
The paper documents the planning, design process and future implementation procedure of a video content database application for the Institute for Science Learning at the University of North Carolina at Chapel Hill. The project consisted of performing a systems analysis of the current video production process at the Institute for Science Learning; interviewing employees at the organization that will use the application most often to learn their needs in the database application; a database design; an interface design; a proposed implementation procedure to introduce the database application to the entire staff of the organization; and an analysis of future considerations in the database’s development.

Headings:

Web Interface Design
User Interface Design
Systems Analysis
Web Database
Database Management System
DESIGN AND IMPLEMENTATION OF A DATABASE APPLICATION TO STORE, ORGANIZE AND QUERY VIDEOTAPE INFORMATION FOR THE INSTITUTE FOR SCIENCE LEARNING AT THE UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL

by
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INTRODUCTION

The Institute for Science Learning (ISL) is an educational learning initiative at the University of North Carolina at Chapel Hill that is spearheaded by Department of Biology Professor Dr. Walter E. “Skip” Bollenbacher. Bollenbacher created the ISL in April 2004 to coordinate a number of educational initiatives that he had created at the university. These initiatives are designed to address the “crisis in science education” at every academic level, from high school to postdoctoral education, to promote a renaissance in science education. The ISL added a video production team to expand the mission of the Institute in September 2004. Immediately the need arose to organize the growing number of miniDV videotapes that accumulated with each video shoot the team conducted.

The current process at which videotapes are utilized for production contains a number of steps. First, tapes are used in the field by video production specialists that are employed by the ISL. Upon returning from the field, tapes are labeled according to a naming schema developed by the ISL. After they are named, they are put into a roughly organized drawer until used in production.

The purpose of this project is to create a database application that the ISL can use to organize information about each of the tapes that they use. The primary need of this database is so all of the tapes used by the ISL can be organized, documented and easily
found for current and future video productions. These tapes encompass varied content from a wide range of shooting environments and the video database will need to accommodate this variance. The database uses PHP to access a MySQL database. This database stores information not only about each tape this is used by the ISL, but also about each project that uses the tape. The database also stores information about each piece of time code associated with the tape. Processed tapes are labeled and referred to by that label in subsequent uses.

Section two of this master’s paper includes a systems analysis of the ISL including an analysis of the group using the service, analysis of the content to be included in the database, analysis of the primary and secondary users of the system and management of the database system. Section three outlines the technical considerations of the database. Section four documents design considerations of the database. Section five highlights future considerations that may improve the utility of the current application’s design.

SYSTEMS ANALYSIS

ANALYSIS OF GROUP USING THE SERVICE

The ISL is made up of a number of smaller groups that together tackle science education in North Carolina. At the high school level, the ISL facilitates the work of Delivering Edge-cutting Science, Technology, and Internet across North Carolina for Years to come (DESTINY). DESTINY is a comprehensive science education program that is two-fold. First, DESTINY provides teacher workshops and lesson plans and materials for science teachers at the high school level to better teach science to North Carolina students. Secondly, DESTINY travels around the state of North Carolina on two science buses,
named Destiny and Discovery, to provide a mobile science lab experience to students across the state. These mobile labs currently serve 95 of the 100 counties in North Carolina though they are primarily aimed at more under-privileged areas of the state where quality science education and materials is lacking, but may be in high demand.

ISL also oversees Seeding Postdoctoral Innovators in Research and Education (SPIRE). SPIRE is a special National Institute of General Medical Sciences (NIGMS) Institutional Research and Academic Career Development Award (IRACDA) program with a primary focus at a holistic approach to postdoctoral training. This approach promotes teacher training and professional development into postdoctoral education that had previously relied on research as its primary component. The SPIRE program at UNC-Chapel Hill currently contains 15 fellows; another 15 have completed the program since its inception in 1999.

The Instructional Media Group (IMG) of the ISL addresses undergraduate education. The IMG is responsible for developing and building web-deliverable science instructional modules. These modules are created in Macromedia Flash and incorporate 3-D, video and programming to provide interesting and informative science instruction. These modules are developed with the input and content creation of science professionals that work hand in hand with IMG designers to create these modules. The IMG is also responsible for creating advertising and promotional material for DESTINY and SPIRE. This material may include fliers, web sites, or commercials, among other production pieces. The video team that will primarily use this database is part of the IMG.
Finally, the Tailored Technology Research Group (TTRG) is another group within the ISL that serves in a support role similar to the IMG. TTRG provides network and computer support for the IMG, DESTINY and SPIRE as well as implementing video conferencing and technology infrastructure consultation and creation at the University of North Carolina at Chapel Hill as well as historically minority universities in the UNC-system including Elizabeth City State University, Fayetteville State University and the University of North Carolina at Pembroke.

ANALYSIS OF THE TYPE OF CONTENT STORED

Though all of the ISL’s groups perform a similar mission, the individual needs of each of these groups are quite different. DESTINY for example, may need a promotional video about their program to generate interest among state legislators while SPIRE may need their postdoctoral fellows videotaped during teaching lectures, for later critiquing by SPIRE staff. The IMG may need a brief video piece about a microbiologist to include in one of their teaching modules, while the TTRG may need a promotional video highlighting their videoconferencing capabilities. Because these needs are unique across each group, the video database will have to be at the same time both specific and broad to include the nuances of each program. Furthermore, if new groups are created by the ISL, flexibility must be included for growth and change.

The database created will be a central repository for metadata describing all of the video content that is created for the ISL. This video content will include interviews and b-roll,
raw footage and finished pieces. Any video that is shot by the ISL will be included in the database. Thus, all information included in this database is video production-specific and highly explanatory for future use.

