schedule(PENS)

### 2.3.1 Comparison with Degree Works

The Degree Works [9] application involves various features such as display students profile, process look ahead and what-if. The student profile shows the students information, advisor's name, Transfer hours, Degree etc. The bar chart shows students' progress towards graduation, including progress towards all requirements as well as total credit hours. The What If feature shows how degree audit would appear when the major is changed or added. Running a What If process shows if any of students' previously completed course work would fulfill requirements in the new major or minor as well as any future requirements. This will populate a new audit including university studies and major requirements. Look ahead feature is to input potential courses for future semesters to determine how they will count in university studies.

	Track courses	Track Student Progress	Notes	Subs & Waivers	What-if	Look Ahead (Show courses for which student plan to register in future terms)
PENS	✓	✓	✓	✓		✓
Degree Works	✓	✓	✓	✓	✓	✓

Table 3. Comparing PENS with Degree Works

**3. Software Quality Requirements & Evolution**

**3.1 Security**

Database security refers to the information security, protects the confidentiality, integrity and availability of an organization’s databases. Security is important for any multi user application in which different users have different levels of permissions for database objects.

**3.1.1 Analysis of current PENS**

Although Microsoft Access is one of the major desktop databases in the world, it has a poor reputation when it comes to implementing security

Access and user-level security [11]: Access does not support user-level security for databases that are created in the new file format (.accdb and .accde files). The data such as academic records or employment data, which certainly requires more extensive database security than MS Access can offer.

Corruption Issues [12]: MS access can be vulnerable to corruption at any point in time wherein one cannot access the database files such as .accdb or .mdb. One may not be able to continue their vital project work because of the database corruption. There are various causes of the corruption [13] of the MS Access database such as Virus or Malware Attack, Sudden System Shutdown, Incompetent Database Design or Structure, Concurrent use of Access Database by Multiple User, improperly installed plug-ins & Weak Network Connectivity, Disconnecting from a Database Incorrectly.

**3.1.2 Analysis of alternative Technologies**

**3.1.2.1 MySQL Data Security**

MySQL provides robust data security [14] to protect data including secure connections, authentication services, fine-grained authorization and controls, and data encryption. The most basic security feature of the MySQL [15] is the privilege system which allows determining who can access the database. The implementation includes a simple user-password scheme as well as enables associating each user with a network location to prevent access from unwanted or untrusted locations. MySQL prevents authentication attempts for connections coming from unknown locations. MySQL provides connection encryption as it implements SSL library [16]. Client-server endpoints require certificates and their own set of private keys to be able to use encryption. Although, the database provides no assistance nor tools for setting up SSL in MySQL.

### **3.1.2.2 MS SQL Server Security**

#### **a. Authentication**

SQL Server supports two authentication modes [17] which are nothing but Windows authentication mode and mixed mode. Windows authentication is also specified as integrated security as the SQL Server security model is tightly integrated with Windows. The users on windows who has been authenticated earlier need not have to provide the credentials again. In mixed mode, authentication is supported by Windows as well as by SQL Server. Username and password pairs are maintained within SQL Server.

#### **b. Authorization and Permissions**

Security administration simplifies when permissions are granted to roles instead of the users. It is difficult to recreate the separate permissions than adding or removing users from a role. Roles can be nested but too many levels of nesting can degrade performance. We can also add users to fixed database roles to simplify assigning permissions [18]. In SQL Server, an extra layer of protection can be provided using the stored procedure and other user-defined functions. Users can be prevented from directly interacting with database objects by granting permissions only to the stored procedures or functions while denying permissions to underlying objects such as tables. To achieve this, ownership chaining is used by SQL Server.

#### **c. Data Encryption**

Encryption and Decryption is provided by SQL Server using a certificate, asymmetric key, or symmetric key. This is managed by the server using an internal certificate store. The store uses an encryption hierarchy that protects the certificates and keys at one level with the layer above it in the hierarchy. This feature area of SQL Server is called Secret Storage [18]. Symmetric key encryption is the fastest mode of encryption supported by the encryption functions. This mode is suitable for handling large volumes

of data. The symmetric keys can be encrypted by certificates, passwords or other symmetric keys.

### **3.1.2.3 Java**

#### **a. Declarative Security**

Declarative protection means that the application of security mechanism for an application is externally declared and controlled. Deployment details have described the security structure of the J2EE (Java 2 Platform, Enterprise Edition) application, including security roles, access control and authentication requirements [19]. The Application Server supports the deployment descriptors specified by J2EE v1.4 and has additional security elements included in its own deployment descriptors. Declarative security is the application deployer's responsibility. Two levels of declaratory security are an application level security and the component level security. The latter consists of web components and EJB components. A secure web container authenticates the user and authorizes access to servlet or JSP using the defined security policy in the servlet XML Deployment Descriptor.

#### **b. Programmatic Security**

The security of the program is embedded in an application and can be used to make security-related decisions, when declarative protection is not enough to express the security model of an application, a single declarative security cannot be sufficient, when an application for all cases, conditional login is required in a particular workflow for all cases. Authentication, login and logout methods of HttpServletRequest interface are provided by Servlet 3.0.

#### **c. Message Security**

In message-level security [19], security information is within SOAP (Simple Object Access Protocol) message or attachments, which permits security information to travel with a message or an attachment. As an illustration, a part of the message can be signed by a sender and can be encrypted for a particular receiver. When sent from the initial sender, the message may be from the intermediary nodes before reaching the desired receiver. In this scenario, the encrypted part will remain obscure for any intermediary nodes and it can only be decrypted by the desired receiver. For this reason, message layer security is sometimes known as the end-to-end security.

Benefits of Message Layer Security include the following:

- All the hops have security with the message till the message arrives at its destination.
- Security is applied selectively to different parts of the security message and for attachment if the XML Web service security is used.

- Message security can be used on multiple hops.

### 3.1.2.4 Golang

#### a. Security

Cross-site Scripting (XSS) is addressed with Go's automatic reference identification using standard library HTML templates. It attempts to detect the context of code (HTML, JS, CSS, wire, etc.) and properly encodes the input to avoid XSS. For password, Go does not include standard libraries for bcrypt or scrypt. It comes with a whole host of common suspects (MD5, SHA1, and more), but additional libraries need to include for a better password hash. Also, this language reduces and blocks errors in concurrency which is often happens in parallel programs. These are examples of advantages that provide more concrete and reliable solutions and it is a huge gain in cybersecurity [20].

### 3.1.2.5 JavaScript

There are many JavaScript security [21] issues that have received widespread attention. JavaScript interacts with DOM, by permitting malicious actors to distribute scripts on the web and run them on client computers. It is dangerous to the end users. There are two ways to prevent this JavaScript security risk.

The first one is sandboxing which nothing but a script running separately so that they can only access some resources and perform specific tasks. The second solution is implementing the same basic policy, which prevents a script from one site from accessing data used by scripts from other sites. To prevent DOM-based JavaScript security risks, numerous JavaScript security vulnerabilities have resulted from browser authors failing to take these measures [22].

#### a. Browser and plugin coding errors

JavaScript provides an interface for a wide range of browser capabilities, some of which may cause flaws such as buffer overflow. These flaws may allow attackers to write scripts that require running any code on the user's system. This code is not limited to any other JavaScript applications [23]. For example, taking advantage of a buffer overrun, an attacker may be allowed to access operating system APIs with super user privileges.

These flaws have influenced major browsers including Firefox, Internet Explorer and Safari. In a wide range of plugins, such as video players, Adobe Flash, and Microsoft Active Explorer enabled by default in Internet Explorer, flaws can also be used by JavaScript (such flaws have been exploited in the past)

### 3.1.2.6 AngularJS

#### a. Angular's cross-site scripting security model

Cross-site scripting (XSS) lets attackers inject malicious codes into web pages, such code can steal user data especially access data or impersonate a user. This is one of the most common attacks on the web [24]. To systematically block XSS bugs, the angular makes all values doubtful by default. When a property is inserted into the DOM from the template, through the property attribute, style, class binding or interpolation. Angular disinfects and avoids unreliable values.

#### b. Sanitization and security contexts

Sanitization is an incredible inspection of an unreliable value, which by turning it into a value that is safe to insert into the DOM. In many cases, sanitization does not change the value at all. The notation depends on the reference: A value that is harmless in CSS is potentially dangerous in the URL [24]. Angular defines the following security contexts:

- Style is used when CSS is bound in style property.
- HTML is used when a value is interpreted as HTML, for example, when binding to innerHtml
- URL is used for URL properties, such as <a href>
- Angular sanitize unreliable values for HTML, styles and URLs; The sanitizing resource URL is not possible because it has an arbitrary code.

### 3.1.2.7 ASP.NET

To provide Web application security [25] ASP.NET works in accordance with the Microsoft .NET Framework and Microsoft Internet Information Services (IIS). Authentication is nothing but whom the user claims to be. The application acquires credentials from a user and validates those credentials against some authority. If the credentials are valid, the entity that submitted the credentials is considered an authenticated identity [25].

Authorization feature limits access rights by granting or denying specific permissions for an authenticated identity. The authorization determines whether or not a specific resource should be identified. In ASP.NET, there are two ways to authorize access to a given resource [25]. The file authorization is done by the FileAuthorizationModule. To determine whether a user should have access to the file, it checks the Access Control List (ACL) of the .aspx or .msx handler file. ACL permissions are validated for the user's Windows identity or for Windows identity of the ASP.NET process [25]. URL authentication is done by UrlAuthorizationModule, which makes users map to ASP.NET applications in the URL. This module can be used to permit or reject the access to arbitrary parts of an application for specific users or roles [25].

### **3.1.3 Discussion**

Java message security is independent of the application environment or transport protocol. The disadvantage of using message-layer security is that it is relatively complex and adds some overhead to processing. Java code itself is small because the virtual machine holds so much power for memory management and security. If a security problem appears in the lowest levels of Java, there's no need to recompile and relink all your code. Many problems are solved by upgrading the JVM alone. Security of JavaScript is not strong based the above discussion. Because JavaScript provides an interface for a wide range of browser capabilities, some of which may cause flaws such as buffer overflow. These flaws may allow attackers to write scripts that require running any code on the user's system. Based on the analysis of above different technologies SQL Server, ASP.NET and AngularJS is recommended. AngularJS provides cross-site scripting security model that disinfects and avoids unreliable values.

## **3.2 Usability: Human Computer Interaction(HCI)**

Human computer interaction(HCI) [26] helps to improve and enhance system facilities and to satisfy users' needs and necessities. HCI will assist designers, analysts and users to identify the system needs from text style, fonts, layout, graphics and color. Usability make sure that if the system is efficient, effective, easy to learn, easy to remember. It also confirms that the system provides job satisfaction to the users. The goals of HCI are to produce usable and safe systems, as well as functional systems.

### **3.2.1 Basic Principles of HCI**

#### **3.2.1.1 Learnability/Familiarity:**

The longer the time taken to acquire that familiarity the more difficult it is for the user to interact with the interface effectively. This learning time can be reduced by making use of the knowledge that the user already has. When the user performs an unfamiliar task, there is an inherent internal barrier to getting the task completed [27].

The learning process has to become involved in order to accomplish the user-centered goal. Any system, which reduces or obviates this learning process will enhance task performance by reducing mental workload. One common way of applying learnability is to use a paradigm known to the user. Common themes such as office or desktop can utilize the user's prior knowledge. Similarly, screen objects can suggest by their color, shape, and other attributes.

#### **3.2.1.2 Ergonomics/Human Factors:**

Human Computer Interaction cannot take place without taking ergonomics into the equation. Although the literal meaning of ergonomics is “energy efficient” Ergonomic design involves understanding the users and what they need to do with the system and where they will use it [27].

When the user is seen as an unreliable, unpredictable component of the system, the importance of the user’s humane characteristics is negated and undervalued, resulting in systems that are difficult to use, awkward and inefficient. Individual users possess common capabilities such as reading, listening, touch, and motor skills, in addition to average height, size and weight, the physical diversity, psychological abilities and disabilities of users have to be analyzed and evaluated when designing interfaces.

### **3.2.1.3 Consistency/Standards:**

Consistency and standards are central to usability. Users need not have to wonder whether different words, situations or actions mean the same thing. Lack of consistency has even lead to dire consequences. Global consistency depends upon standardization. For example, a volume control is always turned clockwise for every device. This universal standardization means that no instructions are needed, and no mistakes are made during the operation [27].

Software standards provide consistency from one application to another. For example, dialogue boxes look same in different windows applications. Minimization/Maximization buttons are all standardized in the operating system rather than the application. This consistency provides user advantage because a new program can be utilized immediately without having to learn how to save a file. Web pages although less standardized often require a high degree of standardization because of their diversity and multiplicity. For example, hyperlinks are colored blue and underlined as standard indications of an active link.

### **3.2.1.4 Feedback/Robustness**

Whenever a user operates a switch, presses a button, turns a dial, clicks a mouse, or interacts in any way with a machine or with a system, there must be feedback that is unambiguous [27]. Feedback can come in the form of a sound, a light, text on a screen, dialogue boxes etc.

However, the ideal form of feedback is allowing users to see things happen. If a system gives no feedback at all then the user may assume that the command has not been received, accepted, or acted upon. This may cause the user to press the button again, repeat the command or even think that the device is no longer working. Sometimes this

may result in mistaken data input, endless looping, or several duplicated actions, which take further time and effort to recover.

