COMPUTERIZED COLLECTION AND ANALYSIS OF HVI DATA

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Abstract

Synergy of the new computer technology and the latest achievements in cotton industry produces indisputable benefits. Integrating computerized methods of data collection, increasing precision in calculations, reducing the human-induced errors in the cotton testing procedures increase effectiveness and productivity.

The main scope of the article is to present the software system designed for capturing, checking the instrument, transferring, organizing test data received from the HVI machine during all its operations, particularly, machine calibration, reference cotton testing, and commercial material runs at the International Textile Center, Lubbock TX. The system furnishes dynamic Database construction, directly from the HVI machine output text file. Quality of the testing is significantly improved by introducing automated calibration check calculations and options for registering operator's effect during testing. Straightforward graphical user interface, especially designed for novice computer operators, provides visual reference tools and is simple enough to require minimum training time for the HVI machine technicians.

Versatile structure of the system prototype allows potential application of the program for a wide variety of data manipulation tasks, offering platform and Database independence capabilities.

Introduction

With the fast pace of modern industry and severe commercial competition, it has been practically proved that insufficient amount of information inevitably results in erroneous conclusions and loss of data precision, whereas spending employee's time on manual operations is very expensive. Cotton testing procedures, in particular, involve significantly large scale of output information and consist of operations, which require precise stability of the machinery and accurate actions of the operator. Detection of the necessity in calibration of the machine is very important for the reliability of the commercial testing results. As far as the HVI data is concerned the output of the routine test runs on the reference cottons are as important for detecting any long or short-term variations, as obtaining valid test results on cotton bale samples from the customer.

Just in one day of running the HVI machine information flow can exceed 40,000 bytes in ASCII characters, which is equivalent to a 50-page long text file. However, this raw information is needs to be properly processed and organized into a relation database to be of a greater use.

Hence, a software system needed to check the testing instrument if the test results are valid and issue warning signals in case check failed and calibration is needed, convert and store the test output in the form of a database, to put it in a nutshell.

The line of the operations of the HVI machine is schematically shown in the Figure 1. As the machine takes in a cotton sample to be analyzed the test results are output to the display and some of the data goes directly to the output through the printer attached to the machine. While the instrument is checked for proper calibration the reference values of Length, Strength and Elongation are compared to the new values obtained by the machine. This check is performed by the operator performing a number of calculations for each value and for both short and long reference cotton samples. After the check is completed the commercial cotton samples could be tested, or the machine needs to be calibrated. When running both commercial and instrument check tests the data has a readable output only to the printer port. After the test printouts are collected, the information they contain needs to be further analyzed and stored on some media for further usage. Before it was done by manual input of the information into database.

This way of data processing appears to be not one of the most efficient. A software system can facilitate most of these operators and provide solutions for data processing and interfacing.

Program Specifications and User Requirements

Many of the operations during cotton testing on HVI machine as it shown in Figure 1are particularly affected by the human factor. A number of them can be replaced by a system performing the tasks automatically, for example the instrument check operation. This will diminish possible human - induced errors and reduce the time needed for calculations.

The major task is to ensure proper testing sequence and sufficient calibration of the HVI machine, along with reliable and fast data saving and easy-to-use interaction to the new software. Converting the printer output data to a form storable on magnetic media and suitable for further computerized processing is necessary. Visualizing the output of the test runs will give a better picture of testing pattern, optional representation of the data in the form of

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graphs, along with the structured output, such as table view, facilitate reviewing data for possible errors.

Finally, optimal solution should be found for the architecture and operation of the local Database Management System (DBMS) for analysis, access, update, and storage of the data obtained from the HVI machine test and commercial runs.

The requirements are summarized in the following list:

- ✓ Organize intermediate link to receive data from the printer output
- ✓ Ensure correct order of testing operations
- ✓ Warning system for instrument instability detection
- ✓ Direct reading of the test results into storage media, avoiding manual input
- ✓ Build a DBMS for test data transactions
- ✓ Straightforward user interface
- ✓ Visual representation of test results

Suggested Solution

Taking all of the application requirements into account after intensive research prototype architecture of the system, depicted in Figure 2, has been developed. The beginning part was creating a program that would capture the data that goes directly to the printer from the HVI machine LPT port, to where the printer is connected. This program would interface to the HVI machine LPT port and store the data received in a location specified by the operator. However, the question of CPU usage arises here, this program should run in parallel with the main software on the HVI computer designated for cotton testing and should only activate itself when the data is sent to the printer. It is necessary to point out that originally, only commercial test data was saved on the HVI computer hard drive, in the ASCII format. All the data obtained for module testing, calibration check, system status output was only printed out on paper.