ANALYSIS OF USERS OF THE APPLICATION

The video database is an in-house tool to help facilitate the quick retrieval of video content and is used by two distinct groups within the organization. The group that will gain the most utility from the system is the members of the IMG Video Team. Presently, the team is composed of four members. All four members are students at UNC-Chapel Hill and all four are in temporary positions within the ISL. The need, therefore, for a comprehensive web application to document tapes for the video team is timely as the members of the team will change periodically from year to year. All video team members are adept at using retrieval systems to query and return data. Two members of the team collected the majority of the video content that exists now and will be included in the system. These two members, therefore, have an added dimension to their working knowledge of the database from their past experience collecting the actual content stored.

The other group that will take advantage of the database is the rest of the ISL that actively look for ways to integrate video into their work. They, therefore, may query the database in search of usable content. Because these members also work in the Internet and information field almost exclusively, they too are adept at handling general information retrieval systems. Unlike the members of the video team, however, they are not as familiar with the content that is included in the database.
TECHNICAL CONSIDERATIONS

Many programming combinations can be used to implement the database design necessary to achieve the video database needs of the ISL. The overall goal is to create a three-tiered architecture that utilizes most efficiently the best technologies at each level to present the highest quality product. Three-tier architecture is a concept applied to client-server architecture that segments the primary components of the web application—client-side graphical user interface, application server and a database management system into individual parts. The benefit of using this architecture design is that each of the three pieces can be upgraded or changed with little effect on the other parts of the architecture.

Database interaction needs can be accomplished through ASP (active server pages) or PHP (PHP hypertext preprocessor) among others. Design of databases may be facilitated by database management systems such as Oracle, MySQL or DB2. Web sites may be designed in HTML (Hypertext Markup Language) and JavaScript or Flash and Actionscript. Careful consideration of options contributed to the technical design of this database system. Design issues include the universal acceptance of the decided upon database management system, its robustness for future development, and the desires of the system administrator for the site.

The client-side design of the web site is coded in a combination of HTML and JavaScript. Both of these languages are ubiquitous in web design and have been used and supported by all web browsers for many years. HTML is used to design the forms that the user will
manipulate to enter and edit information while JavaScript handles events selected by the user. CSS (cascading style sheets) are also be used to enable consistency for the aesthetic look and feel of the database application and to polish the overall look of the page.

PHP was chosen as the middleware option for its generous support of relational databases. PHP is also open-source and quite popular in the web database community making it a logical choice for this project. Because so many web developers develop PHP-accessed databases, a wealth of troubleshooting information and practical built-in functions ease the task of developing in this environment.

MySQL was chosen as the database management system because it is also widely supported in the web database environment and, though not as powerful as other SQL (structured query language) systems like Oracle, it fills a niche in being easy to implement in PHP. This database management system is also an open source product, which reduces costs associated with the database project. Furthermore, the system administrator for the ISL uses PHP and MySQL for other projects within the organization, so the decision to use this technology in particular was not a difficult one.

DATABASE DESIGN CONSIDERATIONS

The individual table layout of the IMG Video Database features three main tables with join tables to connect two of the larger tables. By designing the database this way, one can preserve data normalization and adhere to Third Normal Form (3NF). Maintaining
3NF is the understood standard for common database applications and works sufficiently in the context in which it is used here.

Though the ISL does not have a database for all of their video content, they do have a naming schema for their videotape labels so that tapes for projects are relatively well-organized. The schema puts primary importance in the group (DESTINY, SPIRE, etc.) for which the tape was recorded and features a number of other naming considerations. These include a short description of the project, the date the shoot took place, a subtitle or topic-specific identifier for the tape and a shoot-specific identifier that relates that tape to any other tapes shot on the same day. For example, if two tapes were used for the same project on the same day, the shoot-specific identifier for the tape may be ‘1/2’ to denote this tape was the first one used of two for that day.

In addition to the aforementioned schema, interviews were conducted of each member of the video team. Responses to the interview questions along with the schema, helped guide the number of tables and the fields that would be included in the relational database design. The interviews were the most important determinant in the layout and design of the web application since the video team will be the primary users of the system. The interviews revealed that in addition to group-specific identifiers considered in the schema, other pertinent metadata about each tape was necessary for storage in the database.
These three considerations—maintaining 3NF, following the naming schema and listening constructively to user interviews— influenced the database structure. The main tables used in this database are a tape table, time code table and project table. The project table features a project id unique identifier, producer field, project description and group that commissioned the work. The tape table contains a tape id unique identifier, project id that maps to the project id of the project table, date the shoot took place, location of the shoot, camera operator, description, camera type, aspect ratio of the video recorded, quality of video recorded, a Boolean for master copy of tape and a last dubbed field. The time code table features a time code id unique identifier, tape id that maps to the tape table, an in-point and out-point field, the type of video in the user-specified time code and a brief description field that describes what is contained with each section of time code. By organizing the tables this way, the most prominent features of the naming schema are maintained as well as new information that may be important as the database grows with use. The following is an explanation of some tables and fields that require a more thorough look at their purpose and structure.

A camera operator field was a consideration that had not been utilized in the previous naming schema. A camera operator field insures accountability about the content of the tape on a number of levels. Simple context questions can be answered quickly and efficiently if the camera operator’s name is attached to the tape being submitted. This simple addition can ease the pressure of a deadline-filled production room by attaching a name with a video quickly. If a client complains of intrusiveness or a lack of professionalism during a particular shoot, or if the quality of a tape is lacking, one need
look no further than who was operating the camera that day to know who was responsible for the situation. Though the potential for this situation is low with the present state of the IMG Video Team, the addition of this field adds an additional quality control element as new student interns join the team each semester.