### 3.2.2 Analysis of current PENS system

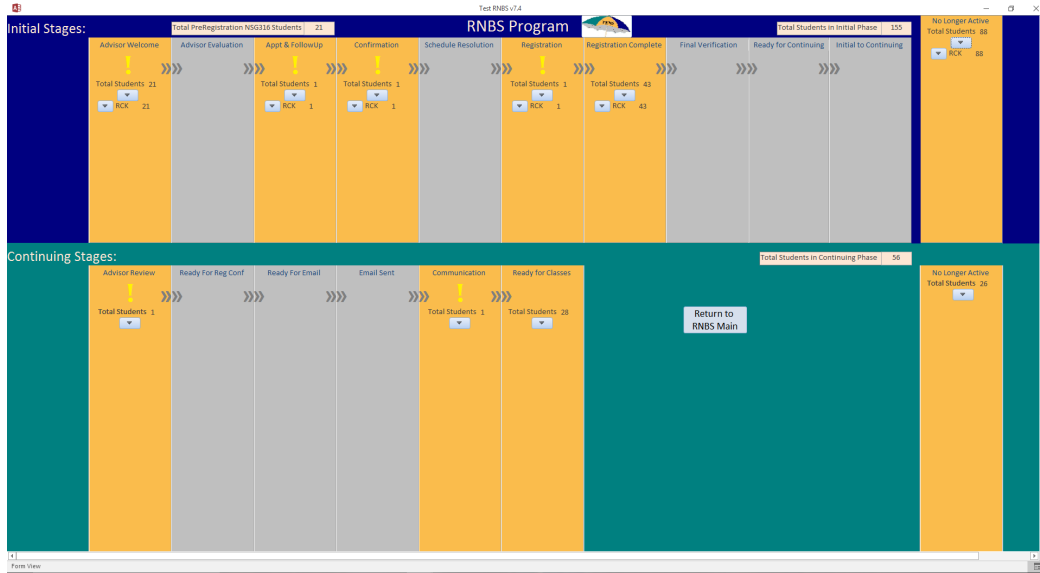


Image 4: Workflow management of current PENS

In the above image of workflow management of current PENS, it is a bit difficult to understand the navigation from one stage to another. The text area, titles, texts should be arranged in a specific layout. The use of each text area should be done properly. Since human attention is limited and we are able to maintain almost five objects in our short-term memory only at one time. Due to the limitations of short-term memory, there cannot be all sixteen stages on a single screen. The clutter should be minimal. All unnecessary information competes for the user's limited attention resources, which can prevent the user's memory retrieval of relevant information. Also, to distinguish between the information and the title, the stage title should be bold. Moreover, there is no white space anywhere in the above image. The white space is the area between the individual design elements. White Space is a great design tool for better systematic display of content to balance elements and improve visual communication experience.

### 3.2.3 Analysis of alternative technologies

#### 3.2.3.1 HTML/CSS

HTML or HyperText Markup Language [28] is widely used to create web pages and every browser supports HTML language. Although, it can be used to create only static and plain pages, so HTML is not useful if we need dynamic pages. It also requires writing a lot of code for making a simple web page.

CSS or cascading style sheet [29] is a text-based coding language used to specify website formats. CSS improves web master efficiency, especially during implementing and changing style elements. It provides the designer the power to replace the entire website or folder with only a few lines of code, which means fast loading time. Also, ensures consistency for global audiences. However, there is one limitation of CSS where the programmer needs to consider and test all the code in many browsers for compatibility before making any website or mobile application live.

### **3.2.3.2 BootStrap**

Responsive web design is about creating web sites that automatically adjust to view itself, looks good on all devices from small devices to large desktops. Bootstrap [30] is the most popular HTML, CSS, and JavaScript framework for responsive, mobile-first websites development. It is compatible with all modern browsers. It is a free front-end framework for faster and easier web development. It also consists of a pack of JavaScript components that comprises functionality which makes it easy to adept operating things such as tooltips, modal windows, alerts, etc. One of the main benefits of using bootstrap is the speed of development. Bootstrap comes with pre-style components for alert, dropdown, nav bar etc. Therefore, being rich in a feature, Bootstrap offers several advantages of using it.

### **3.2.3.3 JavaScript**

JavaScript [31] is relatively easy to learn and implement. Previously, the sites were static HTML sites that had no formatting and no interaction. But JS changed it to the first client-side language. It is used to create the side of the site that the user sees and contacts with it. With HTML and CSS, JavaScript is the most universal of the client-side script rationally. If HTML directs the contents of a page, and the CSS looks and feels, JavaScript directs the behavior of a page. JavaScript changes both the CSS styles and HTML attributes of a page, the content changes, and things look like when the user interacts with it. As it is a client-side, the load on the website server decreases. JavaScript plays well with other languages and can be used in a large variety of applications.

### **3.2.3.4 AngularJS**

AngularJS [32] is the most chosen framework for creating interactive components of a website. It was designed as a full-featured JavaScript framework to increase the simplicity and efficiency. AngularJS is very effective, especially in creating dynamic, single page apps and supporting MVC (Model View Controller) programming structure. AngularJS is just plain HTML. The browser parses these templates in DOM and converts it to the AngularJS compiler. Then, the AngularJS framework templates traverse to get the rendering instructions named Directors. These ready-to-use

templates also make it easy for people with small computing skills that come with great apps.

### **3.2.4 Discussion**

Although JavaScript is one of the most simple, versatile and effective languages, once appended onto web pages execute on client servers immediately; therefore, can also be used to exploit the user's system. Even though a certain restriction is set by modern web standards on browsers, malicious code can still be executed. ASP.NET can be used to develop large apps with less coding. It is a safe and secure environment. It is easy to write and maintain source code. Although coding becomes somewhat complex for customization. Bootstrap gives the attractive user interface for various devices such as mobile, desktop, tablet. Although its styles are verbose and can lead to lots of output in HTML which is not needed. JavaScript is tied to jQuery and is one of the common libraries which thus leaves most of the plugins unused. Bootstrap is non-compliant HTML. Based on the analysis of above different technologies Bootstrap and AngularJS is recommended. As Bootstrap provides the view for all types of devices including mobile, tablets or desktop with less amount of coding.

## **3.3 Portability**

### **3.3.1 Analysis of current PENS system**

Whenever various Windows operating systems like Windows 98, Windows ME, Windows 2000, Windows XP, or Windows Vista are used to access the same database, there is always a possibility that the database may experience corruption issues. Also, Microsoft Access is not designed to operate on Apple Macintosh computers. Furthermore, Access cannot gel with the applications that are web based as its forms and reports are only serviceable in a Windows environment and are not compatible with an internet browser like Internet Explorer. Also, from the maintenance perspective, there is an overhead of daily tasks and installs i.e. the distribution of a client server applications [33].

Installation is necessary: Desktop applications are required from user manual installation as well as from certain places in the hard drive. One must spend time and effort in this installation process, which usually isn't that time consuming, but can still be obnoxious.

### **3.3.2 Analysis of alternative technologies**

#### **3.3.2.1 JavaScript**

##### **a. Platform-Specific Workarounds**

Feature testing is well-suited to check the support of large functional areas. For example, one can use it to determine whether a browser supports image rollovers. On the other hand, sometimes one may have to work around individual bugs in a particular browser, and there can be no easy way to test for the existence of the bug [34]. In this case, one has to create a platform-specific solution that is related to a particular browser vendor, version or operating system (or some combination of three). Navigator of the window object offers information about the browser's vendor, the version and operating system on which it is running. One can use this information to incorporate platform-specific code into the program

#### **b. Compatibility Through Server-Side Scripts**

One more approach to compatibility is possible when including server-side scripts such as JavaScript in a web application. A program on the server side can examine the user-agent field of the HTTP request header so that the user can determine what the user is running. With this information, the program can generate custom JavaScript code that is known to work properly on that browser [29]. Or, if the server-side script determines that the user's browser does not support JavaScript, then it can create web pages that do not require JavaScript. An important drawback of this approach is that when a user has disabled JavaScript support in their browser, then the server-side script cannot be detected.

#### **3.3.2.2 AngularJS**

AngularJS is a powerful JavaScript-based development framework for creating a Rich Internet Application (RIA). AngularJS offers developers the options for writing client-side applications (using JavaScript) in a clean MVC (Model View Controller) manner. AngularJS written application is Cross-browser compliant [30]. AngularJS automatically handles JavaScript code for each browser. AngularJS 1.x was produced thinking about portable. Although designers can utilize it for building versatile applications however they typically tackle execution related issues [35] [36].

#### **3.3.2.3 Java**

##### **a. Source code portability**

A programming language offers the easiest and most familiar form of portability in the form of Java i.e. source code portability. A given Java program should produce similar results regardless of the underlying CPU, operating system or Java compiler [37]. Java provides more accurate semantics and leaves less up to the implementer. In Java, memory is not free until it can no longer be accessed and there is no undefined variable in this language. Java program just need to recompile and then can be executed on any platform.

## **b. OS portability**

Windows program calls to the operating system are a bit different than Macintosh and Unix programs. These calls are crucial to writing non-trivial programs, so until this portability problem is addressed, porting will remain difficult. This problem is resolved by Java's set of library functions (Java-supplied libraries like AWT, Swing, Lang) that interacts with a fictional OS and a hypothetical GUI. Every Java implementation provides libraries that implement this virtual OS / GUI. Java programs use these libraries to easily port the necessary OS and GUI functionality [37].

### **3.3.2.4 Golang**

Golang comes with very progressive and efficient libraries for various needs. For example, it is very easy to set up a web server that runs various contemporary tasks in Go. Since concurrent programming such as "new" theory is written directly in the heart of the language, Golang is very efficient on those tasks, which would be more difficult to perform in other languages [38].

Golang has strong influence and also comes with many tools that use the same format to automatically format code for all users. It is a multi-platform and multi-system language that can be used to develop applications for Linux, Windows, Mac, and other types of hardware architecture.

### **3.3.2.5 ASP.NET**

In the Visual Studio, cross-platform applications and libraries for Microsoft platforms can be built quickly using the .NET Framework Portable Class Library project type [39]. The portable class library can help to reduce the time and cost of development and testing codes. The .NET Framework Portable Class Library can be used to implement model-view-view models (MVVM) patterns and to share assemblies in multiple platforms. After building the portable .NET Framework assemblies, those assemblies can be referenced from apps that target multiple platforms such as Windows and Windows Phone.

MVVM (Model-View-View-Model) is an application pattern that separates the user interface from built-in business logic. The .NET Framework Portable Class Library Project type can be used to ensure that the resources in class libraries are accessed from multiple platforms. This project type is available in Visual Studio 2012 and targets portable subsets of the .NET Framework Class Library. Using portable class libraries ensures that the library can be accessed from desktop applications, Silverlight apps, Windows Phone apps, and Windows 8.x Store apps.

### **3.3.3 Discussion**

Most of the desktop applications are not portable and require manual installation from the user. Web applications have desktop apps which are quite portable that work with just about any computer with a decent web browser. Desktop applications need to be manually updated. Web applications are quite maintainable and are automatically updated. As the installs of client applications on desktops can be time consuming, web applications can be accessed anywhere in a more mobile friendly way. A Web-based front end minimizes installation issues. The users only need a browser. The database doesn't care whether the user is sending requests via a Windows PC, a Mac, or a machine running Linux.

Desktop applications are usually not portable and restricted to one location. In case of web-based application, if one moves from one computer to another it won't influence the interaction with web-based application. As mentioned earlier, web applications need to be installed only once while desktop applications need to be installed on each machine separately. When it comes to updates, things stay the same. Desktop applications need some space on a computer while web applications use the cloud storage. Sometimes, space on the hard drive may not be enough for an app, and improving it is inconvenient. In the past few years, web applications have become more popular. Internet connection can be found almost everywhere, and people are actively using their mobile devices for different purposes, consequently, web software development looks extremely attractive and promising. Based on the analysis of above different technologies ASP.NET and AngularJS is recommended as both provide model view controller architecture.

## **4. Analysis & Design of Proposed PENS System**

### **4.1 Proposed PENS**

ITS was charged with evaluating the current PENS system and determining its applicability to other colleges on campus for other online programs in business, Arts & Science. ITS is helping to support the sole developer of PENS with support and maintenance of the current PENS system. ITS in conjunction with CHHS is also helping graduate the PENS system to a more sustainable platform and are exploring the Build vs. Buy possibilities. With the evaluation process it is being taken into consideration that other UNCW colleges will be bringing up their Online Accelerated Programs as well and those colleges will be in need of a management system as CHHS has once they have hit a critical mass.

#### **4.1.1 Software Architecture Diagram**

The user requests are handled by the Controller. The controller contains control logic which manages user requests. The controller can be designed in C# or .NET

technologies. So, for example, our proposed PENS could have input forms and buttons that allow the advisor to view the students' data or make notes. These actions require the model to be updated, so the input is sent to the controller, which then manipulates the model as appropriate. It means to view the students' data; the controller will get the data from the SQL Server database which then sends data to the view. The view defines how the applications' data should be displayed. The View can be designed in various front-end technologies such as JavaScript, Bootstrap, HTML, CSS. In our proposed PENS application, the view would define how the list of the students is presented to the user and receive the data to display from the controller.

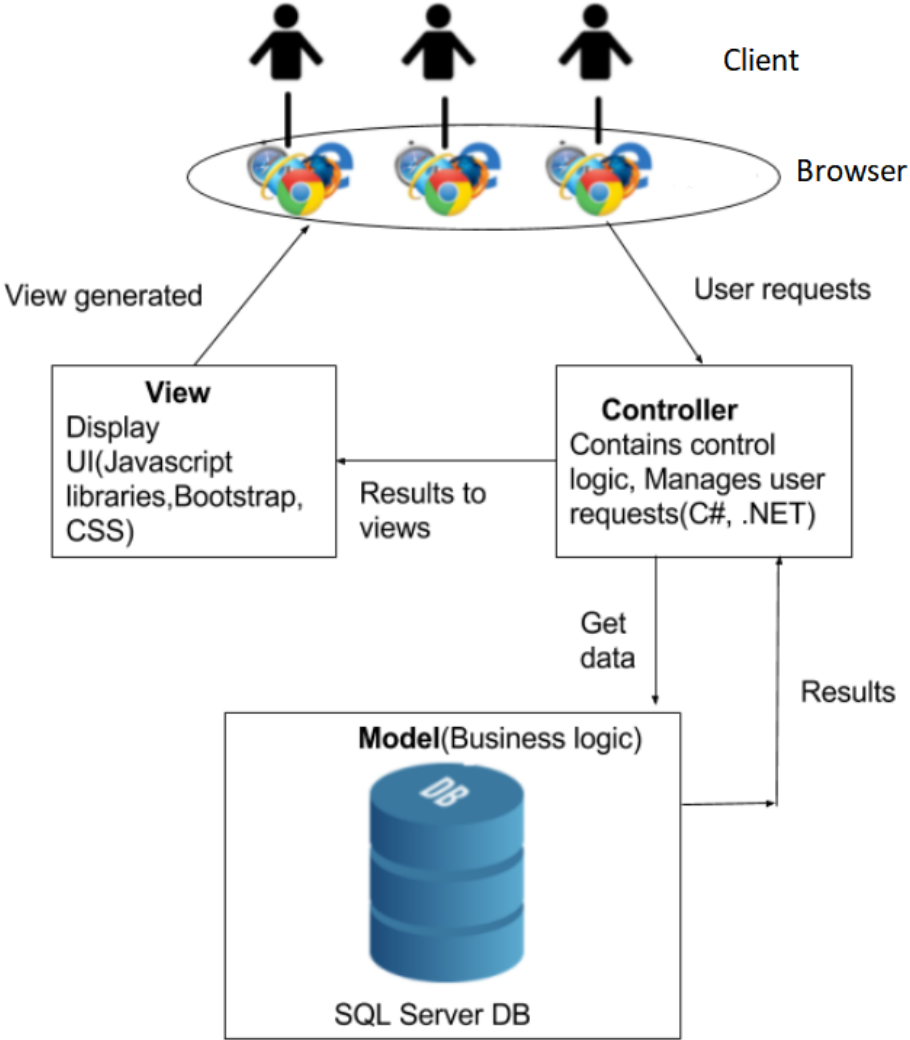


Figure 7: Software Architecture Diagram

**4.2 Discussion**

We chose MVC development [10] because of its numerous advantages.

