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Implementation of Multiple Protocol Supporting Medical Testing Machine Software Integration

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Abstract

Laboratory tests help the medical industry to diagnose almost all deaths today. Advanced laboratory testing equipment enables laboratory technicians and doctors to obtain the most accurate results at all times using standard and automatic procedures at all times. Specialists record the result extracted from the scanner and then paste the result into a hospital or laboratory management software to produce a final patient result. This transfer of records from the machine to report the production software process is still in many diseases lab books and clinics. The proposed research work is mainly focused on the evaluation of various diagnostic analysts and communication processes supported by relevant analysts. This research also helps to understand the different media of physical communication and its importance. The system was used to process ASTM protocols and data exchange. Using a systematic parser according to the protocols and rules defined in the appropriate machine system understands and produces the effect required by the reporting software. This method will avoid manual transmission of the software and improve the accuracy of the medical report, which helps to understand the quality of the result and make automatic translation of the result easier.

Keywords: *LIS, Analyzer, HL7, ASTM, HOST, Control Characters.*

1. Introduction

Medical Device Integration Technology is emerging at a rapid pace and the ability to knowledge care is a very important step in patient care. there is a wealth of information flowing from a wide range of devices, as well as an area of care monitoring such as aldohexose meters and blood analyzers, vital signal monitors, and more. if these sources are combined with effective tools and external systems such as Electronic Medical Records (EMR), they will provide real-time data [21] [22]. Integrated medical devices with knowledge of the effective flow of hospital data systems (HIS) and other downstream rivers create new opportunities for care providers, medical device companies and IT companies to plan, request accuracy and enhance patient care [19] [23] [24] . Medical Device Integration is primarily intended to mechanically record information information to supported connected systems that can receive code or hardware modules [14]. this can lead to improvements in the quality of the patient's medical information and diagnostic system. With the help of tangible and intangible material with medical tools the recording information is entered directly into HIS, RIS or LIS.

As the medical device supports standard communication media but not all medical devicesupport or works on standard data exchange protocols. Globally ASTM and HL7 as the data exchange principles that are gaining popularity among many medical devices and retailers, many local or small companies still go through management processes related to cost management and easy communication and fulfillment of basic data exchange requirements [1] [2]. In order to establish a standard or high-end medical device that supports a medical device integration program it needs to understand common connectors and communication protocols. This document aims to provide a brief study required on the development of a medical device integration program.

2. Background

Type of medical record exchange

To begin with, the first step in the integration of a medical device is to understand the different type of medical records exchanged between instrument and LIS. In general, medical device support based on

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the type of records or data [9].

Patient Information: Includes personal patient information which may include patient name, contact details, age, sample id, test details, or medical details.

Test Outcome Data: These records include test results that may or may not include the name of the parameter, number of test results, parameter unit, results status, test method, test process or result comment.

Calibration data: To get accurate results, every sensor part and electronics component in every medical instrument must be calibrated on a regular basis. The system calibration details, including resultant values and calibration timestamping, is included in these records.

Reference range data: Every test parameter has a natural or appropriate range that will be used to tally any abnormalities in the results. Medical instruments may be used to obtain these ranges for each parameter. These ranges are configurable in medical instruments, and they can be set up using the device's configuration or setup choices[10][17][20].

Machine statistics data: Sensors, engines, pumps, and electronic modules are used in any medical device. These modules' status and statistics may be exchanged with LIS or HIS, while these data are usually requested by direct machine control software systems and only very rarely with LIS or HIS[12].

Test continuity data: As the HL7 similar to a few communication processes supports real-time currently using exchange data for progress with a connected system. These records may include progress by term or percentage, incremental or decreased values, variability of multiple readings or graph information required. Also, this information is rarely required by LIS or HIS [11].

Error / Failure Data: This information directly affects the test results and the testing process. Provides details of any type of system failure. This information can be retrieved from a medical device while the trial is in progress or after the completion of the trial.

Rejected test data: Due to incorrect sample or unexpected sample received by medical device result test failure. In this case the machine refuses the sample and returns the details of the sample rejection with the predefined error or message of information to the medical device.