The addition of a producer field is also necessary for production efficiency. Similar to the addition of the camera operator field, a producer field adds accountability in the production process. The addition of this field also provides a top-level point person for macro level questions and concerns.

A full-text description field is an important component of the database design that was impossible in the schema design. Though the schema featured a description section, the label size of a miniDV videotape prevents a thorough description of what is included on the tape. Similar to the addition of a camera operator field, a full-text description field adds a more robust account of what is included on the tape that can answer context clues and other general concerns quickly and efficiently.

Camera type is another important consideration that was not implemented in the schema design but is implemented in the design of the database. The IMG uses three video cameras to record their video content. The primary camera is a Sony PD-170, a 3-CCD (charge-coupled device) camera. Though an explanation of CCD is unnecessary in this context, most higher-quality miniDV video cameras are 3-CCD. This camera was purchased in March 2005 and is the newest of the cameras that the IMG uses. The two
secondary cameras used by the IMG are a Canon XL-1, 3-CCD, that was purchased in 2000, and a 1-CCD Sony TRV-20. The Canon XL-1 and the Sony TRV-20 are secondary cameras for different reasons.

Because the Canon XL-1 was purchased five years ago, the video quality of the images the camera captures are in decline because of both the age of the camera and general wear and tear of its constant use. The Sony TRV-20, on the other hand, is a 1-CCD camera that does not produce images at a quality comparable to either the Sony PD-170 or the Canon XL-1. This camera was purchased in 2004 and is considered consumer-grade, not appropriate for the quality of video that the IMG now produces. Apart from the actual circuits used inside the camera, general quality issues exist in video camera manufacturers. Sony’s professional-grade cameras, in the experience of the video team, shoot higher quality in low light based upon the lens package the Sony PD-170 uses. Canon XL-1’s, on the other hand, shoot somewhat poorly in low light.

These considerations are of paramount importance as the production of video projects move forward and for the use of previously used tapes after the fact. Camera type, along with the aforementioned description field, can let a video editor know if the tape that they are supposed to use will be appropriate for the editor’s needs. For example, if a Canon XL-1 was used in very low light, it may not be appropriate for a professional quality production and need to be filmed again at a later date. Likewise, if b-roll (filler footage) is needed from a tape that the video editor is not familiar with, he or she can look at the
camera used for the footage to help in their consideration as to whether or not the footage could be used.

Aspect ratio and video quality, similar to camera type, are necessary fields to document the quality of each tape for future considerations. A corollary to the five main components of the naming schema, the schema states that aspect ratio is to be set at 4:3 and video quality is to be set at 60 min. SP or DVCAM. These two settings can be changed on each of the three cameras used by the IMG, but the highest quality video is recorded at 4:3 and 60 min. SP or DVCAM. These settings insure continuity and quality throughout all the video recorded. This standard, however, was not always in place. Some of the tapes that will be included in the database were recorded at 16:9 (widescreen) aspect ratio or in 90 min LP mode. These settings, much like camera type, can compromise the quality of the footage and become a flag to a video editor as to whether or not the footage is appropriate to be utilized.

Just as DVD video has eclipsed VHS tape as the home viewing media of choice, it is possible that the miniDV standard that is the most common and popular format presently, may wane as recording technology improves. In addition, one need look no further than highly used VHS tapes to see how videotape can degrade with heavy use. The addition of a Boolean to denote the master of a tape and the “Last Dubbed Date” field helps to keep the format of each tape up-to-date with a visual reminder of the tape’s relative age.
Digital video editing programs rely on time code (synchronized running time) for each videotape to let the editor know at what point on a tape a relevant event occurs. This is important not only for digitizing the most appropriate content efficiently, but also for efficient editing. Time code documentation is done in the digital video editing program but must be completed on paper or not at all while shooting in the field. Adding a time code table to the database enables a user of the database to search for individual points on any tape and return results. The time code table, though it will replicate what is already done in the digital editing suite, will be maintained well after a specific editing project is complete and will serve as a record for efficient retrieval in the future.

**INTERFACE DESIGN**

**DESIGN PHILOSOPHY**

The predominant theme in creating the interface design for this web application was a step-based approach in data entry and an open approach to searching. By segmenting and creating a slower flow of data entry, the hope is that data integrity will be better preserved. Conversely, searching any database should be an effort-free task. Making the task effort-free insures that the database will be used often for the purpose in which it was intended.

The segmented approach is applied to this database in a number of different ways. First, account management and user access is divided among administrators, editors and general users. The administrator of the database will only be responsible for analyzing user logs and optimizing the database by creating indexes and dynamic field entry
components. Editors, on the other hand, are responsible for adding tapes to the database and editing content as they see fit. Generally, the editors of the database will also be members of the video team. Finally, general users will be able to access the database for simple searches of content. Predictably, an administrator or editor will have more options than a general use for manipulation of the database. These options will be determined based upon the login of the user.

This database is also segmented in the screens that an administrator, editor or general user navigates as they use the application. Each one prepares the user for the next one they will encounter. When anyone attempts to access the video database, a login screen will first appear. Upon proper authentication, a user can work with the database. If an administrator or editor accesses the site, their successful login will present them with a number of administrative and general searching options for the site. General users, on the other hand, will be presented with a much smaller palette of options. Administrative and editors’ choices include three path options in a coherent navigational structure. These appear in the center of the screen and the topmost selection will be a link for “Search Video Database.” The second link is “Add Tape/Time code” while the third and final link is “View All Entries.” “Search Video Database” is the most prominent of the links because, after the backlog of current tapes is entered into the system, the most common usage of the site will be searching for pertinent tapes.