1. MVC is a faster development process: It supports parallel and rapid development. One programmer can work on the model and other can work on view or controller that way the application can be developed three times faster.

2. It has the ability to provide multiple views: Nowadays there is a high demand for new ways to access the application and MVC development is definitely a great solution. Code duplication is also negligible in MVC development.
3. It provides support for asynchronous techniques: MVC architecture can be integrated with the JavaScript framework. It can work well with desktop widgets, site-specific browsers as well as pdf files.
4. Modification does not affect the entire model: In a web application, user interface tends to change frequently. Adding a new type of views are very easy in MVC pattern because the Model part does not depend on the views part. Therefore, any changes in the Model will not affect the entire architecture.
5. MVC model returns the data without formatting: MVC pattern returns data without applying any formatting. Hence, the same components can be used and called for use with any interface.

### **4.3 Methodology for New PENS**

We want to make the PENS more secure and more portable. As discussed earlier web apps can be faster and more responsive. In the traditional world of desktop applications, data is usually stored on the computer's hard drive. In the new world of web apps, emails and all the data are stored online on the web. We can get to it on a web browser from any computer that's connected to the Internet. We can access the web app from any device laptop, desktop, mobile or tablet. Web based applications do not depend on the environmental settings or on the hardware that usually cause problems, due to this there are lesser environmental conflicts in web-based applications.

As desktop applications are only accessible to users on desktop, they are secure. Although desktop applications are more secure than web applications, web apps can be built more secure as almost all web development technologies come with their own security features. Moreover, there are best practices to follow while implementing security features in web apps. Thus, using the cutting edge technologies such as Java, AngularJS, ASP.NET, etc. for developing the PENS as a web app would solve the issues in the current PENS. In the below image of workflow management of current PENS, it is a bit difficult to understand the navigation from one stage to another. The text area, titles, texts should be arranged in a specific layout. The use of each text area should be done properly. Since human attention is limited and we are able to maintain almost five objects in our short-term memory only at one time. Due to the limitations of short-term memory, there cannot be all sixteen stages on a single screen. The clutter should be minimal. Also, to distinguish between the information and the title, the stage title should be bold. Moreover, there is no white space anywhere in the above image.

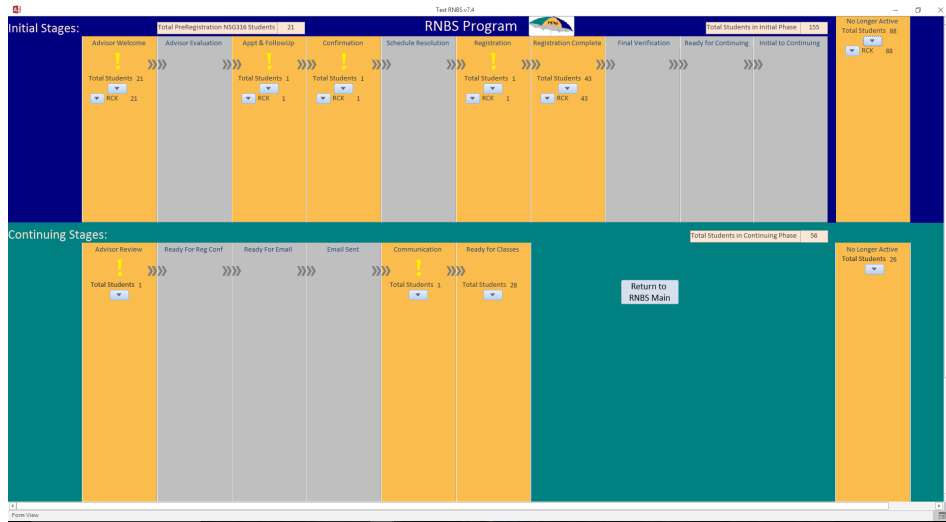


Image 4: Workflow management of current PENS

The white space is the area between the individual design elements. White Space is a great design tool for better systematic display of content to balance elements and improve visual communication experience.

## 5. Implementation for new PENS

### 5.1 Mockups for new PENS

We designed few mockups for new web-based PENS application using the Balsamiq tool. Balsamiq [40] is one of the wireframing / prototyping software tools for the desktop, web or mobile. These tools help to create click-through software prototypes. It focuses on the ideation phase, early stage, back-of-the-napkin wireframes. The mockups have been designed for few stages of the PENS workflow management.

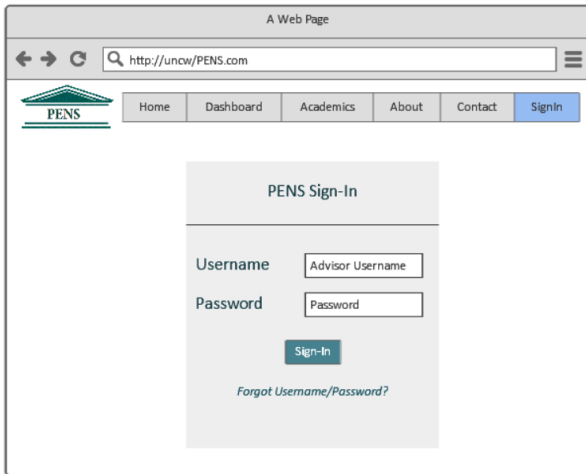


Image 5: Advisor Login

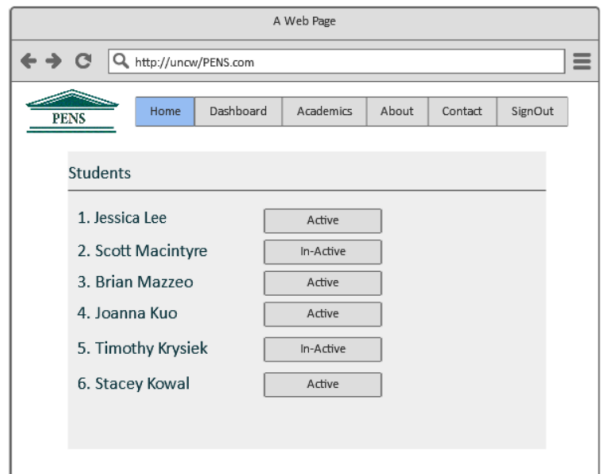


Image 6: After advisor logs in, students list will be shown along with the status

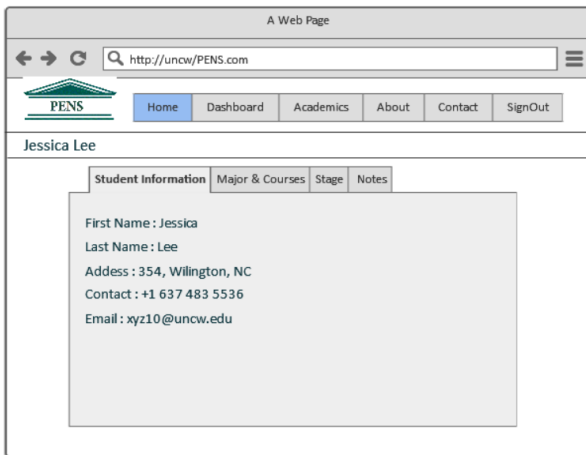


Image 7: On clicking student's name, student's information will be shown

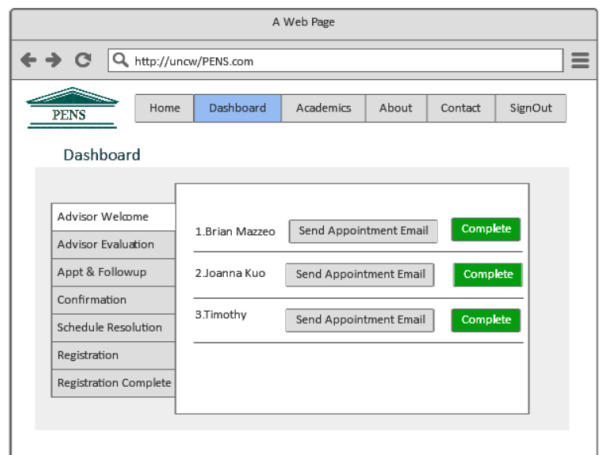


Image 8: Stage 1 (Advisor Welcome)

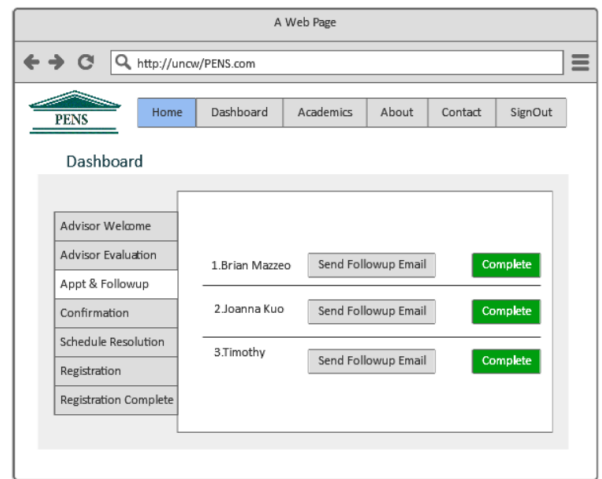
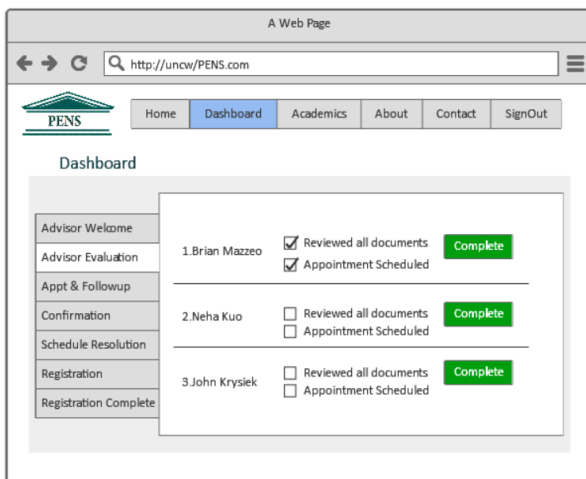


Image 9: Stage 2(Advisor Evaluation)

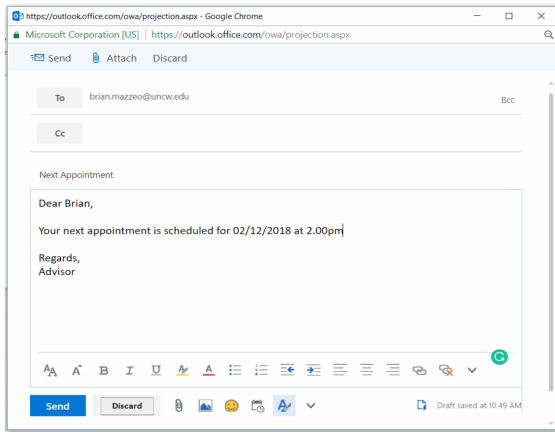


Image 11: Auto Generated Outlook Appointment Email template

Image 10: Stage 3(Appt & Follow Up)

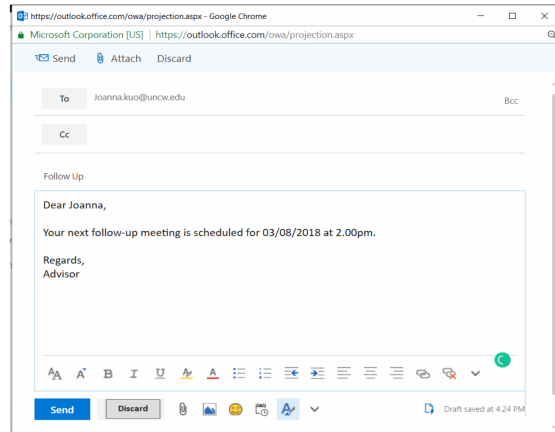


Image 12: Auto Generated Outlook Follow Up Email template

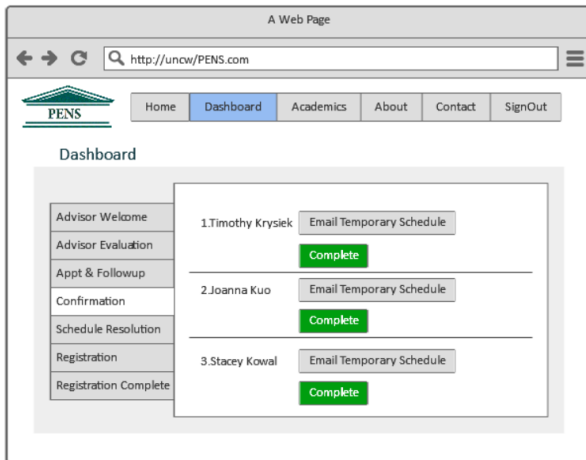


Image 13: Stage 4(Confirmation)

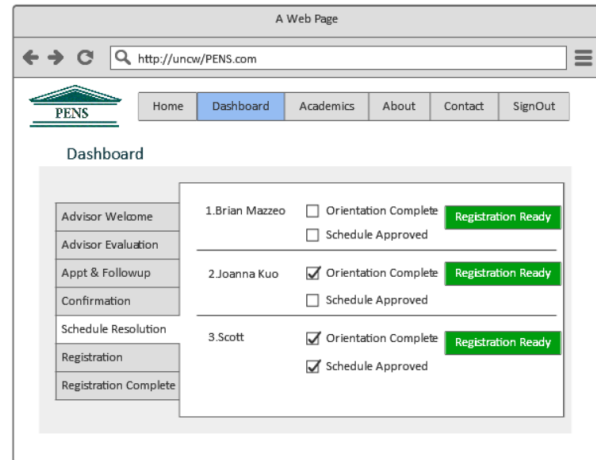


Image 14: Stage 5(Schedule Resolution)

## 5.2 Implementation

We developed a small user interface for new web-based PENS application. It is developed in the technologies such as C#, ASP.NET, Bootstrap and SQL Server. This user interface provides access to the registered Advisors. It provides the functionalities including Registration, Login, Forget/Recover Password. Once the Advisor logs in, the advisor can see the list of students and their statuses. For recovering the password, an email will be sent to the user to reset the password.