After the data is captured and saved it should be processed, analyzed and saved into the database. Processing of the data should include interpretation of the input file with the data from the printer port. Data will be also analyzed for proper calibration of the instrument during Length and Strength test for both short and long reference cottons. After the response from the system is obtained on the reliability of the instrument calibration either a warning about improper calibration is issued or a successful output directs operator to commercial or other test runs.

While the data is processed and analyzed, it is also exported into a relational database, where it will be available for further analysis or review. Database is divided into two main parts, one part contains tables with commercial tests according to the job numbers, second part contains data that was obtained during module testing, calibration check, etc.

It is very common that the computer hardware available at various businesses is characterized by a wide diversity of brands and operation systems. This imposes the question of most efficient usage of available resources and compatibility. Making the DBMS platform and Database type independent will solve this problem.

Implementation Details

The system developed features the most advanced technology in software development, is platform and database independent. Abstractly it consists of the following blocks:

1. Terminate and Stay Resident (TSR) Program.
2. File Parsing Block.
3. Data Display.
4. Instrument Check.
5. Warning System.
6. Data Exporting Block.
7. Database: Commercial and HVI Machine Test Data.

The system appearance is depicted in Figure 3.

The TSR Program has been implemented in the lower-level programming language Assembly. It listens to the LPT port of the HVI computer and copies the data sent to the printer into a specified location in the text file format exactly how it appears on the paper. After printing is finished TSR program terminates itself and frees the CPU resources for running other applications. The data captured each time something is sent to print is appended to already existing data in the text file, or the text file is created anew if no test has been run for that day.

Input: File Parsing Block – takes the input text file, reads in the reference values and test results, prepares the data to be analyzed.

Display: Data is displayed in a form of a spreadsheet on the screen. Test results could be also viewed as a chart, dynamically changing the parameters to be displayed. Also the standard deviations are plotted, and other statistical parameters are output.

Instrument Check: Verifies if the incoming data pass the tolerance check and machine is calibrated for commercial testing. If the calibration check fail (decision based on two-cotton testing for length, strength, and uniformity) a warning message is issued to notify operator of the potentially erroneous machine status.

Data Exporting Block: Saves data in a relational database (MS Access), including test-related information. The test data is saved in tables according to the date of the test; commercial output is preserved in the table named according to the project number.

The data is read from a text file, the file is parsed, data is tokenized and displayed on the screen. After this the values of length, strength, and uniformity are checked for error tolerance:

Length ± 0.018 units
Strength ± 1.2 units
Uniformity ± 1.8 units

If the average of the test results falls between these values, the Instrument Check test passed and the machine is ready for commercial testing. In case Instrument Check failed and machine needs calibration, operator is informed by another dialog window and has a few options to proceed with: run another test, view the graphs of the tested values, or go to calibration. Graphical representation of the test result is displayed to the user as in the form of a chart, together with some important statistical information (see Figure 4).

After all the tests are completed the data is saved into MS Access 97 relational database. A sample part of a database table is given in Figure 6 (Original text file output is shown on figure 5). The format of the MS Access database is exportable into major spreadsheet analytical software packages, as well as can be published with word processing documents.

Summary

The system developed was tested on continuos data input from a text file generated by a printer-port-capturing TSR program. In the testing procedure the instrument check was performed with 100% accuracy, overall performance of the program is fairly good and reliability is rather high. The features implemented include:

1. Printer port data capturing.
2. Saving captured data in text format at a specified location.
3. Reading input in text format.
4. Displaying numerical data.
5. Saving test data into relational database.
6. Performing Calibration check of the instrument.
7. Highly productive User Interface.
8. Commercial testing data display and saving.
9. Platform and Database independence capabilities.

The system developed potentially is an optimal solution for time consuming procedures of data processing in cotton industry. It brings precision and accuracy into calculations and leads to major improvements in cotton quality determination.

References

Jepson, B.1998.Java database programming, Wiley Computer Publishing, New York,NY.

Hartsmann C, Cornell G.1998.Core Java/Advanced Features, The Sunsoft Press, Palo Alto, CA.

Larson J.1995. Database Directions/ From Relational to Distributed, Multimedia, and Object-Oriented Database Systems, Prentice Hall, Upper Saddle River, NJ.

McFadden F., Hoffer J..1993. Modern Database Management, The Benjamin/ Cummings Publishing Company, Inc. New York, NY.