The search interface, unlike the “Add Tape/Time code” features a simple presentation. If an administrator, editor or general user clicks on “Search Video Database,” they will be
presented with one search field and an accompanying submit button. Another link on the search page is labeled “Advanced Search,” and takes the user to a more in-depth searching engine. A user can enter whatever descriptive content they desire and then press the submit button to return results. The search works by initiating a select statement that will search for the submitted string against a number of fields included in the database. The field in which they occurred will order the results. For example, if a user types the word “DESTINY” into the search field, the returned results would display the results that featured “DESTINY” in the long description followed by results that featured “DESTINY” as a group in the ISL, followed by “DESTINY” as a word contained in the time code descriptions, etc. The most important returned result, however, is the tape number that corresponds to each result. This number will tell the searcher which tapes hold the information they may be looking for. Each result will only be a partial description of the total entry for that tape. As mentioned previously, many fields are included in this web application; a link is included next to each result that will take the user to a full record. Administrators and editors will also see an “Edit” link next to each result so they can edit content as needed.

The “Advanced Search” option takes users to a more complex search mechanism that features multiple data entry windows and a number of select box menus that help lead to the information requested. The results returned, however, will have the same look and feel as the “Search Video Database” approach and feature view links for general users and view and edit links for administrators or editors.
The “Add Tape/Time code” feature is only available for administrators and editors; general users will not have access to this component. This section of the database, as the name implies, will be the platform through which administrators and editors can add content to the database. Clicking on this link brings a user to an Add Tape form, which features a myriad of input text boxes, select boxes and Boolean selections.

Once an administrator or editor has completed filling out the form, pressing the submission button will accomplish three distinct tasks. First, the selections on the form will submit a SQL query to both the tape and project tables. Secondly, a unique tape id will be assigned to contents of the form submitted. Finally, a new page will generate for time code entry. On this page, administrators or editors can enter a single time code in and out point, type of content descriptor and a brief description of that part of the tape. Once that information is completed, an administrator or editor can submit that time code and enter another time code entry, or complete their submissions for that tape. The tape id identifier is submitted with each in and out point for the time code for proper term matching in later searches. Also found on each time code entry page is a statement and presentation of the tape id identifier to physically label the videotape for storage. The administrator or editor can then begin the process of adding a tape again by starting over at the first selection screen.

The “View All” link produces a dynamic page that features all of the content in the database with a structure much like general search results. The process by which this page is generated is essentially the same as a search but returns every field in the database
instead of a user-specified set. This process is generally taxing for database systems but
given the infancy of the database and the low number of tapes that will have their
information entered, this process should not be problematic. As the database grows,
however, it may become unwise to offer this feature and it may need to be removed.

**DATA INTEGRITY**

Data integrity is always a major concern when creating database applications, which a
large number of users will use, whether they are experienced in entering data and using
retrieval systems or not. For this reason, data integrity was maintained through every
level of the database application’s design. One way in which data integrity was preserved
is through the use, on the client-side, of select boxes to narrow content options. An effort
was made to analyze every instance in which the data being entered was confined to a
small set of options, and only those options were offered for selection. By only offering
those options, data integrity concerns like spelling errors and capitalization are quickly
and easily remedied.

The ‘Project Producer’ field is a quality example of the benefits of this approach.
Presently, the ‘Project Producer’ field contains the first and last names of ten employees
at the ISL. Some have already left the organization while others are still employed there.
Presently, only these ten names are qualified as project producers. To manually enter the
name of the project producer for every tape that is entered is a recipe for inconsistency.
Names can easily be misspelled. Misspellings, though they can be handled in search
systems, can be avoided all together with the use of a select box that limits data entry
choices to only qualified options. This philosophy was applied to the ‘ISL Group,’
‘Camera Type,’ ‘Camera Operator,’ ‘Aspect Ratio,’ Recording Type,’ and ‘Project’ fields
in addition to its application on the ‘Project Producer’ field.

The ‘Shoot Date’ and ‘Last Dubbed Date’ fields are another opportunity to exercise data
integrity constraints to achieve consistent addition and retrieval of data that operates on
each layer of the three-tier architecture applied to this project. Unlike the select boxes
aforementioned, the decision was made to not use select boxes for date and instead use a
general data entry procedure. In MySQL, a consideration exists for date. In the tape table,
therefore, a date field exists which types the content entry at YYYY-MM-DD, the proper
form for MySQL’s date type. Though the MySQL component of the data entry equation
was satisfied with the date field typed for date, there is no guarantee that data will be
entered into that field appropriately. A number of other checks are needed to insure that
consistent data is being entered. The hope is that an administrator or editor will
effortlessly enter content such as 2005-11-18 when completing the ‘Shoot Date’ or ‘Dub
Date’ rather than 11-18-05 that will not map appropriately to the MySQL database.

The middleware option for checking for appropriate data entry is by using PHP to check
the entered content for regular expressions. Regular expressions are elaborate matching
patterns that can be applied to any field in a form application to test the entry contents to
a predefined format. The format applied to the two date fields, predictably is YYYY-
MM-DD. Upon submission of the form, a PHP script tests for the appropriate format and
returns a Boolean for approval or disapproval.
On the client-side of the design, JavaScript can also test for regular expressions, another check on the input that a user may enter. Code can be applied to the entry of the two date fields to accomplish this task. JavaScript regular expression checking works similarly to its PHP counterpart. Upon submission, the entry can be tested against a predetermined matching pattern to test its integrity. Additional JavaScript code can be added to explain to the user that they entered their information inappropriately. This is achieved through the use of innerHTML, a function of JavaScript that allows text to be written dynamically in a web document. Upon an inappropriate entry’s submission, dynamic text is written below the instruction section at the top of the document warning the user to enter the date in the correct format.