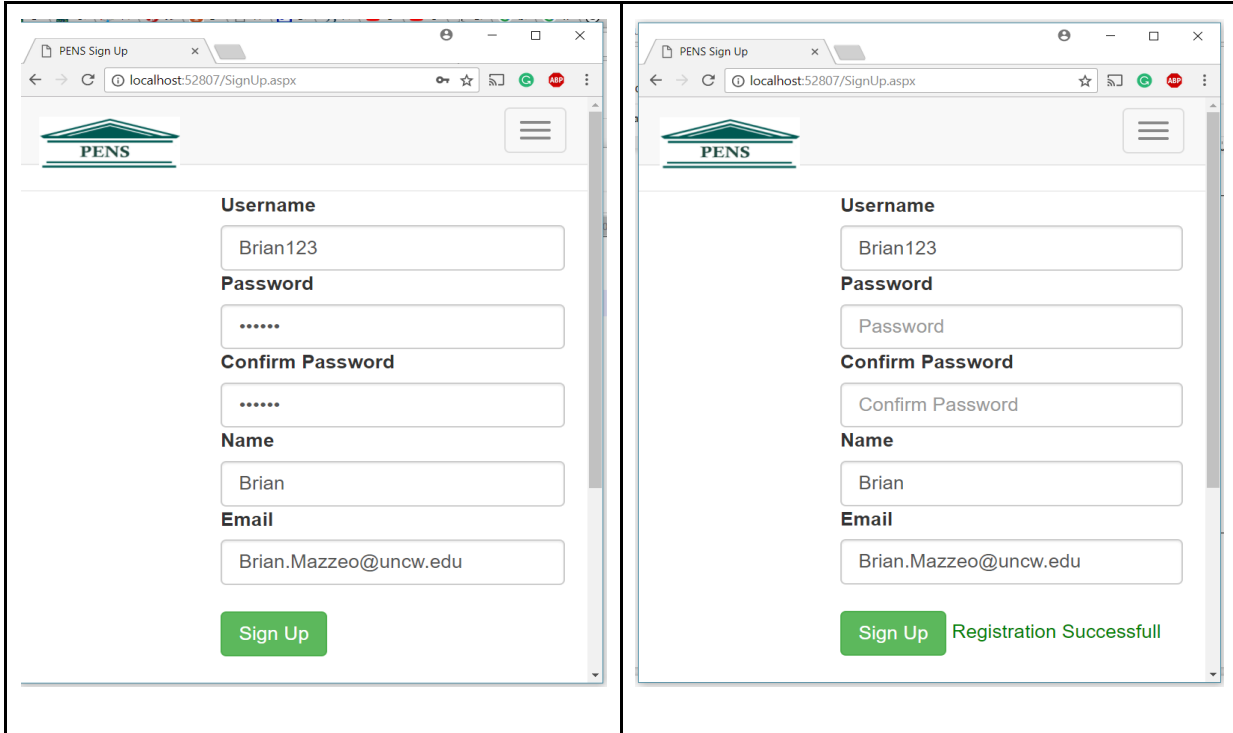


Image 15: Web Based PENS Registration Page (Mobile View)

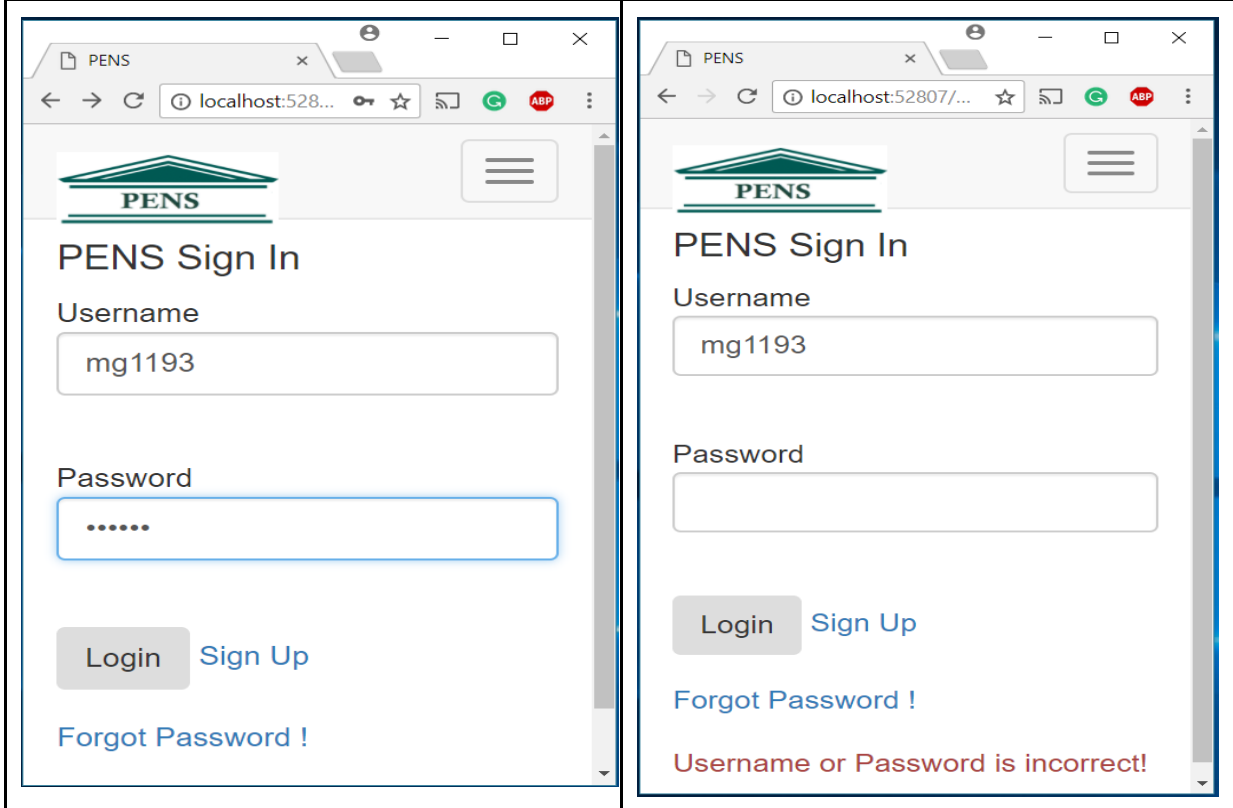


Image 16: Login Page and its validation

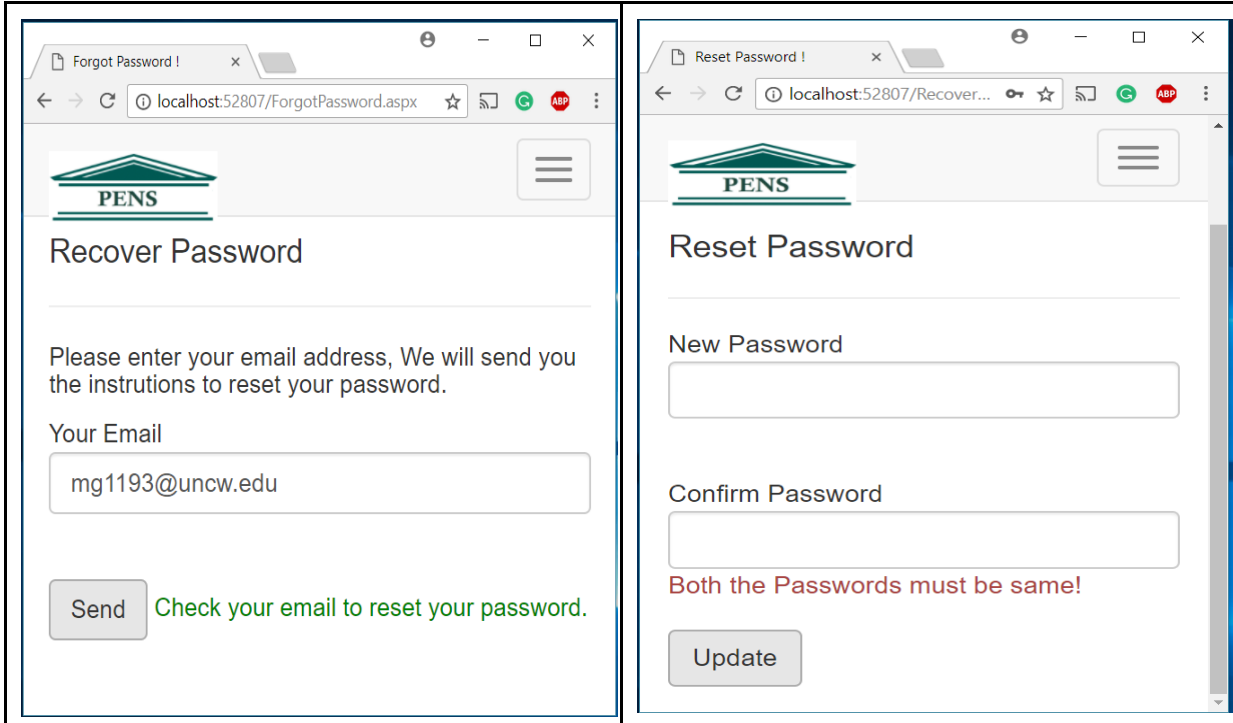


Image 17: Recover Password

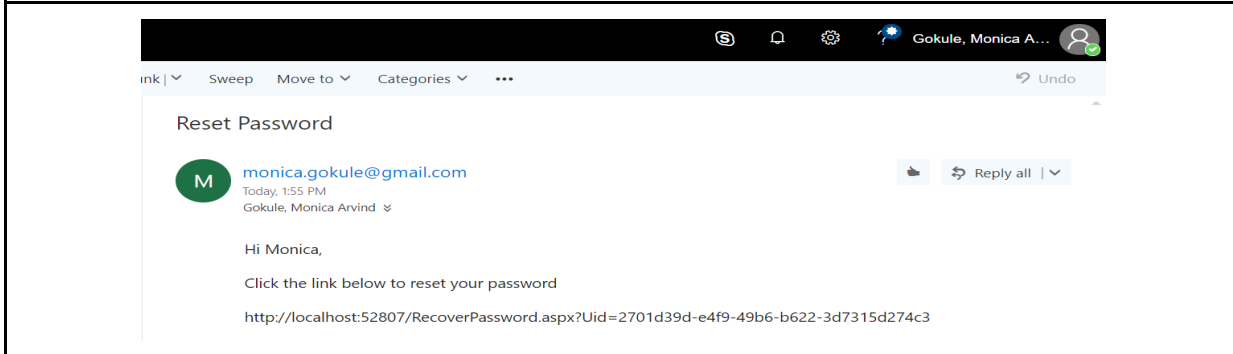


Image 18: Reset Password

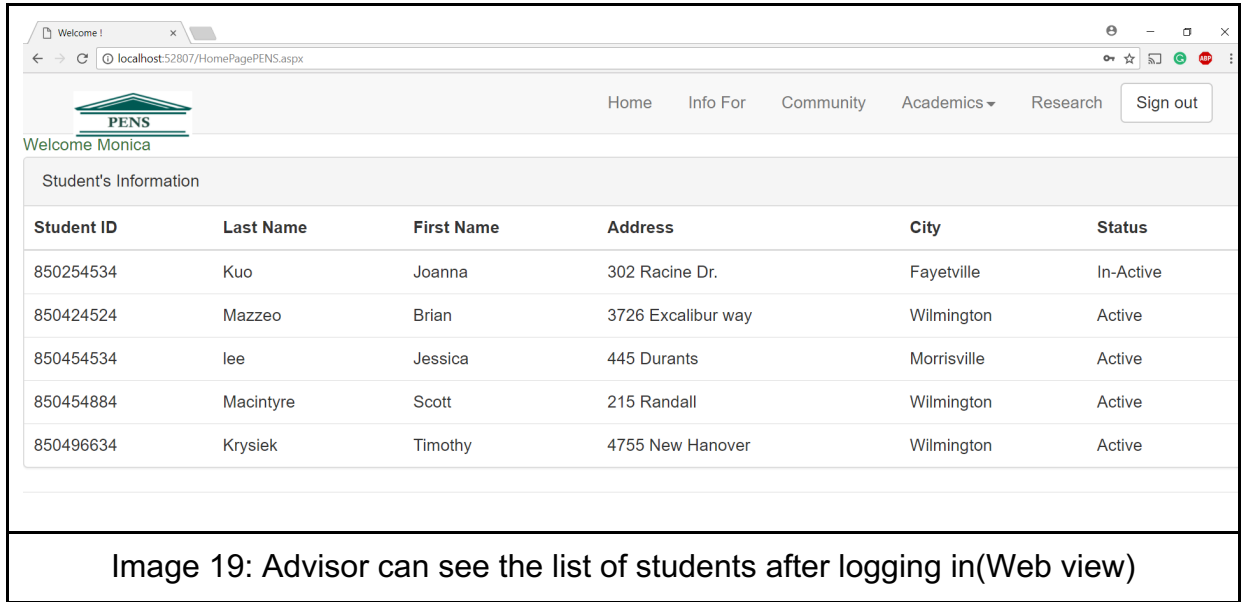


Image 19: Advisor can see the list of students after logging in(Web view)

### 5.3 Validation of the code

Validation of the implementation of the new PENS has been done using W3C Validator v1.0.6 extension tool [41] for Microsoft Visual Studio Community 2015. Also, in visual studio there is inbuilt functionality to check the accessibility.