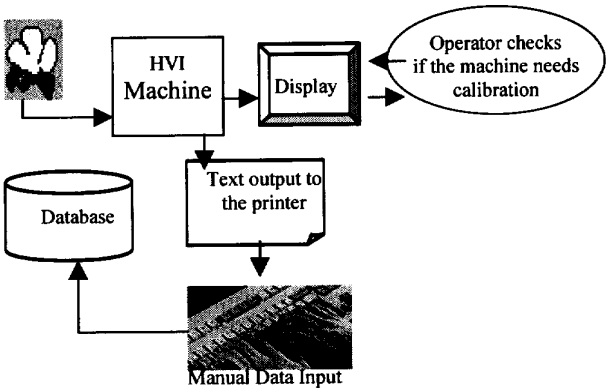

Figure 1. HVI machine operations and data flow.

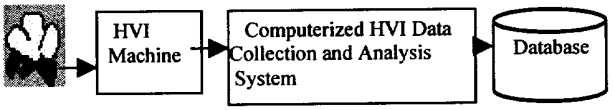

Figure 2. Desired HVI machine data flow configuration.

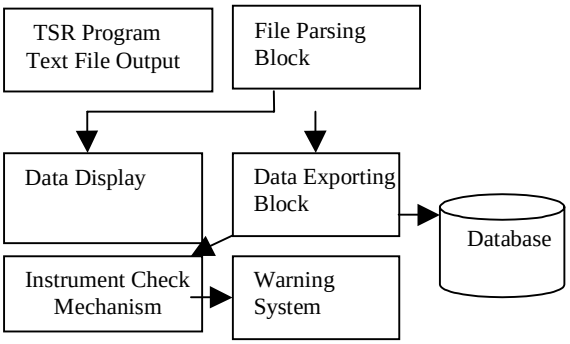

Figure 3. Computerized Data Collection and Analysis System.

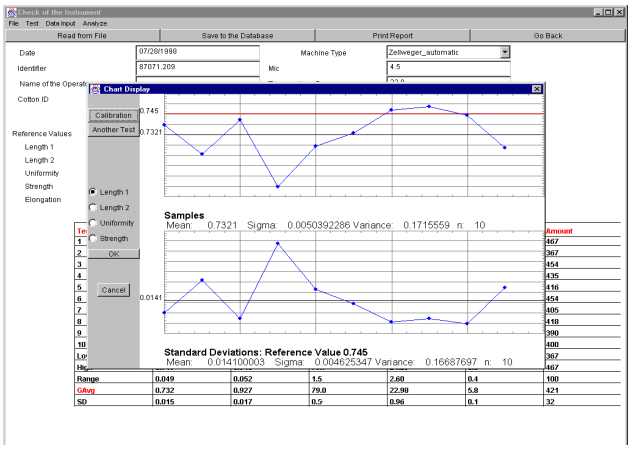

Figure 4. Chart Viewer.

O P INTL. TEXTILE CTR. TTU
Length/Strength Testing Results
HVI Calibration Mode (Upper Half Mean Length, Uniformity Index)
Date: 07/29/1998
Identifier: 87071.210

Short	0.736	0.937	78.6	25.20	7.0
Long	0.966	1.154	83.7	33.70	7.0

I.D. = 28173 Mic = 4.0

Test #	Len 1	Len 2	Unif	Strength	%Elong	Amount	S. F.
1	0.780	0.983	79.3	24.41	6.6	460	H
2	0.774	0.982	78.8	23.61	7.0	436	H
3	0.800	1.003	79.8	24.39	6.7	523	H
4	0.768	0.979	78.4	24.87	7.3	416	H
5	0.787	1.001	78.6	23.73	6.8	440	H
6	0.784	0.974	80.5	24.22	7.2	446	H
7	0.761	0.967	78.7	23.61	7.0	455	H
8	0.763	0.952	80.2	23.97	7.2	447	H
9	0.763	0.962	79.3	22.93	7.2	444	H
10	0.766	0.966	79.3	22.93	7.3	397	H
Low	0.761	0.952	78.4	22.93	6.6	397	H
High	0.800	1.003	80.5	24.87	7.3	523	H
Range	0.040	0.051	2.1	1.95	0.7	126	H
GAve	0.775	0.977	79.3	23.87	7.0	446	13.2

Figure 5. Sample Input Text File Fragment

Test	Length1	Length2	Uniformity	Strength
1	0.780	0.983	79.3	24.41
2	0.774	0.982	78.8	23.61
3	0.800	1.003	79.8	24.39
4	0.768	0.979	79.8	24.87
5	0.787	1.001	78.4	23.73
6	0.784	0.974	78.6	24.22
7	0.761	0.967	80.5	23.61
8	0.763	0.952	78.7	23.97
9	0.763	0.962	80.2	24.22
10	0.766	0.966	79.3	22.93
Low	0.761	0.952	78.4	22.93
High	0.800	1.003	80.5	24.87
Range	0.040	0.051	2.1	1.95
GAvg	0.775	0.977	79.1	23.87

Figure 6 Sample Database Table Contains Information from the File Fragment in Figure 5.