Perhaps the easiest way to achieve this integrity on the client-side is through the instructions that accompany the tape entry portion of the data entry procedure. They instruct the user to enter data into every field as appropriate and to adhere to the YYYY-MM-DD constraint. In addition, below the two date fields the format, YYYY-MM-DD, is again noted. By using a combination of methods to test for error correction, data integrity was maintained at all three tiers of the database application’s design.

**USABILITY ISSUES**

Function and usability is always a concern when creating any interface and the thought process and design of this web application was no different. A number of usability
questions arose during the creation of the web application that were answered with careful attention to detail and design.

Proper navigation through the web application was the first issue tackled during the application’s development. As aforementioned, once user authentication is assured, each specific type of user, administrator, editor or general user, receives a different first page in which to make their navigational choices. These links on the page are the only navigational elements present and are identified so by a visual change upon rollover by a user’s mouse. This rollover change was created by the use of CSS along with HTML to display the link change. Users generally understand that a segment of text is a link if it has an underline or exhibits a color change or other visual change upon rollover.

Subsequent navigation in form submission is achieved through the use of traditional form element buttons. Form element buttons were used instead of CSS-altered links at this stage to exhibit to the user that the navigation choices are made in relation to the database itself, not a typical page changing link. All form buttons are labeled more specifically than simply “Submit” and “Reset” as is often seen in forms to better explain the action that the user will invoke by clicking the button.

Another way that proper usability is maintained is through the inclusion of thorough instructions during each step of the “Add Tape/Time code” and “Search Video Database” processes. In the “Add Tape/Time code” page, detailed instructions explain exactly what the administrator or editor should do to submit information about a tape appropriately.
Each field is labeled properly to denote its purpose. Input text boxes feature label information above the box and select box instructions are contained in the default option choice on the box. During the edit process, the identification of each select box is located above the box much like the input text boxes. Each box label is capitalized and in bold to denote its importance. Similarly detailed instructions accompany the “Search Video Database” page.

The addition of JavaScript error correction is another way in which the user is made aware of the action they are taking and data integrity is preserved. This is achieved through the same process as was outlined previously concerning the data integrity of the “Shoot Date” and “Dub Date” fields. JavaScript’s innerHTML feature is applied to each field. If a field is left blank or inappropriately entered as in either date field case, a warning message appears below the instructions that advises the user to fill out the form correctly. This warning is bulleted to differentiate it from the regular instruction text that appears at the top of the screen.

Though many usability, function and data integrity elements must be considered in the design of a functional web application, aesthetics can still be achieved. A challenge in this web application was the placement of the select box submission options for the “Add Tape/Time code” page. This form features seven different select boxes of varying widths and with varying height when open for selection. In addition to placing these seven select boxes; three input text boxes are included along with a Boolean checkbox and a “Description” text area box. Another consideration was to keep all of the form elements
for a tape on one page without scrolling. The proper design of the tape entry page served as the guiding hand for all of the design decisions made throughout the rest of the application.

The thought process for the initial design of the page was to give all the selection options a uniform appearance by arranging all of the input elements together on the page with the same color scheme and formatting applied to each. To maintain this uniform appearance, a light gray color was applied to the background of the entire input area to visually display this uniformity.

This design placed the input text box elements on the left of a table on the screen while the select box options were placed on the right side of the table. Instructions were included at the top of the page. The entire table was created with a width of 600 pixels. The most common monitor resolution for computer monitors is 1024x768 followed by 800x600. A width of 600 pixels satisfied both common resolution sizes and kept the application compact and useful on a crowded desktop. The table contained two columns; each row had a height of eighty pixels to give vertical space to each of the select boxes since they were placed together in a vertical plane. The input text boxes were placed flush left while the select boxes were centered in the middle of their column. The “Proceed to Timecode Entry” button that takes the user to the time code entry section of the tape addition process was placed flush right at the bottom of the page to show movement and tell the user that there was more to the tape addition process.
Flow through the form was an immediate issue upon analyzing the form’s initial design and through interviews conducted with video team members. Though the seven select boxes were located together on the right side of the page, project-related select boxes were located at both the top and bottom of the page. Furthermore, the application’s compact design compared to all the elements that were required for the form crowded all of the elements together on the page. This confusion was alleviated in the final design of the interface by both the placement of items and the colors used.

The final design of the interface keeps all of the original elements of the form, yet places them differently on the page for a more consistent appearance. First, the table’s look and feel was overhauled with the addition of a header image and new color options for the form itself. Because many different members of the ISL will use this application and the information within the database is pertinent to each of the ISL’s groups, the style for the form was adapted from the official web site for the ISL. The header image used at the top of the form is the same one used for the top of the ISL web site. The color choices used in the form, various shades of blues and grays, were also taken from the design of the official web site.

Following the establishment of the look and feel, the table’s width was extended to 778 pixels in width, 178 pixels more than the initial width of 600 pixels. This resolution is the largest value that can be used that still accommodates the 1024x768 and 800x600 standards before enabling horizontal scrolling. The initial goal to keep the form compact was abandoned in favor of spacing all input data appropriately on the page.
Instructions for the page remain at the top of the screen below the image header. An additional instructional element was added that informs the user how far into the tape entry process they are at the point in which they encounter the form. This additional instruction is another simple reminder of the entry process’s length.