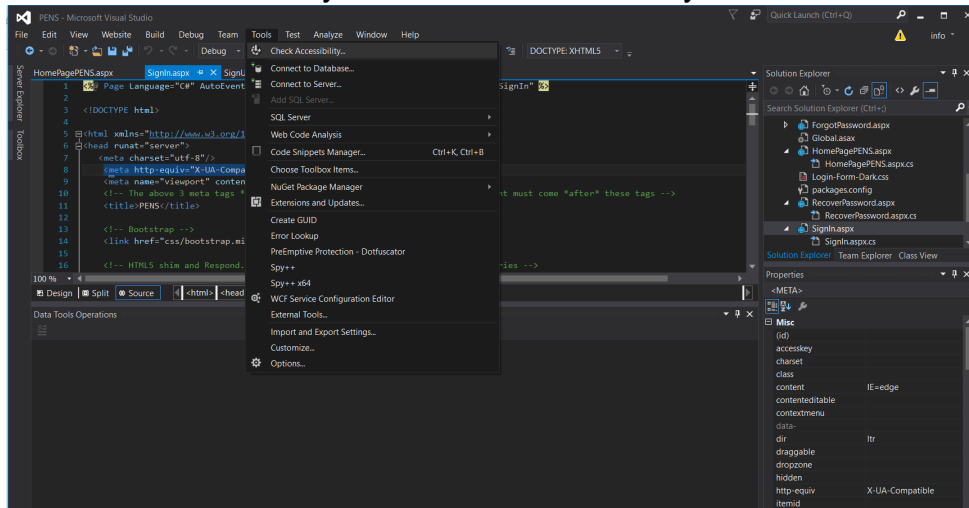


Image 20: Visual Studio has in-built option to check Accessibility

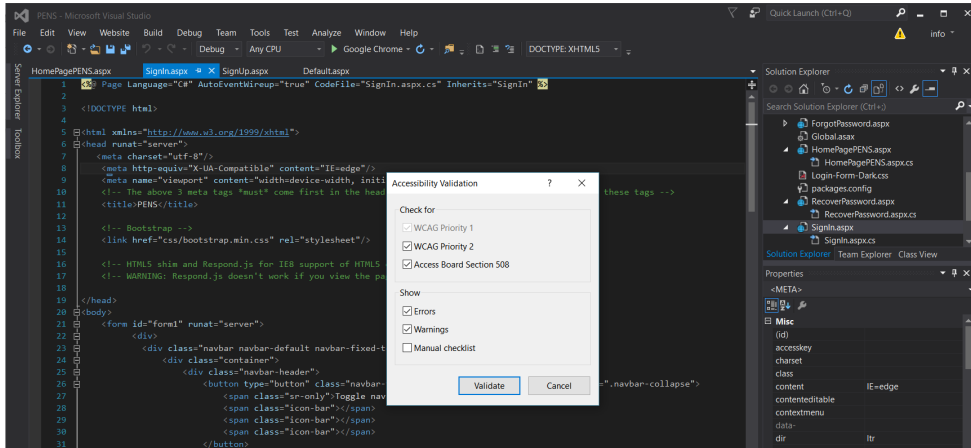


Image 21: Validate

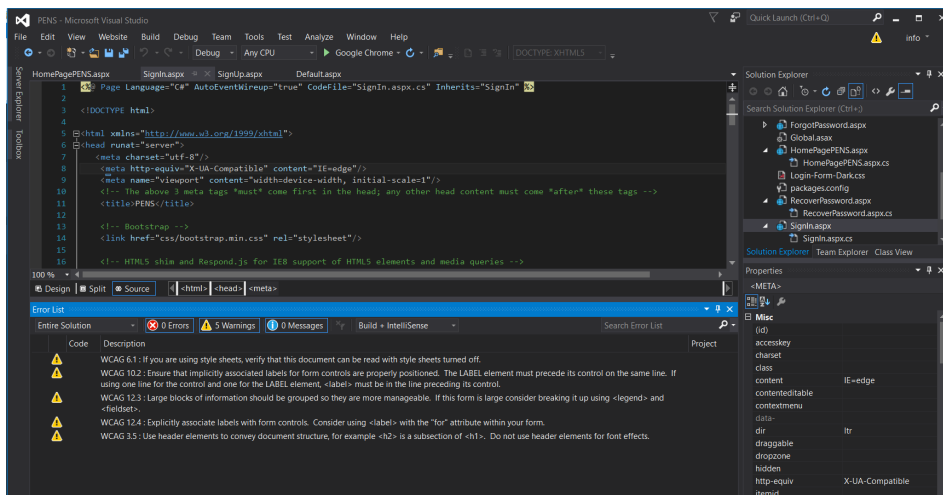


Image 22: Shows Errors, Warnings and Messages (if there are any) on validating

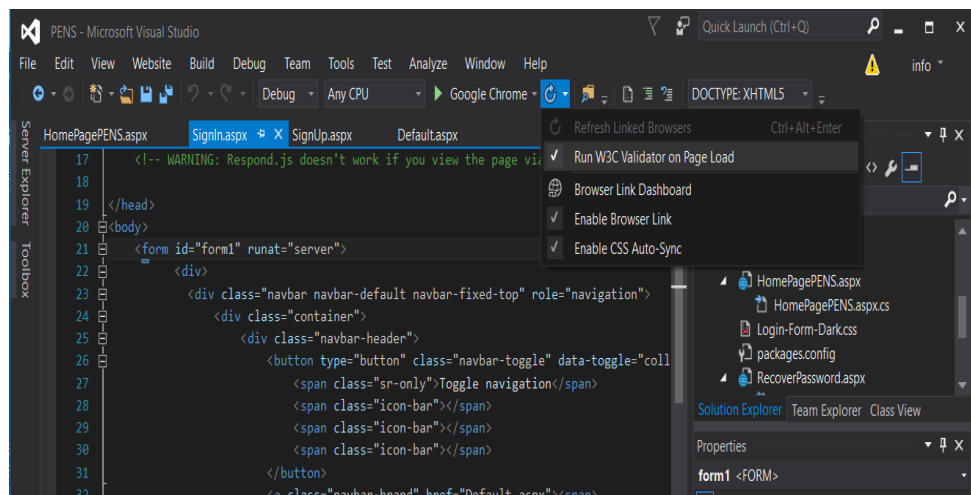


Image 23: W3C Validator runs in background on Page Load

## 6. Design Recommendations

There are many workflow automation tools available in the market. If we need workflow management and course scheduling in one software, there are off the shelf software which offers these functionalities. But if two programs do not communicate effectively, they may hinder efficiency. If we compare cost wise, off the shelf software are cheaper than building a custom software. Off-the-shelf software packages can't accomplish everything though. One of the biggest benefits of custom software development is the increased flexibility and adaptability it gives us. If we need unique features for managing workflow or scheduling of the course, it is sometimes easier to create custom solutions in proprietary software rather than trying and redesigning existing products to fit the vision. If we build our own software, we can integrate with a wide set of APIs from different software and data partners. Although, it takes a great deal of time to successfully complete the proprietary software. The recommended tools and technologies are as follows:

Front End:

- Bootstrap
- C#
- ASP.NET
- AngularJS

Back End:

- SQL Server 2014

Tools:

- Microsoft Visual Studio Community 2015

Bootstrap can be used to design the user interface that is compatible with any end device such as mobile, desktop or tablets. It is open-source front end library used for building web applications. It has HTML and CSS-based design templates for typography, forms, buttons, navigation, and other interface components, as well as optional JavaScript extensions.

The Asp.Net framework is language independent, means one can choose any programming language which best suited to the application. Asp.Net reduces the long lines of code required to develop large applications. With the built-in configuration information, it is easy to deploy.

At backend, we can use SQL Server 2014 to save our data. Currently, ITS also uses the SQL Server 2012 so migrating old data to the newest version would be straightforward if needed. Also, SQL Server is very reliable, robust and highly efficient with great security

features. Visual Studio 2015 can be used design the SQL Server database and connect our program to the database.

AngularJS framework is the latest technology which is derived from HTML and used to develop web-based application. It provides a Model-View-View–Model Architecture which is one of the contemporary web development processes. It offers Two-Way Data Binding meaning when the view changes, the model changes too and vice versa. Thus, data binding is one of the most impressive features of the AngularJS Technology. Dependency Injection is an important feature and plus point of AngularJS framework.

## 7. Lessons Learned

The first step was to analyze the current PENS system and courses like 'Software Engineering' and 'Analysis Modeling and Designing' helped me to analyze it much more efficiently. It also helped me with UML and ER diagrams of the current PENS system. The current system has 78 database tables and it was challenging to draw ER diagrams as there is no concept of the foreign or primary key in current system's MS Access database. This helped me understand the need for keys and benefits of SQL Server database.

During my internship at ITS, I learned various technologies such as Bootstrap, NodeJS, C#, ASP.NET which I was not familiar with. Bootstrap is responsive CSS that adjusts to phones, tablets, and desktops and it includes HTML and CSS based design templates for forms, buttons, tables, navigation, modals, image carousels, etc. I understood that ASP.NET has the ability to reduce the amount of time needed to code. I used these technologies to design user interface of new web-based PENS. The software architecture diagram of New PENS [Figure 7: Section 3] helped me understand the Model View Controller architecture and its advantages. The "Database Management" course in the first semester helped me in designing the database while implementing new functionalities for the new web-based PENS. Understanding the user's perspective while designing any app is important. Before designing the user interface for the web-based PENS, I referred to various books to understand the best practices of web UI design. The books I referred were

1. Web UI Design Best Practices: UI Design From The Experts [42]
2. 20 Things I learned about browsers and the web by Google chrome team [43].

The second book by google chrome team is a short guide about web applications design, their advantages. I found it intriguing and easy to understand.

Also, as a part of this capstone project, I had to conduct the survey interviews of the users/developers of the current PENS to get their feedback. Although, because of some political conflict we couldn't proceed with the interview process and we had to cancel it, and this took a lot time. I think with that additional time I could have implemented few more functionalities for the new web-based PENS.

ISO/IEC 25010 framework has been considered to measure the quality of current PENS. This framework provides a broad range of product quality characteristics along with sub characteristics which helped to decide on the quality measures of the current PENS system. For example, Portability consists of three sub characteristics such as Adaptability, Installability, and Replaceability. The quality model determines which quality characteristics will be kept in mind while evaluating the properties of the software

product. Extensive specification of the quality of software and software-intensive computer systems is an important factor in ensuring value to stakeholders. It can be achieved by defining the essential and desired quality characteristics associated with stakeholders' goals and system objectives. It is important that quality attributes are specified, measured and evaluated while using recognized or widely accepted measures and measurement methods. The quality models in this International Standard can be used to identify relevant quality characteristics that can be further used to establish requirements, their criteria for satisfaction and the corresponding measures. This framework helped in applying information about Usability & Security to the new PENS design. It also helped to gain an in-depth understanding of each characteristic and the good practices in human-centered design.

I designed mockups for the new PENS using Balsamiq tool mentioned earlier in this document. I also studied other software prototyping tools such as Bootstrap Studio, which is another powerful tool. I used Balsamiq tool because it is fast and time efficient to design the mockups, but I believe Bootstrap Studio gives more attractive user interface mockups. We have to purchase a licensed copy of Bootstrap studio to use because trial version does not provide all the features.

## 8. Conclusion and Future Work

This capstone project was aimed to analyze and evaluate the current PENS system and propose new web-based design of the PENS system. We considered ISO/IEC 25010 Product Quality Model and selected three characteristics Security, Portability and Usability to evaluate PENS system. Studied security, portability and usability features of alternative technologies such as SQL Server, MySQL, Java, AngularJS including MS Access. We did a thorough analysis of current PENS system and designed UML diagrams to understand the system inside out. We also designed mockups for new web-based PENS system using Balsamiq tool which is a great software prototyping tool. Implemented basic login features using latest technologies such as Bootstrap, C#, ASP.NET, SQL Server.

As a future work, in-depth analysis and evaluation of the current PENS system need to be done including all the workflow management stages and substages, course scheduling and admin features. There are some tools available that university is already using for example Degree Works, ImageNow, and Student Success. A thorough comparison of PENS with these tools needs to be done. Also, there are many workflow automation tools available in the market for example Process Maker, Integrify, Zapier, Process Director (BP Logics), etc. Analysis of these tools should also be done.

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43. 20 Things I Learned About Browsers And The Web by Google Chrome Team