Degree Data: All medical devices need to prepare for a specific test or procedure. All test results may vary depending on these settings or configurations so it is important to determine the accuracy of the result depending on these settings. It is therefore important that you have these records of machine configuration and test results. Not all machines directly support this information.

Graph Data: Few medical devices such as EEG or ECG produce the effect of a functional or predefined pattern pattern. This is a type of mechanical return results in the form of identical members or a series of numbers, which can be used to draw or edit a graphical image. Handling this information is a coherent and complex process. This information is usually obtained in real time during the trial [18].

Graphic format images: As mentioned in the graph information a few medical devices support the graph or effect as an image so these images can be between data type and the benefits of the data are, they can be transmitted through detailed communication while not compatible with broadcast communication.

Medical imaging: Medical devices such as digital x-rays produce lead in image form. These images include details or one or more images. the only disadvantage of such a variety of photographic records; because these are multiple packets of byte-based information that can only be supported by broadcast-based communication protocols such as TCP / IP.

DICOM format images: Digital simulation and medical communication (DICOM) are common in the communication and management of medical image data and linked information. DICOM is commonly used to store and transfer medical images that allow for a combination of medical imaging devices such as scanners, servers, workplaces, printers, network hardware, and PACS from many manufacturers. These types of information are mainly image details with an extended set of information topics as well as patient, test, machine or outcome details [15].

Data Exchange Methods

The communication between the LIS keeper and the analyst goes through different channels. It is important to understand that the analyzer transmits data directly to the LIS host. The Analyzer machine supports a variety of communication methods that are highly targeted to the features

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provided by the analyzer vendor or manufacturer. Generally, there are three main types of communication methods and those are as follows:

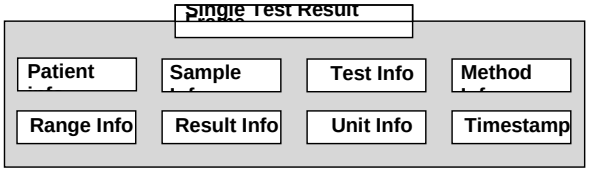
a. -directionalAnalyzers
b. UniBi-directionalAnalyzers
c. Host QueryAnalyzer

Data exchange structure and protocols

Data exchanges always have a fixed structure or structure. These formats may be standard (e.g., ASTM) or related depending on the manufacturer's policies and configuration support. With the exception of all record structures or format analyzer it follows the sequence of sending the records itself or respectively. All records are formatted and sorted using special ASCII characters such as a delimiter such as field delimiter, block delimiter or record delimiter. Understanding this format is very important when performing data segregation in the LIS data integration module. To create these records ASTM (American Society for Testing and Materials) or HL7 (Health Level Seven) are widely used and adopted while developing a new machine. Following the discussion to understand the type of records found in the analyzer, support protocols and their structure and ultimately the special key characters and codes used for record formation.

Records structure

Generally, all records contain specific information related to testing [3] [7]. Figure 4.0 shows the formation of a single test result. This is the least expected information about any tests performed on the analyzer.



One-line records: All information at the end of a single line about a new line character or cart return (CR + LF)Multi-Line Records: Different fields of the same record are arranged in multiple lines where the end of the record can point to a specific pre-selected character, usually the code used at the end of the [ETX] transfer text.

Records based on Fix-Size: In this case each record is a format with size adjustment data where special characters such as 'Space' or 'Zero' are used to fill in the blanks to adjust the exact size of the record.

Batch Data record:In some cases, a new line character or cart retrieval character is not used to separate records instead all the fields of all group records are grouped together and separated using special characters or codes such as [BOF], [EOF], [ETX], or i - [EOT]

Textual graph image:The result of a few tests in the form of graphs such as EEG or ECG, in which case the records are continuously transferred to the LIS manager until the test is in progress or at the end of the test using a standard record format, where the total block or graph[6].

Communication Protocols

ASCII is abridged from the American Standard Code for Information, it is a standard way to enter the transmission code. The standard American code for information exchange codes represents text on computers, telecommunications, and other devices. new encoding schemes are supported by computer code, or they support other continuous characters. each transaction or communication between 2 completed businesses using the ASCII character is set only. This list includes names, digits, and special characters. The LIS host and analyst will communicate using the ASCII set without a standard format or structure, but placing these records in a structured format is called a protocol. Figure 5.0 shows the diagram of the ASCII collection and its application.