The new design divides the project-specific information and the tape-specific information into separate sections on the page. This is achieved through form input placement, along with design color choices and through proper labeling of each section. Project-specific information is placed together below the instructions. These elements include the ‘ISL Group,’ ‘Project Producer’ and ‘Project’ select boxes. The previous concern with the visual height of these boxes when selected is alleviated by placing these elements beside each other in a row instead of in a vertical line on the right of the page. Placing project-specific information first maintains the most important feature of the original naming schema, the ‘Group’ descriptor. In addition, the color of the entire project section of the submission form was changed to adhere visually to ISL style and to separate itself from the tape-specific portion of the form.

Tape-specific information is organized similarly to project-specific information. Because the “Description” field is so large in relation to the input text boxes for the other entries, it takes up the most visual weight with its location on the left side of the form. “Shoot Date,” “Location,” “Master?” and “Dub Date” reside just above the “Description” field. Placing the select boxes that accompany tape information at the bottom of the form and
in a row above the “Proceed to Timecode Entry” button accommodates the vertical height of these boxes when selected and does not interfere with any other input element. Much like the project-specific section, tape-specific inputs feature a different background color to separate them visually on the page.

These design considerations are echoed throughout all of the other pages in this web application through the use of CSS. Using one style sheet to describe the visual appearance of all elements maintains this consistency.

**TECHNOLOGY CHALLENGES**

Whenever a user of any experience level uses a web application that requires clicking through and entering data on a number of different screens, maintaining the current user’s state is an important consideration that cannot be overlooked. Many web applications use cookies to maintain state. Cookies are small pieces of data that are transmitted back and forth between a client and a server with each action a user takes. Instead of cookies, the PHP header() function is used in this web application to carry data among multiple pages. This function mimics some of the basic functions of cookies such as page redirection and variable passing. The header() function is used in part because cookies have been much maligned since their inception and individual user settings can prevent the automatic inclusion of cookies for a given session.

The header() function is first encountered in this web application during the login process. It is also used in the “Add Tape/Time code” section of the application to carry
the unique identifier for the tape that is used to physically label the tape upon the
completion of an entry procedure. The variables passed in the header() function are not
maintained if an administrator or editor wants to add another tape’s information during
the same session.

Deleting content in relational databases like this one is a process that can compromise the
integrity of the database if conducted inappropriately. Because relational databases
depend on unique identifiers in tables that map to other tables, deleting content from only
certain tables can cause mismatches in information with other tables. Cascading deletes
are used to delete all of the information that pertains to a certain unique identifier. Deletes
are not used in this database design, however, because of their risk and the uselessness of
their utility in this context. The purpose of this database is to store information on tapes
that are physical objects. The probability that a tape would be completely removed from
the tape library and subsequent database would be extremely low. Given these factors,
deletes are not used in this application.

SYSTEM IMPLEMENTATION

This web application, upon further development, is one that will be utilized actively by
the ISL. An implementation schedule exists upon final development, to introduce the
application to the entire staff. The implementation procedure is three-fold.

The first step is to train the database administrator and editors, the primary users of the
system, on how to use the database. This training would be both lecture and task-based.
First, the administrator and editors would learn the capabilities, limitations and general layout of the system. The next step would be a task-based exercise to add actual entries to the database that correspond with actual tapes used on video shoots.

The second step in the implementation process would include entering all of the data necessary for each tape into the system. This process would be the most time-intensive but is necessary before an institutional-wide introduction of the application. This would include entering information into the database on every tape that has been used by the IMG. This would include the addition of ninety to one hundred tapes to the database.

The final step of the implementation process would be the introduction of the product to the larger user group, the staff that will use the application. Unfortunately, each group that makes up the ISL– DESTINY, SPIRE, IMG, and TTRG– are all housed in different buildings on campus. Each group, however, holds weekly mandatory staff meetings to discuss upcoming projects and general discussion topics that are pertinent to the organization. Scheduling an instructional information session during all or part of each of those meetings is the best way to introduce the application. Because each staff members’ attendance is mandatory, most staff members should be introduced to the application during one of those sessions.

**FUTURE CONSIDERATIONS**

Though this database is a comprehensive web application that can adequately and accurately update, query and manipulate a relational database, a number of features could
be added in future builds that would extend the usefulness of the database moving forward. Much of the ISL uses Macromedia Flash and other employees are familiar with its utility so a future build of the application may include a Flash client-side design that interacts with PHP scripts on the server and returns results through Flash. With the latest iteration of Flash’s Actionscript programming language, the sendAndLoad() function was created to interact specifically with forms and PHP and therefore could serve as the primary function that could populate a Flash page with dynamically created PHP content. Designing the page in this way would also create a more aesthetically pleasing page than the current limitations of the form look in HTML.

The functionality of this web application could be improved by programming the select boxes that are featured prominently such that they are dynamically loaded with the appropriate selectable content. Because this database is in its infancy and the backlog of current tapes reveals much of the content that will be entered, selectable content like camera operator and camera type are already known and their values are hard-coded into the select box. In the future, however, fields like camera operator or producer may not be known in advance. Programming PHP such that it will load a select box with all of the previous selections for a particular field may be useful. It may also be appropriate to feature an input text box that allows the database administrator to enter his or her own content so it can then be dynamically read by the aforementioned select box.