# Appendix A

## Screenshots of the Current PENS System:

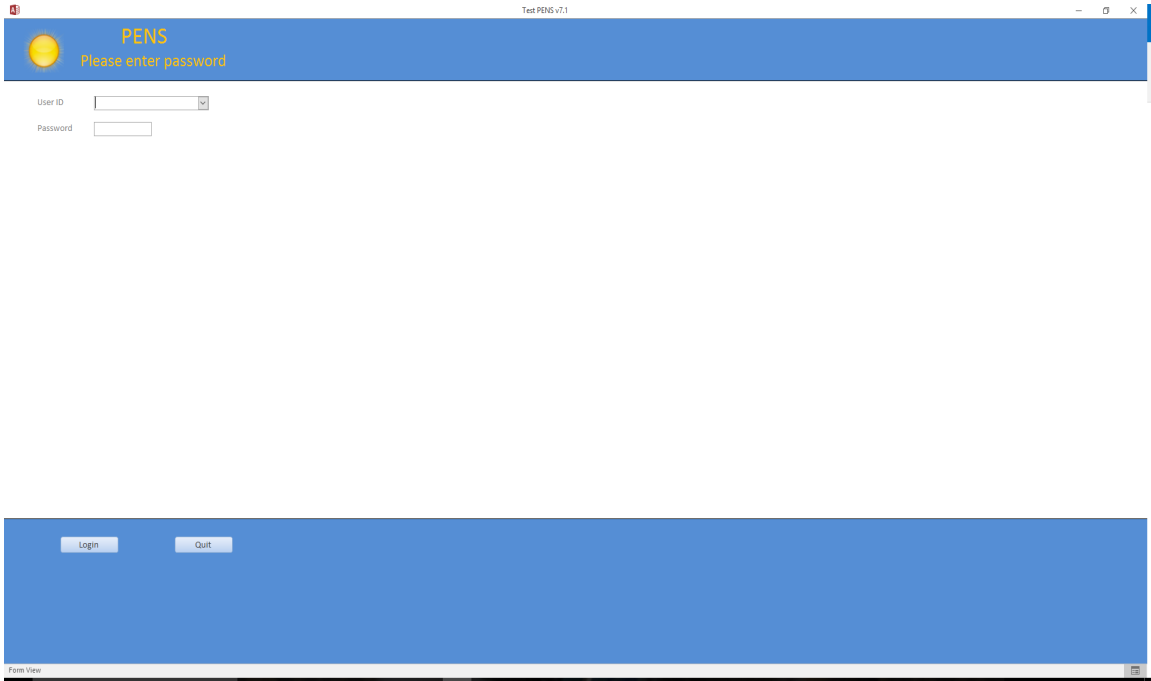


Image 1: Login



Image 2: Gateway Program Selection

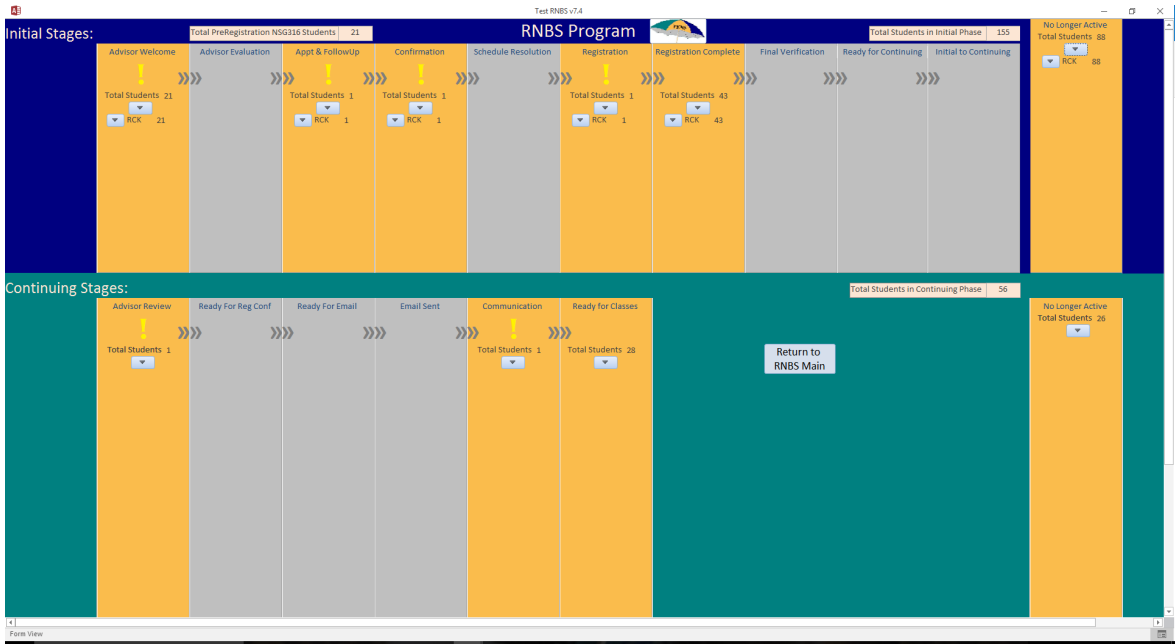


Image 3: Dashboard Advisor View

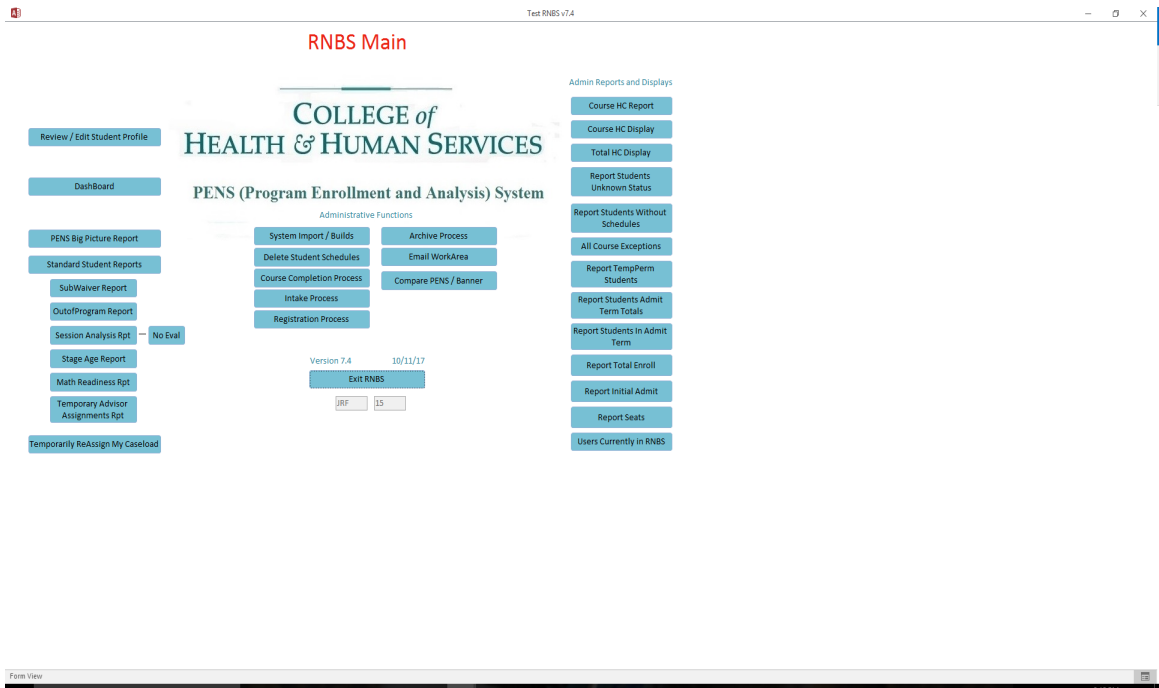


Image 4: Dashboard Admin View

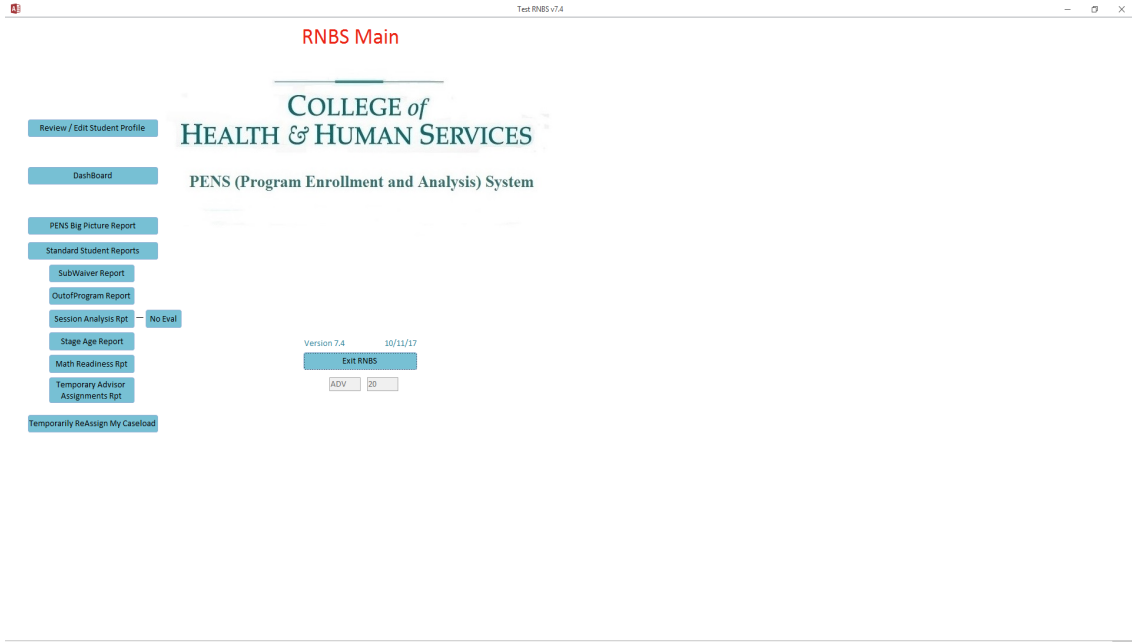


Image 5: Dashboard Advisor View

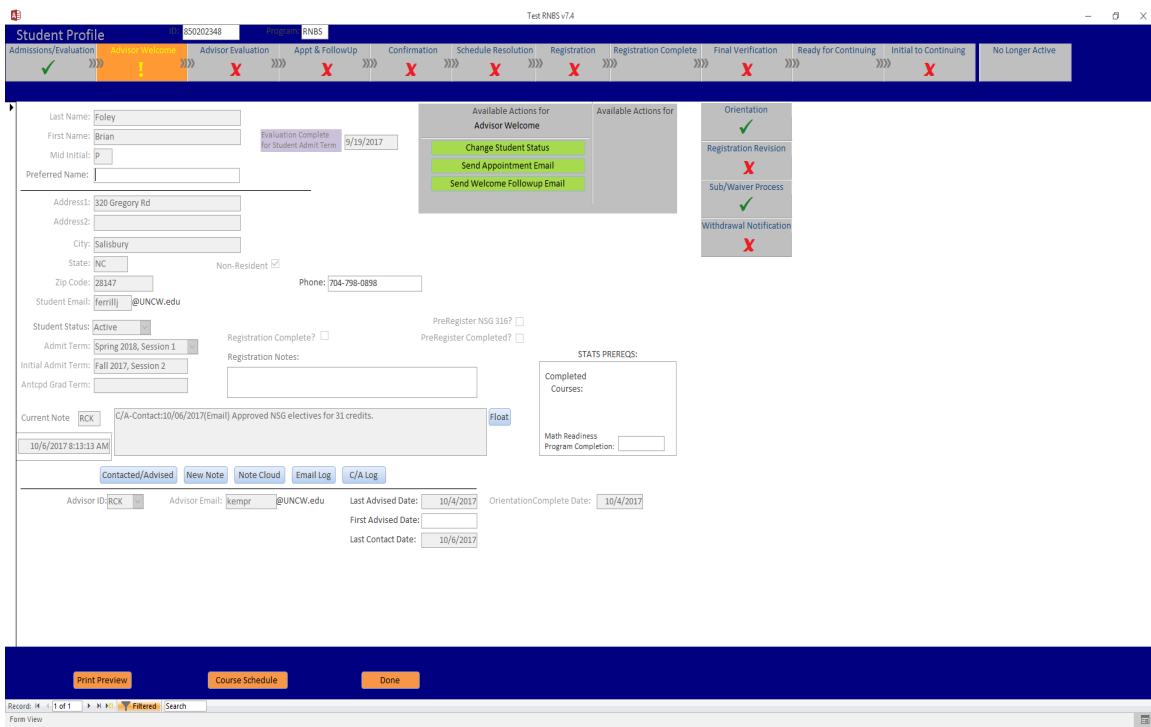


Image 6: Student Profile - Advisor Welcome Stage

Test RNBS v74

**Student Profile** ID: BS0469002 Program: RNBS

Admissions/Evaluation:  Adversor Welcome:  Adversor Evaluation:  **Appt & Followup**:  Confirmation:  Schedule Resolution:  Registration:  Registration Complete:  Final Verification:  Ready for Continuing:  Initial to Continuing:  No Longer Active:

Last Name: Jones  
 First Name: Christopher  
 Mid Initial: N  
 Preferred Name: Chris  
 Address: 135 Stamwyck Rd  
 City: Salisbury  
 State: NC  
 Zip Code: 28147  
 Phone: 252-425-5009  
 Student Email: cmj6747@UNCW.edu  
 Student Status: Active  
 Admit Term: Spring 2018, Session 1  
 Initial Admit Term: Spring 2018, Session 1  
 Antcpd Grad Term: Spring 2019, Session 1  
 Current Note: RCK: C/A-Contact:10/17/2017(Phone) Advised:10/17/2017(Phone) had appointment with him. Wants to take NSG 385 as NSG elective. Put in seat request for SP-1. once approved, send appointment email, if not wants NSG 487 as elective. 10/17/2017 2:13:34 PM  
 Available Actions for Appt & Followup: Change Student Status, Send Appointment FollowUp Email  
 Available Actions for Registration Complete: Registration Revision, Sub/Waiver Process, Withdrawal Notification  
 Available Actions for Registration Revision: Registration Revision, Sub/Waiver Process, Withdrawal Notification  
 Available Actions for Orientation Complete: Orientation, Orientation Complete  
 Stats Prereqs: Completed Courses: Math Readiness Program Completion:   
 Advisor ID: RCK, Advisor Email: kempr@UNCW.edu, Last Advised Date: 10/17/2017, First Advised Date: 10/17/2017, Last Contact Date: 10/17/2017, Orientation Complete Date:   
 Buttons: Contacted/Advised, New Note, Note Cloud, Email Log, C/A Log  
 Footer: Print Preview, Course Schedule, Done

Image 7: Student Profile - Appt and Followup Stage

Test RNBS v74

**Student Profile** ID: BS0466578 Program: RNBS

Admissions/Evaluation:  Adversor Welcome:  Adversor Evaluation:  **Appt & Followup**:  Confirmation:  Schedule Resolution:  Registration:  **Registration Complete**:  Final Verification:  Ready for Continuing:  Initial to Continuing:  No Longer Active:

Last Name: Simpson  
 First Name: Shakita  
 Mid Initial: M  
 Preferred Name: Sh  
 Address: 10000 Holly Tree Dr  
 City: Charlotte  
 State: NC  
 Zip Code: 28215  
 Phone: 704-905-4170  
 Student Email: sms8398@UNCW.edu  
 Student Status: Active  
 Admit Term: Fall 2017, Session 2  
 Initial Admit Term: Fall 2017, Session 2  
 Antcpd Grad Term: Fall 2018, Session 2  
 Current Note: RCK: C/A-Contact:10/16/2017(Email) notified that chem sub is still in process. Followed up with Seaton and Moore. 10/16/2017 8:54:02 AM  
 Available Actions for Registration Complete: Change Student Status, Registration Revision  
 Available Actions for Registration Revision: Registration Revision, Sub/Waiver Process, Withdrawal Notification  
 Available Actions for Orientation: Orientation  
 Stats Prereqs: Completed Courses: STT 210, Math Readiness Program Completion:   
 Advisor ID: RCK, Advisor Email: kempr@UNCW.edu, Last Advised Date: 9/7/2017, First Advised Date: 9/7/2017, Last Contact Date: 10/16/2017, Orientation Complete Date: 9/8/2017  
 Buttons: Contacted/Advised, New Note, Note Cloud, Email Log, C/A Log, Initial Advising Letter Log  
 Footer: Print Preview, Course Schedule, Done

Image 8: Student Profile - Registration Stage

Student Profile

Admissions/Evaluation  Advisor Welcome  Advisor Evaluation  Appt & FollowUp  Confirmation  Schedule Resolution  Registration  Registration Complete  Final Verification  Ready for Continuing  Initial to Continuing

Last Name: Burge  
 First Name: Joan  
 Mid Initial: C  
 Preferred Name: \_\_\_\_\_  
 Address1: 3412 Winterwind Cir  
 Address2: \_\_\_\_\_  
 City: Sanford  
 State: NC  
 Zip Code: 27330  
 Student Email: jcb7952@UNCW.edu  
 Student Status: Withdrawn  
 Admit Term: Spring 2016, Session 1  
 Initial Admit Term: Spring 2016, Session 1  
 Antcpd Grad Term: Fall 2015, Session 1  
 Current Note: ADN Follow up to previous note - Joan left on good terms and felt everyone was helpful - was impressed with the program.  
 Advisor ID: ADN  
 Advisor Email: nelsona@UNCW.edu  
 Last Advised Date: 11/9/2015  
 First Advised Date: 11/6/2015  
 Last Contact Date: \_\_\_\_\_

Available Actions for No Longer Active

Orientation   
 Registration Revision   
 Add/Reorder Process   
 Withdrawal Notification