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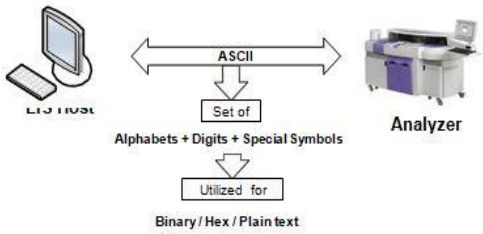

Figure 2.ASCII character set utilization for analyzer communication

Depending on the format of the record and the main format following the two agreements it is widely used and accepted by equipment vendors.

A. ASTM

ASTM International, called the American Society for Testing and Materials. This is a world-class organization responsible for developing and publishing a voluntary agreement on operational or communication standards for various machines, products, equipment, systems and services. Approximately 12,575 ASTM of the voluntary contract standards apply worldwide. ASTM These processes follow the quality format of each bi-directional recording communication. A single result or question can have multiple lines or multiple blocks; however, each block starts with a standard code to redefine the purpose of a particular line. Name the main character of each line in the given example.

Example of data ASTM transmission:

H|\^&|||LIS|||||UniCAP||P|1||20090202143407 **P**|1|AG707416||AG707416|NAME, ALISON||20051111|F
O|1|0548905||^^^f209^1\^^^a- IgE^2||20051130084634|||||||||12345^DR. BILL JOHNSON||BADER & GONDAL 53^112-47 QUEENS BLVD#208 ^^FOREST HILLS, NY 64064-
9841^64064-9841||||||O

B. HL7

Level 7 (HL7) includes the collection of international standards for the transfer of diagnostic laboratory information among other software applications used by many hospitals. These global standards apply to the application layer, called "layer 7" within the OSI model. The HL7 standards are developed by Health Level Seven International, an international standard organization, and are recognized by various bodies such as the American National Standards Institute and the International Organization for Standardization. Multi-Specialty Hospitals and various health care organizations often have multiple pc systems used for each group's action by simply requesting records to track patient information. All such systems must communicate (or "interface") when the system has received new information, or if the system would like to receive data, however not all data will do so [8]. HL7 International Standards specifies a variety of methods, guidelines, and standards for a wide range of interconnected health care systems [1]. Such information or standards are a set of rules that enable information to be shared and processed in a consistent and consistent manner. These standards are designed to allow health care organizations to simply share clinical information. Theoretically, this ability to exchange information should make it easier to reduce the tendency for medical care to be geographically fragmented and radically changed [5].

Example of HL7 datatransmission:

MSH|^~\&|Alexis Lab|Sys-3|GNN OE|Lab- 2|200202150930||ORU^R01|Central-3456|P|2.4<cr>
PID|||9988665544||Avinash^Sharma^E^^^^L|Amit| 19620320|M|||153 Trivedi Dr.^^Mumbai^OH^35292||(022)124532|(022)121- 323||||AC555444444||67-A4335^OH^20030520<cr>
OBR|1|845439^GHH OE|1045813^GHH LAB|15545^GLU|||200202150730|||||||| 232346681^Seconderty^Lab

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P^^^^MD^^|||||||||F||||||444-44- 4444^HIPPOCRATES^Tech T^^^^MD<cr>**OBX**|1|SN|1554-5^GLU^POST 12H CFST- MCNC-PT-SER/PLAS-QN||^187|mg/dl|80_105|H|||M <cr>

3. Implementation

In order to begin the analysis and predictability of various diseases, the process begins with an understanding of the different body part and the most frequently observed parameter of disease laboratories for the diagnosis of a particular disease. Larger laboratory equipment has common ways to connect to computers and support software. These methods apply to continuous data reading or in demand response data mode. Each item or parameter has standard values sets that may vary widely between different patients or different conditions. In the first phase we will work on the various studies availablein disease laboratories and the diagnostic process. Here we will compare the various communication protocols found in laboratory machines with data capture methods. The second is to list a different parameter to participate in a computer survey.When we are ready to study the laboratory communications law in the second phase we will build the integration software to learn what you want from the machines and store it in a database for further analysis. This interface software will also mean comparing the standard or standard value. A study of the various symptoms and the number of variations of the research component in relation to various diseases will help us to identify which disease is most predictable and what is the value or point of consideration in predicting diseases or categories.