Databases of any size function more efficiently if they are indexed on fields that are commonly sought after by searchers. Search logs, however, will not show a dominant
searching trend with a database as young as this one. After some time of use, it will be prudent for the database administrator to analyze search logs and then index fields that are commonly searched.

User state is maintained in this web application through the use of the header() function in PHP. This function is not as secure as either of the other two methods available to maintain state, cookies and sessions. The header() function was used, however, because layers of security for a database with this purpose is not a big concern. Cookies are not necessarily the best option in the future because using cookies requires a user’s browser to have the ability to accept cookies enabled. Also noted previously were some users’ preconceived notions about cookies and their potential intrusiveness. A different way to maintain state that would not include cookies and therefore not require a user to manipulate their cookie settings would be to maintain state through the use of sessions. Sessions, in this context, keep user information like login information and tape information stored on the server rather than on the client-side. Sessions are more secure because they are stored on a server and do not have to be passed back and forth like a cookie. They also have the ability to store more information than a cookie. They do, however, require more serve manipulation to enable sessions that was not available as this application was being built. In the future, this application could be altered to operate by enabling sessions rather than featuring the header() function or cookies.

Final Cut Pro 5, the current video editing solution for the ISL, features XML with every piece of video that is digitally captured in the program. With the appropriate
programming, it may be possible to export this XML into the video database so that
description information can be automatically entered into the database upon a tape’s
digital capture. Final Cut Pro 5’s XML also features shot specific information like frame
rate and the type of audio recorded which may be useful in the future of the database as
more content is added and standards change.

The most potential moving forward is to make the video database a true video database
by featuring all of the content as searchable and downloadable in a digital format. Current
limitations in storage capacity and budget make this consideration unfeasible at this time
but as the price per gigabyte of storage decreases, this will become more of a reality. In
the current system, the actual miniDV tapes are the most important part of the process;
they are numbered appropriately so that a user can query the database and return the
proper tape with the requested content. In the future, these tapes could instead serve as a
backup with the downloadable digital file as the primary resource for users.

CONCLUSION

By conducting a thorough systems analysis of the ISL, an analysis of its users and a
database and interface design, a database application was created that can serve as a
repository for video content within the organization. The database will serve a more key
role in the organization to organize and store information about IMG video content as it
is filled with content and utilized appropriately.
APPENDIX A – ESTABLISHED TAPE NAMING SCHEMA

Institute for Science Learning Video Standards 10/27/04

TAPE LABELING

The labeling process will involve 5 parts in sequential order. They are as follows:

1. Organization- Can be any of the following (more may be added later):
   A. IMG
   B. PMABS
   C. DESTINY
   D. TTRG
   E. DEPARTMENT ON CAMPUS (EX: BIOLOGY)
   F. OTHER

2. Project- Short Description of larger project
   Ex: Brent Felder Dev

3. Date- Date that shoot took place
   Ex: 11/27/2004

4. Subtitle of project- Very topic specific
   Ex: JCSU-Novicki

5. Unique Identifier for tape specific to part 4 of standard
   Ex: A Roll, B Roll, Tape ½, etc.

A finished label may look like this:
PMABS Brent Felder Dev 10/18/2004 JCSU-Novicki 1/2

SHOOTING STANDARDS

All tapes will be shot in 60 min. mode or DVCAM at 4:3 aspect ratio.
APPENDIX B – VIDEO TEAM USER QUESTIONNAIRE

Questions Asked Previous to Database Design

1. What descriptive fields would you expect to find in a video database?

2. How important is a field containing the camera operator of a given video?

3. Would you prefer to search with one input box or would you rather have a number of boxes to fine tune each search?

4. Would you prefer to receive all the details about a tape from a search or would you rather only receive a snapshot of what the entire entry contains?

5. How important is a thumbnail to show in a returned search?

6. Is the inclusion of timecode for each 'set' of shots for a given tape important for a video database?

Questions Following Initial Interface Design

1. How important is it for the database application to resemble the official ISL web site?

2. What was your selection progression as you filled out the form?

3. Were the instructions informative enough?

4. How informative were the labels accompanying each input field?

5. Was it clear in what step of the tape addition process you were in at this page?
APPENDIX C – VIDEO DATABASE UML DIAGRAM
APPENDIX D – WEB INTERFACE SAMPLES

Original Administrator/Editor Add Tape Page
User Login

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LOGIN
Please login to the IMG Video Database below

USERNAME: [blank]

PASSWORD: [blank]

Enter Database
Administrator/Editor Index Page

Welcome to the Video Database Administrator Screen.
Please make your selection from the options below.

SEARCH VIDEO DATABASE
ADD TAPE/TIMECODE
VIEW ALL ENTRIES
General User Index Page
Administrator/Editor Add Tape Page

INSTRUCTIONS
Please fill out all the information possible for the tape you are entering. Please fill out date information in the format YYYY-MM-DD

PROJECT INFORMATION
Choose ISL Group  Choose Project Producer  Choose Project

TAPE INFORMATION
SHOOT DATE LOCATION: MASTER? DUB DATE
(YYYY-MM-DD) (YYYY-MM-DD)

DESCRIPTION:

Choose Camera Operator  Choose Camera Type  Shooting Aspect Ratio  Recording Type

Proceed to Timecode Entry
INSTRUCTIONS
Please fill out all fields below to submit a timecode entry for this tape. Click 'Add Another Clip' to submit this timecode entry. After submitting the final timecode entry, click on 'Return to Administrator Index' to enter another tape.