Print Preview Course Schedule Done

Image 9: Student Profile - Student No Longer Active Status - not a stage

Search Students in Initial Phase

Search by ID Search by Name

Advisor Welcome

Student ID	Last Name	First Name	Mid	Address	City	St	Zip Code	Status	Evaluation Date	Admit Term	Select
850202348	Foley	Brian	P	320 Gregory Rd	Salisbury	NC	28147	Active	9/19/2017	201820A	...
850245212	Halpern	Jennifer	N	3200 Graylyn Ter	Wilmington	NC	28411	Active	10/17/2017	201820A	...
850395694	Herring	Jessica	M	440 Lassiter Rd	Newton Grove	NC	28366	Active	9/27/2017	201820A	...
850410314	Glover	Ellen	W	2125 NC Hwy 121	Greenville	NC	27834	Active	10/6/2017	201820A	...
850436155	Gardner	Amanda	D	45 Duckworth Ave	Brevard	NC	28712	Active	9/19/2017	201820A	...
850460203	Little	Veda	M	3785 Quiet Stream	Concord	NC	28023	Active	9/29/2017	201820A	...
850460331	Webb	Caitlin	J	7510 Glover Rd	Fountain	NC	27829	Active	10/2/2017	201820A	...
850462637	Page	Stephanie	D	2584 Live Oak Meth	White Oak	NC	28399	Active	9/19/2017	201820A	...
850462809	McCosh	Traci	H	535 Lakeview Dr	Mcdeville	NC	28101	Active	9/19/2017	201820A	...
850463685	Justus	Brandy	P	115 Park Ave	Southport	NC	28461	Active	9/29/2017	201820A	...
850463146	Simpson	Mehgan	A	929 Hearthridge Ct	Raleigh	NC	27609	Active	9/26/2017	201820A	...
850466321	Burkhart	Ally	O	6200 Linwood South	Linwood	NC	27299	Active	9/19/2017	201820A	...
850466517	Bledsoe	Jerry	G	1316 E Stonemason	Fuquay Varina	NC	27256	Active	10/6/2017	201820A	...
850468029	Apple	Sarah	E	2020 Eastchester Dr	High Point	NC	27265	Active	10/6/2017	201820A	...
850468300	Crawley	Joetta	B	107 Ashwood Dr	Jacksonville	NC	28546	Active		201820A	...
850468612	Price	Megan	R	213 W Elm Ave	Holly Springs	NC	27540	Active	10/4/2017	201820A	...
850468927	Farley	Laurel	B	1225 Estates Ave A1	Charlotte	NC	28209	Active	10/6/2017	201820A	...
850469558	Howell	Adnan	A	4110 Tristone Falls	Raleigh	NC	27616	Active	10/12/2017	201820A	...
850470423	Floyd	Briana	M	173 High Valley Wa	Laurel Springs	NC	28644	Active	10/18/2017	201820A	...
850470426	Gallagher	Linda	M	5117 Larkspur Ct	Wilmington	NC	28409	Active	10/18/2017	201820A	...
850470427	Walker	Danny	R	1623 Cecelia Dr	Gastonia	NC	28054	Active	10/20/2017	201820A	...

Done

Image 10: Student selection - Initial Phase for Advisor

## Appendix B

### SignUp.aspx

```
<%@ Page Language="C#" AutoEventWireup="true" CodeFile="SignUp.aspx.cs"
Inherits="SignUp" %>

<!DOCTYPE html>

<html xmlns="http://www.w3.org/1999/xhtml">
<head id="Head1" runat="server">
  <meta charset="utf-8" />
  <meta http-equiv="X-UA-Compatible" content="IE=edge" />
  <meta name="viewport" content="width=device-width, initial-scale=1" />

  <title>PENS Sign Up</title>

  <!-- Bootstrap -->
  <link href="css/bootstrap.min.css" rel="stylesheet" />
  <link href="css/Custom-Cs.css" rel="stylesheet" />
  <!-- HTML5 shim and Respond.js for IE8 support of HTML5 elements and media
queries -->
  <!-- WARNING: Respond.js doesn't work if you view the page via file:// -->
  <!--[if lt IE 9]>
  <script src="https://oss.maxcdn.com/html5shiv/3.7.2/html5shiv.min.js"></script>
  <script src="https://oss.maxcdn.com/respond/1.4.2/respond.min.js"></script>
  <![endif]-->
</head>
<body>
  <form id="form1" runat="server">
    <div>
      <div class="navbar navbar-default navbar-fixed-top" role="navigation">
        <div class="container">
          <div class="navbar-header">
            <button type="button" class="navbar-toggle" data-toggle="collapse"
data-target=".navbar-collapse">
              <span class="sr-only">Toggle navigation</span>
              <span class="icon-bar"></span>
              <span class="icon-bar"></span>
              <span class="icon-bar"></span>
            </button>
```

```

        <a class="navbar-brand" href="Default.aspx"><span>
            </span></a>
    </div>
    <div class="navbar-collapse collapse">
        <ul class="nav navbar-nav navbar-right">
            <li><a href="Default.aspx">Home</a></li>
            <li><a href="#">Info For</a></li>
            <li><a href="#">Community</a></li>
            <li class="dropdown">
                <a href="#" class="dropdown-toggle" data-
toggle="dropdown">Academics<b class="caret"></b></a>
                <ul class="dropdown-menu">
                    <li><a href="#">Undergraduate</a></li>
                    <li><a href="#">Graduate</a></li>
                    <li><a href="#">Student Success</a></li>
                    <li><a href="#">Accreditation</a></li>
                </ul>
            </li>
            <li><a href="#">Research</a></li>
            <li class="active"><a href="SignUp.aspx">Sign Up</a></li>
            <li><a href="SignIn.aspx">Sign In</a></li>
        </ul>
    </div>
</div>
</div>
</div>
<!-- Sign Up -->

<div class="center-page">
    <hr />
    <hr />
    <hr />
    <label class="col-xs-11">Username</label>
    <div class="col-xs-11">
        <asp:TextBox ID="tbUname" runat="server" Class="form-control"
placeholder="Username"></asp:TextBox>
    </div>
    <label class="col-xs-11">Password</label>
    <div class="col-xs-11">

```

```

        <asp:TextBox ID="tbPass" runat="server" Class="form-control"
placeholder="Password" TextMode="Password"></asp:TextBox>
    </div>

    <label class="col-xs-11">Confirm Password</label>
    <div class="col-xs-11">
        <asp:TextBox ID="tbCPass" runat="server" Class="form-control"
placeholder="Confirm Password" TextMode="Password"></asp:TextBox>
    </div>

    <label class="col-xs-11">Name</label>
    <div class="col-xs-11">
        <asp:TextBox ID="tbName" runat="server" Class="form-control"
placeholder="Name"></asp:TextBox>
    </div>

    <label class="col-xs-11">Email</label>
    <div class="col-xs-11">
        <asp:TextBox ID="tbEmail" runat="server" Class="form-control"
placeholder="Email" TextMode="Email"></asp:TextBox>
    </div>

    <div class="col-xs-11 space-vert">
        <asp:Button ID="btSignup" runat="server" Class="btn btn-success"
Text="Sign Up" OnClick="btSignup_Click"/>

        <asp:Label ID="lblMsg" runat="server"></asp:Label>

    </div>
</div>
<!-- Sign Up -->
<!-- Footer -->
<hr />
<!-- Footer -->
</form>
<!-- jQuery (necessary for Bootstrap's JavaScript plugins) -->
<script src="js/jquery-3.2.1.min.js"></script>
<!-- Include all compiled plugins (below), or include individual files as needed -->
<script src="js/bootstrap.min.js"></script>
</body>

```

</html>

### **SignUp.aspx.cs**

```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Web;
using System.Web.UI;
using System.Web.UI.WebControls;
using System.Data.SqlClient;
using System.Configuration;
using System.Drawing;
public partial class SignUp : System.Web.UI.Page
{
    protected void Page_Load(object sender, EventArgs e)
    {

    }

    protected void btSignup_Click(object sender, EventArgs e)
    {
        if (tbUname.Text != "" & tbPass.Text != "" && tbName.Text != "" && tbEmail.Text !=
"" && tbCPass.Text != "")
        {
            if (tbPass.Text == tbCPass.Text)
            {
                String ConnStr =
ConfigurationManager.ConnectionStrings["MyDatabaseConnectionString1"].Connection
String;
                using (SqlConnection con = new SqlConnection(ConnStr))
                {
                    SqlCommand cmd = new SqlCommand("insert into Users values("" +
tbUname.Text + ", "" + tbPass.Text + ", "" + tbEmail.Text + ", "" + tbName.Text + "")", con);
                    con.Open();
                    cmd.ExecuteNonQuery();
                    lblMsg.Text = "Registration Successful";
                    lblMsg.ForeColor = Color.Green;
                    // Response.Redirect("~/Signin.aspx");
                }
            }
        }
    }
}
```

```

        else
        {
            lblMsg.ForeColor = Color.Red;
            lblMsg.Text = "Passwords do not match";
        }
    }
    else
    {
        lblMsg.ForeColor = Color.Red;
        lblMsg.Text = "All Fields Are Mandatory";
    }
}
}
}

```

### HomePagePENS.aspx

```

<%@ Page Language="C#" AutoEventWireup="true"
CodeFile="HomePagePENS.aspx.cs" Inherits="HomePagePENS" %>
<!DOCTYPE html>

<html xmlns="http://www.w3.org/1999/xhtml">
<head runat="server">
    <meta charset="utf-8" />
    <meta http-equiv="X-UA-Compatible" content="IE=edge" />
    <meta name="viewport" content="width=device-width, initial-scale=1" />
    <!-- The above 3 meta tags *must* come first in the head; any other head content
must come *after* these tags -->
    <title>Welcome !</title>
    <script src="js/jquery-3.2.1.min.js"></script>
    <!-- Bootstrap -->
    <link href="css/bootstrap.min.css" rel="stylesheet" />
    <link href="css/Custom-Cs.css" rel="stylesheet" />
    <!-- HTML5 shim and Respond.js for IE8 support of HTML5 elements and media
queries -->
    <!-- WARNING: Respond.js doesn't work if you view the page via file:// -->
    <!--[if lt IE 9]>
        <script src="https://oss.maxcdn.com/html5shiv/3.7.2/html5shiv.min.js"></script>
        <script src="https://oss.maxcdn.com/respond/1.4.2/respond.min.js"></script>
    <![endif]-->

```

```

<script>
  $(document).ready(function myfunction() {
    $("#btnCart").click(function myfunction() {
      window.location.href = "/Cart.aspx";
    });
  });
</script>
</head>
<body>
  <form id="form1" runat="server">
    <div>
      <div class="navbar navbar-default navbar-fixed-top" role="navigation">
        <div class="container">
          <div class="navbar-header">
            <button type="button" class="navbar-toggle" data-toggle="collapse"
data-target=".navbar-collapse">
              <span class="sr-only">Toggle navigation</span>
              <span class="icon-bar"></span>
              <span class="icon-bar"></span>
              <span class="icon-bar"></span>
            </button>
            <a class="navbar-brand" href="Default.aspx"><span>
              </span></a>
          </div>
          <div class="navbar-collapse collapse">
            <ul class="nav navbar-nav navbar-right">
              <li><a href="Default.aspx">Home</a></li>
              <li><a href="#">Info For</a></li>
              <li><a href="#">Community</a></li>
              <li class="dropdown">
                <a href="#" class="dropdown-toggle" data-
toggle="dropdown">Academics<b class="caret"></b></a>
                <ul class="dropdown-menu">
                  <li><a href="#">Undergraduate</a></li>
                  <li><a href="#">Graduate</a></li>
                  <li><a href="#">Student Success</a></li>
                  <li><a href="#">Accreditation</a></li>
                </ul>
              </li>
            </ul>
          </div>
        </div>
      </div>
    </div>
  </form>

```

```

        <li><a href="#">Research</a></li>

        <li>
            <asp:Button ID="btnSignOut" runat="server" Class="btn btn-default
navbar-btn" Text="Sign out" OnClick="btnSignOut_Click" />
        </li>

    </ul>
</div>
</div>
</div>
</div>
<asp:Label ID="lblSuccess" runat="server" CssClass="text-success"></asp:Label>
<div class="panel panel-default">
    <div class="panel-heading">Student's Information</div>
    <asp:Repeater ID="rptrStudentInfo" runat="server">
        <HeaderTemplate >
            <table class="table">
                <thead>
                    <tr>
                        <th scope="col">Student ID</th>
                        <th scope="col">Last Name</th>
                        <th scope="col">First Name</th>
                        <th scope="col">Address</th>
                        <th scope="col">City</th>
                        <th scope="col">Status</th>
                    </tr>
                </thead>
                <tbody>
            </HeaderTemplate>
            <ItemTemplate>
                <tr>
                    <td><%# Eval("StudID") %></td>
                    <td><%# Eval("LastName") %></td>
                    <td><%# Eval("FirstName") %></td>
                    <td><%# Eval("Address") %></td>
                    <td><%# Eval("City") %></td>
                    <td><%# Eval("Status") %></td>
                </tr>
            </ItemTemplate>

```

```

        <FooterTemplate>
            </tbody>
        </table>
    </FooterTemplate>
</asp:Repeater>
</div>
</form>

<!-- Footer -->

<hr />

<!-- Footer -->
<!-- Include all compiled plugins (below), or include individual files as needed -->
<script src="js/bootstrap.min.js"></script>

</body>
</html>

```

### HomePagePENS.aspx.cs

```

using System;
using System.Collections.Generic;
using System.Linq;
using System.Web;
using System.Web.UI;
using System.Web.UI.WebControls;
using System.Configuration;
using System.Data.SqlClient;
using System.Data;

public partial class HomePagePENS : System.Web.UI.Page
{
    protected void Page_Load(object sender, EventArgs e)
    {
        if (Session["USERNAME"] != null)
        {
            String uname = Session["USERNAME"].ToString();
            lblSuccess.Text = "Welcome " + uname + "";
        }
    }
}

```

```

    }
    else
    {
        Response.Redirect("~/SignIn.aspx");
    }
    if (!IsPostBack)
    {
        BindStudentInfoRptr();
    }
}
private void BindStudentInfoRptr()
{
    String CS =
ConfigurationManager.ConnectionStrings["MyDatabaseConnectionString1"].Connection
String;
    using (SqlConnection con = new SqlConnection(CS))
    {
        using (SqlCommand cmd = new SqlCommand("select * from Student", con))
        {
            using (SqlDataAdapter sda = new SqlDataAdapter(cmd))
            {
                DataTable dt = new DataTable();
                sda.Fill(dt);
                rptrStudentInfo.DataSource = dt;
                rptrStudentInfo.DataBind();
            }
        }
    }
}

protected void btnSignOut_Click(object sender, EventArgs e)
{
    Session["USERNAME"] = null;
    Response.Redirect("~/Default.aspx");
}
}