i. Creating Interface for the pathology labMachines

ii. Analysis of common & distinct symptomsof variousdiseases

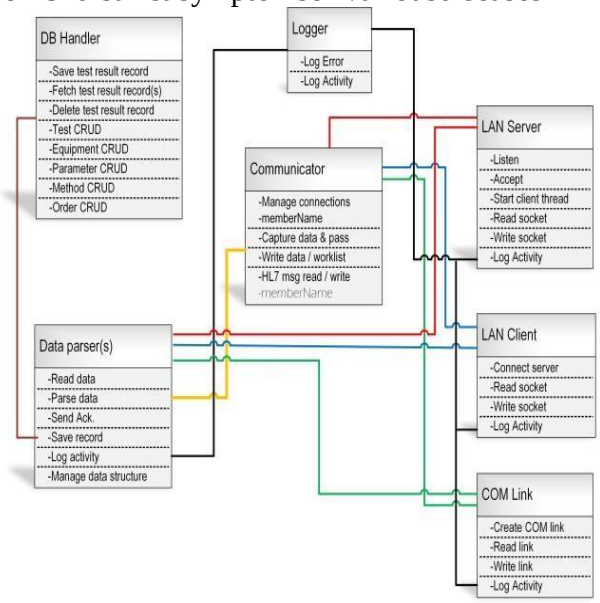

Figure 3. Class diagram

Parameter	Return	Description
Parser:SplitIncomingData()		
• Compare delimiter • Incomingstring	Parsed string array	Parse incoming data with given delimiter
Parser:SplitBlocks()		
• Compare delimiter • Inputstring	Parsed string array	Parse input string block with given delimiter
Parser:SplitField()		

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• Compare delimiter • Inputstring	Parsed string array	Parse input string Field with given delimiter
Parser:SubString()		
• Inputstring • Startindex • Length	Extracted string	Get mid string or sub string from given input

