Web based Gage Management System for Quality Assurance

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1. Introduction:

Gage Management System (GMS) is a comprehensive database management system to maintain information about all gages in a firm efficiently and with ease. Gage Management is the process of efficiently managing and locating gages in an industrial setup in addition to generating reports and scheduling calibration dates. Calibration is a “set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material, and the corresponding values realized by standards” [1]. In a typical industrial setup with large number of gages, tracking calibration schedules and maintaining gage information becomes a huge task. In this context, GMS are very useful and essential tools that facilitate handling this large quantity of information efficiently.

This paper introduces the novel concept of an internet based GMS that will revolutionize the way gage management system will be designed in the future. This system is designed to easily organize the maintenance of gage records such as gage history for calibration. Also, the system facilitates tracking gages within a company, maintaining calibration schedules, tracking gage supplier information and storing calibration certificates. The advantage of this system is that it allows accessing such information through a network and does not require the physical presence of an engineer at the server location itself.

The primary objective of this work is to develop the next generation Gage Management System that is flexible and user friendly. The work presented in this paper involves the development of an Internet based software system for managing the gages and securing gage information. The major task of involves developing a robust relational database system that can handle all relevant information and organize them effectively.

2. Available Packages:

There are a few gage management systems currently available but such applications have been built using two-tier architecture with Visual Basic or Visual C++ as the front end and MS Access as the backend database. These applications have to be installed on a computer where the program is supposed to run. This consumes large memory space and also the database applications have to be loaded on the system.

If it is a network based application then it overcomes physical barriers but often, only the administrator can install and make changes to the application. Also, only the administrator can deal with database design. There are other disadvantages with current GMS. In the event of a computer crash, all information involved may be lost. However, there are also many advantages with these systems. As they reside on the user’s computer, there are fewer chances that the information may be misused online and there is greater security for the data. This issue can be solved to some extent by creating the database on the user’s machine and then connecting to the system through the internet. There are lots of features on the two-tier architecture where many features can be included with ease.

Many of the current features supported by GMS are such that they require multiple resources to be installed and they are also not flexible compared to the web based systems. Most of the currently available software are single user versions and need a person with expert knowledge for operating and maintenance.

Such software, unlike the internet based ones, where we can have multiple user access and is also secured using a unique access for the particular system, where the login information can be shared between a few people who need to manage and access this information. The Client/Server versions available in the market now are very expensive and need extensive networking.
3. Internet Based System:

The Internet based GMS has a simple three-tier architecture system that aids in the organization and accessibility of the stored information in accordance with the industry requirements. The system is 3-tier architecture designed so that it can communicate with user and the database through the internet.

![3-Tier Architecture](image1)

The software has been developed using Java. Oracle is the database that resides in the server and can be accessed across the Internet with the help of a Java enabled web browser. Unified Modeling Language (UML), which is a standard language for writing software blueprints, is used to design and document the software. The software also provides an insight into using XML (Extensible Markup Language) for the data transfer of calibration reports between the users and the vendors. This user friendly application is designed using object oriented programming techniques which enable easy maintenance and software upgradeability.

This system will function with minimal resources. The Internet based GMS is developed using tools such as Java JSP, Java Servlets, Oracle, HTML and XML. The front end is designed using HTML and JSP, JSP was used for implementing dynamic pages. The main database which holds all the information is created using Oracle. The main programs are written in Java and Java Servlets. The key to this system is the robust database designed to handle all the tables and entities available.

![E-R diagram for the Gage Management System](image2)
The Entity – Relationship diagram is shown in Figure 2. Entities are real world things capable of independent existence and attributes are the properties that describe the entity. The rectangular boxes are entities and the oval boxes are the attributes. The diamond boxes are the Relationship that relates the entities.

The system is very user-friendly with help screens available for better navigation and also for guiding the first time users with better understanding of the system. Another additional feature for this system is that it uses XML (Extensible Markup Language) which is a new technology for web applications. XML is a World Wide Web Consortium standard that lets users create their own tags. It simplifies business-to-business transactions on the web. This system uses XML for the data transfer of the calibration file to and from the calibration vendors and it is fast and convenient. In the previous versions they need to wait for the calibration details to come from the vendors by mail and then they have to upload the information onto the database manually and this is avoided.

This system is aimed at reducing the effort to manage the gage records in a firm efficiently and with ease using internet. The advantage of this design is that it is easy to maintain and upgrade the software because Object Oriented programs encourage modularity and thus programs are independent of other parts of the program. The unified software development approach was used in the development of this software system. This is an iterative approach based on Unified Modeling language (UML) which is the most widely used modeling tool in the software industry. UML is divided into various phases and workflows to aid in the easy development of the software system.

4. User Interfaces:

The main feature of the system is that it is internet based and requires the minimal resources for its operation and availability at any place with a computer and an internet connection. The previously available versions had to be installed on the computer with many necessary requirements such as a computer with lot of memory and a good processor where the programs reside. It needs to be installed on many computers if they are interconnected on an intra network needing special drivers and additional cost for its maintenance. The internet based system eliminates most of the resources required compared to conventional systems. One more key feature of this system is that it lets the creation of user defined fields and the dynamic creation of user tables. This allows much of the flexibility for a versatile system. The dynamic creation of tables makes the system more advanced so that there need not be any installed programs on the user’s computer to create the tables. This saves lot of cost in buying resources and adding additional hardware for running the system. Even the database account for the entire user list resides on the main server and so this becomes a very good alternative service to the currently available versions. If the user is concerned about the security of their data, the database can be setup at the user’s site for confidentiality reasons. The Figure 3 on the next page shows some basic screen shots from the system. The top left is the login screen where the user can register and logon to the site; it also has the link for creating XML files for exchanging calibration information between the user and calibration vendors. The top right is the main screen the user will see after logging in, it lets the user to populate the database. During the first visit to the system, the user will be asked to create the tables and customize the fields on the tables if needed. It can also be compared to the main menu with all the functionality available in the software. The bottom left shows how the information is entered into the database. There are many Java Scripts written to validate the entered data, there is also a separate script used for date validations. The calibration information can either be loaded manually or can be imported directly from a XML file. The bottom right screen shows how the summary of the gages are reported. There are different kinds of summaries available based on the user requirements. There are reports generated for calibration information, supplier information, gage tracking etc. On the main screen there are links for creating “Add New Fields” where the user will be able to analyze all the basic available fields and then he will be able to add up to 3 user defined fields that can be either a number field or character field or even a date entry. There are functions added to access the Help function from any screen if the user is lost or if the user needs additional information on how it works. The print function is also located on all the screens to enable the user to print the information from the web browser. The user is expected to log out or sign off after using the system to add security to the system.
5. Conclusion:

In recent years, large companies have moved away from in-house manufacturing to global manufacturing. They outsource machining of parts to vendors around the world. Global manufacturing gives large companies the advantage to reduce operating costs. Thus there is a need for data to be shared over a wide geographical spread. Technology is transient and new software and new protocols for the internet are constantly being developed. This allows faster and safer access to information within and outside an organization. The Gage Management System (GMS) was successfully implemented and the output was as expected as it met all criteria of the objectives during the design of the project. This software is the first reported instance of an internet based gage management system. An updated version of this software optimized for high speed network access and with advanced features will be a task for the future. Thus web based gage management systems will help to improve the quality of the organization by better record keeping and scheduling for calibration of the available gages.

6. References:
[1]. VIM (International Vocabulary of Basic and General Terms in Metrology)