LABEL THIS TAPE: 60

TIMECODE INFORMATION

IN POINT
(MM:SS)

IN POINT
(MM:SS)

Choose Clip Type

SHORT DESCRIPTION OF CLIP

RETURN TO ADMINISTRATION INDEX

Add Another Clip
INSTRUCTIONS
Please type your search string into the search box below. To view a full record of each returned result, click on the 'View' option to the right. Click on 'Edit' to edit the selected item.

INSERT SEARCH STRING

Search
General User Search Page
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INSTRUCTIONS
Please type your search string into the search box below. To view a full record of each returned result, click on the 'View' option to the right. Click on 'Edit' to edit the selected item.

ADVANCED SEARCH

INSERT SEARCH STRING

Tape # | Location   | Description                                                                 | Options |
-------|------------|------------------------------------------------------------------------------|---------|
14     | Asheville NC | This tape was shot at Asheville High School for the DESTINY promo video. It features an interview with Shannon Bagget. There is also a lot of b-roll of Asheville High School and people on the bus. | View | Edit |

Group | Project    | Producer                      | Options |
DESTINY | asdfasdfsaf | Skip Bollenbacher              | View | Edit |
DESTINY | destiny    | Lauren Hunt                   | View | Edit |
DESTINY | DESTINY PROMO | Rich Beckman       | View | Edit |
DESTINY | DESTINY PROMO | Rich Beckman       | View | Edit |
DESTINY | Skip Bollenbacher | Lauren Hunt       | View | Edit |
DESTINY | Skip Bollenbacher | Lauren Hunt       | View | Edit |
DESTINY | Skip Bollenbacher | Lauren Hunt       | View | Edit |
General User Search Results Page

INSTRUCTIONS
Please type your search string into the search box below. To view a full record of each returned result, click on the 'View' option to the right.

ADVANCED SEARCH

![Search Results Page]

- Tape # 14: Asheville NC
  - Description: This tape was shot at Asheville High School for the DESTINY promo video. It features an interview with Shannon Bagget. There is also a lot of b-roll of Asheville High School and people on the bus.
  - Options: View

<table>
<thead>
<tr>
<th>Group</th>
<th>Project</th>
<th>Producer</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>DESTINY</td>
<td>asdfasdfsdf</td>
<td>Skip Bollenbacher</td>
<td>View</td>
</tr>
<tr>
<td>DESTINY</td>
<td>destiny</td>
<td>Lauren Hunt</td>
<td>View</td>
</tr>
<tr>
<td>DESTINY</td>
<td>DESTINY PROMO</td>
<td>Rich Beckman</td>
<td>View</td>
</tr>
<tr>
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<td>View</td>
</tr>
<tr>
<td>DESTINY</td>
<td>Skip Bollenbacher</td>
<td>Lauren Hunt</td>
<td>View</td>
</tr>
</tbody>
</table>
Administrator/Editor Advanced Search Page
## Administrator/Editor Advanced Search Results

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### Instructions
Please insert search terms in any of the boxes below to search by Tape, Project or Timecode. To view a full record of each returned result, click on the 'View' option to the right. Click on 'Edit' to edit the selected item.

### General Search

**Insert Tape Parameters**
- Location: [Search]

**Insert Project Parameters**
- ISL Group: [Search]

**Insert Timecode Parameters**
- Clip Type: [Search]

**Insert Dates**
- Between: [Search]

<table>
<thead>
<tr>
<th>Tape #</th>
<th>Location</th>
<th>Description</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>Oklahoma</td>
<td></td>
<td>View</td>
</tr>
<tr>
<td>16</td>
<td>High Point NC</td>
<td>Information about High Point</td>
<td>View</td>
</tr>
<tr>
<td>17</td>
<td>High Point NC</td>
<td>Information about High Point</td>
<td>View</td>
</tr>
<tr>
<td>5</td>
<td>Georgia</td>
<td>New Info</td>
<td>View</td>
</tr>
<tr>
<td>19</td>
<td>Utah</td>
<td>Salt Lake City</td>
<td>View</td>
</tr>
<tr>
<td>14</td>
<td>Asheville NC</td>
<td>This tape was shot at Asheville High School for the DESTINY promo video. It features an interview with Shannon Bagget. There is also a lot of b-roll of Asheville High School and people on the bus.</td>
<td>View</td>
</tr>
</tbody>
</table>
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VIEW FULL RECORD
The full record of your search is below

Tape Number: 14

Location: Asheville NC

Description: This tape was shot at Asheville High School for the DESTINY promo video. It features an interview with Shannon Bagget. There is also a lot of b-roll of Asheville High School and people on the bus.

Date: 2004-02-15

Camera Operator: Jonathan Miller

Camera Type: Sony PD-170

Aspect Ratio: 4:3

Tape Quality: DVCAM

Dub Date:

Group: IMG

Project: Print to Tape

Producer: Lea Hart

Done
Administrator/Editor Edit Entry Page

INSTRUCTIONS
Please fill out all the information possible for the tape you are editing. Please fill out date information in the format YYYY-MM-DD

PROJECT INFORMATION
Choose ISL Group
Choose Project Producer
Choose Project
Print To Tape

TAPE INFORMATION
SHOOT DATE
2004-02-15
(YYYY-MM-DD)
LOCATION:
MASTER?
DUB DATE
(YYYY-MM-DD)
DESCRIPTION:
This tape was shot at Asheville High School for the 90916087 promo video. It features an interview with Shannon Bagget. There is also a lot of b-roll of Asheville High School and people on the bus.

Camera Operator
Jonathan Miller
Camera Type
Sony PD-170
Aspect Ratio
4:3
Tape Quality
DVCAM

Update Entry