Table 1.Parser class function set

4. Results

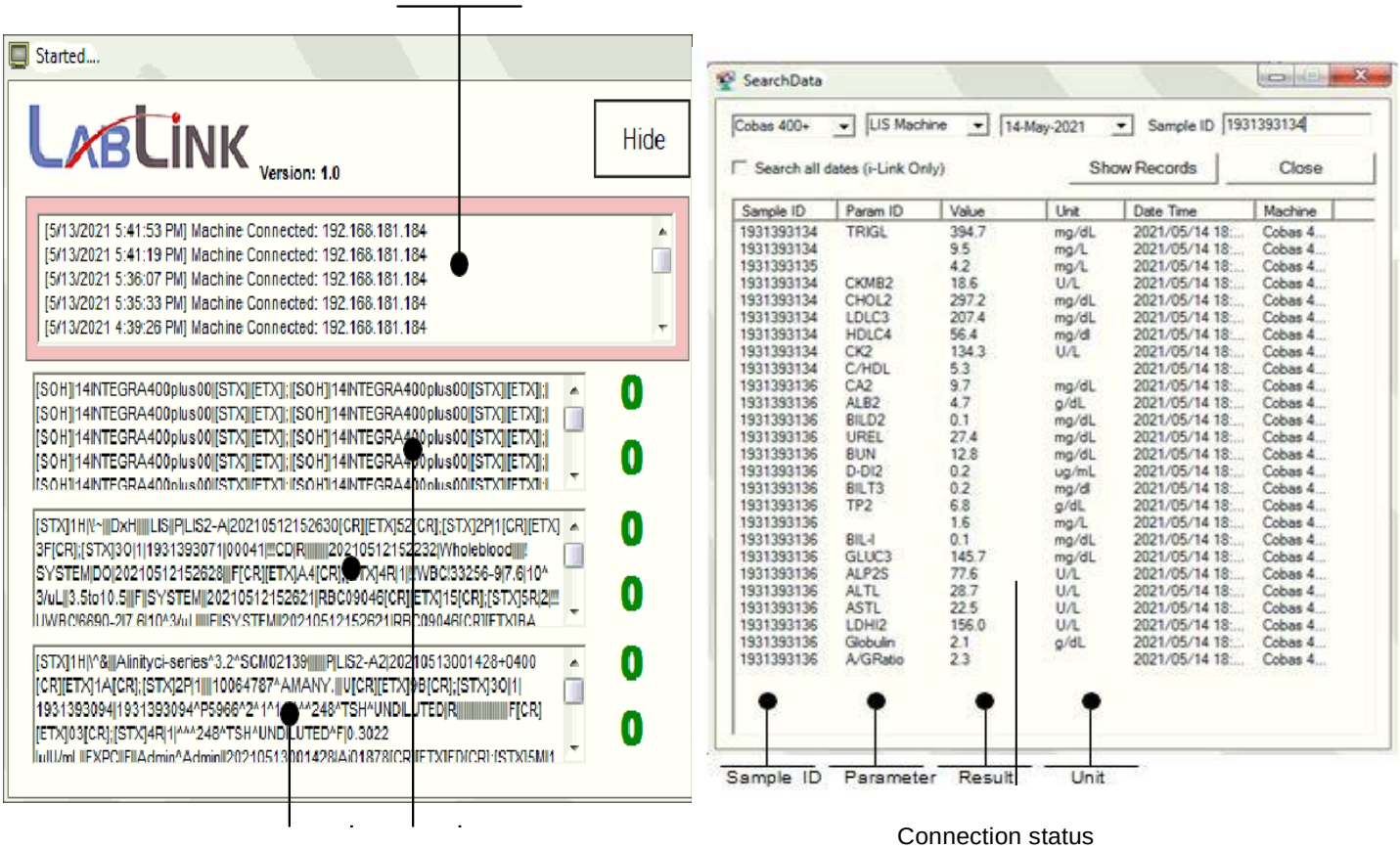

Figure 4. Parser result

5. Conclusion

This study is aggregated information from a variety of sources from a research paper to medical device manufacturers who have provided a manual for each machine or analyzer. This paper is designed to give a brief overview of something different from physical connections to logical configuration in LIS machine integration. Includes the normal connection method again the standard communication protocol involved in the interface. This document is deliberately written to guide a site support engineer, program integrator, and LIS software developer.

6. Implementation

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iii. Creating Interface for the pathology labMachines

iv. Analysis of common & distinct symptomsof variousdiseases

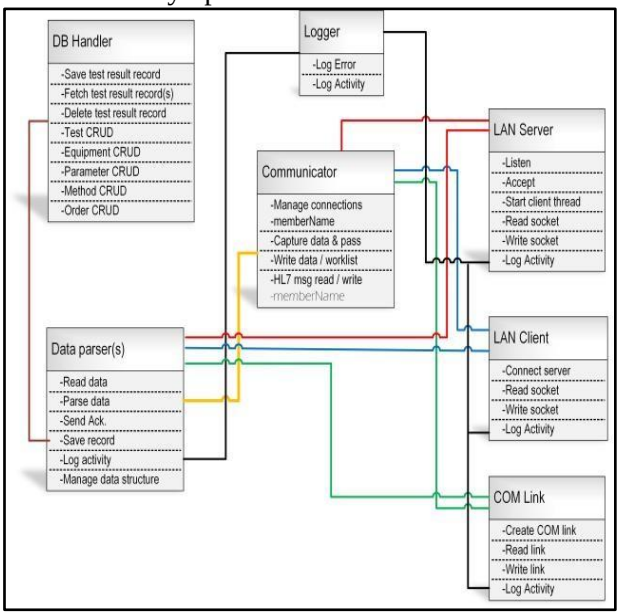

Figure 3. Class diagram

Parameter	Return	Description
Parser:SplitIncomingData()		
• Compare delimiter • Incomingstring	Parsed string array	Parse incoming data with given delimiter
Parser:SplitBlocks()		
• Compare delimiter • Inputstring	Parsed string array	Parse input string block with given delimiter
Parser:SplitField()		
• Compare delimiter • Inputstring	Parsed string array	Parse input string Field with given delimiter

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Parser:SubString()		
• Inputstring • Startindex • Length	Extracted string	Get mid string or sub string from given input

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