```

## SignIn.aspx

```

<%@ Page Language="C#" AutoEventWireup="true" CodeFile="SignIn.aspx.cs"
Inherits="SignIn" %>

<!DOCTYPE html>

<html xmlns="http://www.w3.org/1999/xhtml">
<head runat="server">
  <meta charset="utf-8">
  <meta http-equiv="X-UA-Compatible" content="IE=edge">
  <meta name="viewport" content="width=device-width, initial-scale=1">
  <!-- The above 3 meta tags *must* come first in the head; any other head content
must come *after* these tags -->
  <title>PENS</title>

  <!-- Bootstrap -->
  <link href="css/bootstrap.min.css" rel="stylesheet"/>

  <!-- HTML5 shim and Respond.js for IE8 support of HTML5 elements and media
queries -->
  <!-- WARNING: Respond.js doesn't work if you view the page via file:// -->
  <!--[if lt IE 9]>
  <script src="https://oss.maxcdn.com/html5shiv/3.7.3/html5shiv.min.js"></script>
  <script src="https://oss.maxcdn.com/respond/1.4.2/respond.min.js"></script>
  <![endif]-->
</head>
<body>
  <form id="form1" runat="server">
    <div>
      <div class="navbar navbar-default navbar-fixed-top" role="navigation">
        <div class="container">
          <div class="navbar-header">
            <button type="button" class="navbar-toggle" data-toggle="collapse"
data-target=".navbar-collapse">
              <span class="sr-only">Toggle navigation</span>
              <span class="icon-bar"></span>
              <span class="icon-bar"></span>
              <span class="icon-bar"></span>
            </button>
            <a class="navbar-brand" href="Default.aspx"><span>

```

```

        </span></a>
    </div>
    <div class="navbar-collapse collapse">
        <ul class="nav navbar-nav navbar-right">
            <li><a href="Default.aspx">Home</a></li>
            <li><a href="#">Info For</a></li>
            <li><a href="#">Community</a></li>
            <li class="dropdown">
                <a href="#" class="dropdown-toggle" data-
toggle="dropdown">Academics<b class="caret"></b></a>
                <ul class="dropdown-menu">
                    <li><a href="#">Undergraduate</a></li>
                    <li><a href="#">Graduate</a></li>
                    <li><a href="#">Student Success</a></li>
                    <li><a href="#">Accreditation</a></li>
                </ul>
            </li>
            <li><a href="#">Research</a></li>
            <li><a href="SignUp.aspx">Sign Up</a></li>
            <li class="active"><a href="SignIn.aspx">Sign In</a></li>
        </ul>
    </div>
</div>
</div>
</div>
</div>

<!-- Sign in start -->
<div class="container">
    <div class="form-horizontal">
        <hr />
        <hr />
        <h4>PENS Sign In</h4>
        <div class="form-group">
            <asp:Label ID="Label1" runat="server" CssClass="col-md-2 control-label"
Text="Username"></asp:Label>
            <div class="col-md-3">
                <asp:TextBox ID="UserName" CssClass="form-control"
runat="server"></asp:TextBox>

```

```

        <asp:RequiredFieldValidator ID="RequiredFieldValidatorUsername"
        CssClass="text-danger" runat="server" ErrorMessage="The Username field is Required
        !" ControlToValidate="UserName"></asp:RequiredFieldValidator>
    </div>
</div>
<div class="form-group">
    <asp:Label ID="Label2" runat="server" CssClass="col-md-2 control-label"
    Text="Password"></asp:Label>
    <div class="col-md-3">
        <asp:TextBox ID="Password" CssClass="form-control" runat="server"
        TextMode="Password"></asp:TextBox>
        <asp:RequiredFieldValidator ID="RequiredFieldValidatorPass"
        CssClass="text-danger" runat="server" ErrorMessage="The Password field is Required
        !" ControlToValidate="Password"></asp:RequiredFieldValidator>
    </div>
</div>
<div class="form-group">
    <div class="col-md-2"></div>
    <div class="col-md-6">
        <asp:Button ID="Button1" runat="server" Text="Login" CssClass="btn
        btn-secondary" OnClick="Button1_Click" />
        <asp:LinkButton ID="LinkButton1" runat="server"
       PostBackUrl="~/SignUp.aspx">Sign Up</asp:LinkButton>
    </div>
</div>
<div class="form-group">
    <div class="col-md-2"></div>
    <div class="col-md-6">
        <asp:LinkButton ID="lbForgotPass" runat="server"
       PostBackUrl="~/ForgotPassword.aspx">Forgot Password !</asp:LinkButton>
    </div>
</div>
<div class="form-group">
    <div class="col-md-2"></div>
    <div class="col-md-6">
        <asp:Label ID="lblError" runat="server" CssClass="text-
        danger"></asp:Label>
    </div>
</div>
</div>

```

```

        </div>
        <!-- Sign in end -->

    </form>
</body>
</html>

```

### **SignIn.aspx.cs**

```

using System;
using System.Collections.Generic;
using System.Linq;
using System.Web;
using System.Web.UI;
using System.Web.UI.WebControls;
using System.Data.SqlClient;
using System.Configuration;
using System.Data;
public partial class SignIn : System.Web.UI.Page
{
    protected void Page_Load(object sender, EventArgs e)
    {

    }

    protected void Button1_Click(object sender, EventArgs e)
    {
        String ConnStr =
ConfigurationManager.ConnectionStrings["MyDatabaseConnectionString1"].Connection
String;
        using (SqlConnection con = new SqlConnection(ConnStr))
        {
            SqlCommand cmd = new SqlCommand("select Username from Users where
Username = " + UserName.Text + " and Password = " + Password.Text + """, con);
            con.Open();
            SqlDataAdapter sda = new SqlDataAdapter(cmd);
            DataTable dt = new DataTable();
            sda.Fill(dt);
            if(dt.Rows.Count!=0)
            {

```



```

        <span class="sr-only">Toggle navigation</span>
        <span class="icon-bar"></span>
        <span class="icon-bar"></span>
        <span class="icon-bar"></span>
    </button>
    <a class="navbar-brand" href="Default.aspx"><span>
        </span></a>
</div>
<div class="navbar-collapse collapse">
    <ul class="nav navbar-nav navbar-right">
        <li><a href="Default.aspx">Home</a></li>
        <li><a href="#">Info For</a></li>
        <li><a href="#">Community</a></li>
        <li class="dropdown">
            <a href="#" class="dropdown-toggle" data-
toggle="dropdown">Academics<b class="caret"></b></a>
            <ul class="dropdown-menu">
                <li><a href="#">Undergraduate</a></li>
                <li><a href="#">Graduate</a></li>
                <li><a href="#">Student Success</a></li>
                <li><a href="#">Accreditation</a></li>
            </ul>
        </li>
        <li><a href="#">Research</a></li>

        <li><a href="SignIn.aspx">Sign In</a></li>

    </ul>
</div>
</div>
</div>
</div>
<div class="container">
    <div class="form-horizontal">
        <h4>Reset Password</h4>
        <hr />
        <div class="form-group">

```

```

        <asp:Label ID="lblMsgg" runat="server" CssClass="col-md-2 control-label"
Font-Size="XX-Large" Font-Bold="True"></asp:Label>
    </div>

    <div class="form-group">
        <asp:Label ID="lblPassword" runat="server" CssClass="col-md-2 control-
label" Text="New Password" Visible="False"></asp:Label>
        <div class="col-md-3">
            <asp:TextBox ID="tbNewPass" CssClass="form-control" runat="server"
Visible="False" TextMode="Password"></asp:TextBox>
            <asp:RequiredFieldValidator ID="RequiredFieldValidatorPass"
CssClass="text-danger" runat="server" ErrorMessage="Please enter new password !"
ControlToValidate="tbNewPass"></asp:RequiredFieldValidator>
        </div>
    </div>

    <div class="form-group">
        <asp:Label ID="lblRetypePassword" runat="server" CssClass="col-md-2
control-label" Text="Confirm Password" Visible="False"></asp:Label>
        <div class="col-md-3">
            <asp:TextBox ID="tbConfirmPass" CssClass="form-control"
runat="server" Visible="False" TextMode="Password"></asp:TextBox>
            <asp:CompareValidator ID="CompareValidatorPass" runat="server"
CssClass="text-danger" ErrorMessage="Both the Passwords must be same!"
ControlToValidate="tbNewPass"
ControlToCompare="tbConfirmPass"></asp:CompareValidator>
        </div>
    </div>

    <div class="form-group">
        <div class="col-md-2"></div>
        <div class="col-md-6">
            <asp:Button ID="btRecPass" runat="server" CssClass="btn btn-default"
Text="Update" OnClick="btRecPass_Click" Visible="False" />
            <asp:Label ID="lblPassRec" runat="server"></asp:Label>

        </div>
    </div>

</div>
</div>
</form>

```

```

<!-- jQuery (necessary for Bootstrap's JavaScript plugins) -->
<script src="js/jquery-3.2.1.min.js"></script>
<!-- Include all compiled plugins (below), or include individual files as needed -->
<script src="js/bootstrap.min.js"></script>
</body>
</html>

```

### **RecoverPassword.aspx.cs**

```

using System;
using System.Collections.Generic;
using System.Linq;
using System.Web;
using System.Web.UI;
using System.Web.UI.WebControls;
using System.Configuration;
using System.Data;
using System.Data.SqlClient;
using System.Drawing;

public partial class RecoverPassword : System.Web.UI.Page
{
    String CS =
ConfigurationManager.ConnectionStrings["MyDatabaseConnectionString1"].Connection
String;
    String GUIDvalue;
    DataTable dt = new DataTable();
    int Uid;

    protected void Page_Load(object sender, EventArgs e)
    {
        using (SqlConnection con = new SqlConnection(CS))
        {
            GUIDvalue = Request.QueryString["Uid"];
            if (GUIDvalue != null)
            {
                SqlCommand cmd = new SqlCommand("select * from ForgotPassRequests
where id='" + GUIDvalue + "'", con);

```

```

con.Open();
SqlDataAdapter sda = new SqlDataAdapter(cmd);
sda.Fill(dt);
if (dt.Rows.Count != 0)
{
    Uid = Convert.ToInt32(dt.Rows[0][1]);
}
else
{
    lblMsgg.Text = "Your Password Reset Link is Expired or Invalid !";
    lblMsgg.ForeColor = Color.Red;
}

}
else
{
    Response.Redirect("~/Default.aspx");
}
}

if (!IsPostBack)
{
    if (dt.Rows.Count != 0)
    {
        tbNewPass.Visible = true;
        tbConfirmPass.Visible = true;
        lblPassword.Visible = true;
        lblRetypePassword.Visible = true;
        btRecPass.Visible = true;
    }
    else
    {
        lblMsgg.Text = "Your Password Reset Link is Expired or Invalid !";
        lblMsgg.ForeColor = Color.Red;
    }
}
}
}

```

```
protected void btRecPass_Click(object sender, EventArgs e)
```

```

{
    if (tbNewPass.Text != "" && tbConfirmPass.Text != "" && tbNewPass.Text ==
tbConfirmPass.Text)
    {
        using (SqlConnection con = new SqlConnection(CS))
        {
            SqlCommand cmd = new SqlCommand("update users set Password='" +
tbNewPass.Text + "' where Uid='" + Uid + "'", con);
            con.Open();
            cmd.ExecuteNonQuery();
            SqlCommand cmd2 = new SqlCommand("delete from ForgotPassRequests
where Uid='" + Uid + "'", con);
            cmd2.ExecuteNonQuery();
            Response.Redirect("~/SignIn.aspx");
        }
    }
}
}
}

```

### Default.aspx

```

<%@ Page Language="C#" AutoEventWireup="true" CodeFile="Default.aspx.cs"
Inherits="_Default" %>

```

```

<!DOCTYPE html>

```

```

<html xmlns="http://www.w3.org/1999/xhtml">

```

```

<head runat="server">

```

```

    <meta charset="utf-8">

```

```

    <meta http-equiv="X-UA-Compatible" content="IE=edge">

```

```

    <meta name="viewport" content="width=device-width, initial-scale=1">

```

```

    <!-- The above 3 meta tags *must* come first in the head; any other head content
must come *after* these tags -->

```

```

    <title>PENS</title>

```

```

    <!-- Bootstrap -->

```

```

    <link href="css/bootstrap.min.css" rel="stylesheet">

```

```

    <!-- HTML5 shim and Respond.js for IE8 support of HTML5 elements and media
queries -->

```

```

    <!-- WARNING: Respond.js doesn't work if you view the page via file:// -->

```

```

<!--[if lt IE 9]>
  <script src="https://oss.maxcdn.com/html5shiv/3.7.3/html5shiv.min.js"></script>
  <script src="https://oss.maxcdn.com/respond/1.4.2/respond.min.js"></script>
<![endif-->
<style type="text/css">
  .jumbotron{
    margin-top:30px;

    color:darkcyan;
  }
</style>
</head>
<body>
  <form id="form1" runat="server">
    <div>
      <div class="navbar navbar-default navbar-fixed-top" role="navigation">
        <div class="container">
          <div class="navbar-header">
            <button type="button" class="navbar-toggle" data-toggle="collapse"
data-target=".navbar-collapse">
              <span class="sr-only">Toggle navigation</span>
              <span class="icon-bar"></span>
              <span class="icon-bar"></span>
              <span class="icon-bar"></span>
            </button>
            <a class="navbar-brand" href="Default.aspx"><span>
              </span></a>
          </div>
          <div class="navbar-collapse collapse">
            <ul class="nav navbar-nav navbar-right">
              <li class="active"><a href="Default.aspx">Home</a></li>
              <li><a href="#">Info For</a></li>
              <li><a href="#">Community</a></li>
              <li class="dropdown">
                <a href="#" class="dropdown-toggle" data-
toggle="dropdown">Academics<b class="caret"></b></a>
                <ul class="dropdown-menu">
                  <li><a href="#">Undergraduate</a></li>
                  <li><a href="#">Graduate</a></li>

```

```

        <li><a href="#">Student Success</a></li>
        <li><a href="#">Accreditation</a></li>
    </ul>
</li>
<li><a href="#">Research</a></li>
<li><a href="SignUp.aspx">Sign Up</a></li>
<li><a href="SignIn.aspx">Sign In</a></li>
</ul>
</div>
</div>
</div>
</div>

```

```

<div class="container">
    <div class="jumbotron">
        <h1 class="display-3">University of North Carolina Wilmington</h1>
        <p class="lead">The CHHS consists of three professional schools: School of
Health and Applied Human Sciences, School of Nursing and School of Social Work.
These schools offer nationally accredited programs of study in nursing, clinical research
and product development, social work, athletic training, exercise science, gerontology,
public health, physical education and health teacher licensure, recreation therapy and
recreation, sport leadership and tourism.</p>
        <hr class="my-4"/>
        <p class="lead">
            <a class="btn btn-primary btn-lg" href="#" role="button">Learn more</a>
        </p>
    </div>
</div>
</form>
<!-- jQuery (necessary for Bootstrap's JavaScript plugins) -->
<script
src="https://ajax.googleapis.com/ajax/libs/jquery/1.12.4/jquery.min.js"></script>
<!-- Include all compiled plugins (below), or include individual files as needed -->
<script src="js/bootstrap.min.js"></script>
</body>
</html>

```

