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H.I.S Integration With Ecg For Service Acceleration Using Mirth Connect

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Abstract

The integration between H.I.S and the application program of an EKG medical device aims to find a solution in connecting the two different systems using the features of the Mirth Connect software and the international standard HL7 message format. This integration process involves the exchange and transformation of data in every message delivery from the HIS simulation to the tool application and vice versa. Basically, communication software, commonly called bridging software, works to make it easier to send messages to different destination software protocols, and can also easily or (mapping) any destination data to be sent and received by each application. The main key in this bridging software is the mapping that must be configured properly so that message communication can be connected and data can be sent and received according to message requests. For every data transmission, there is a status created and controlled by the program during the process of sending patient data messages, where it is intended as a notification to the user of the state / state that is being run by the program.

Keywords: *ECG, HIS, HL7, Mirth Connect, Cardio Point.*

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INTRODUCTION

Cardiovascular disease (including coronary heart disease and stroke) is the most common non-communicable disease in the world. Cardiovascular disease was estimated to have caused 17.8 million deaths in 2017, and more than two-thirds of them occurred in low- and middle-income countries [1]. The use of an EKG (Electrocardiogram) device is one of the many medical devices that are widely used by doctors in hospitals or clinics. ECG is a diagnostic tool used to detect electrical activity in the heart in the form of a graph that records electrical changes in the heart related to time [2].

Generally, hospitals already have a hospital system to register until examinations, but the system still has problems when doctors want to see the history of certain diseases from patients who use medical devices, where the hospital application (HIS) will not be able to be connected by applications from installed tools. Doctors must manually open the data of patients who have come to do the examination. With a hospital information management system, hospitals can manage complex problems, such as medical reams and other administrative procedures.

RESEARCH METHOD

Integration using the Mirth Connect application has also been used in previous research, namely by using the HL7 message format into an application called OpenClinica and transSMART with automation techniques [3]. Mirth Connect consists of four parts: source connector, filter, transformer, and destination connector [4]. HL7 is a rule that can be interoperable between various types of information for applications, and this medical standard is developed by stakeholders such as users, suppliers and members regarding other medical information because they want every type of application service to be made to meet the needs. Thus, HL7 can transfer information between the organization (hospital) concerned with doctors who treat patients, patients can obtain information for diagnosis and treatment [5].

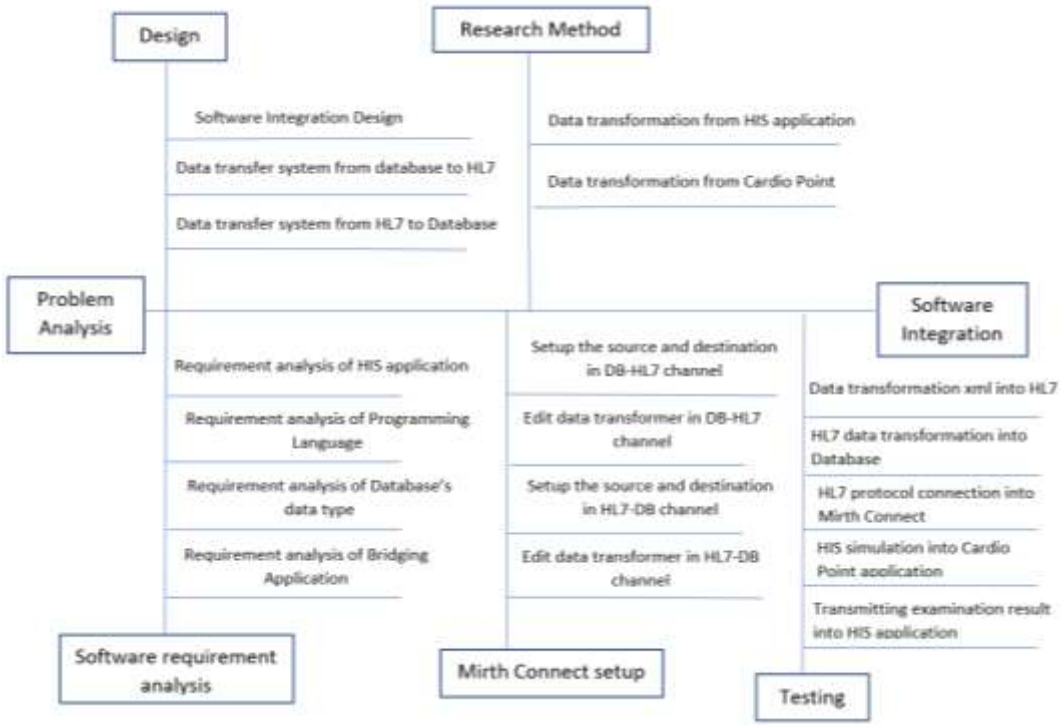

Figure 1. Fish Bone Diagram

INTEGRATION FLOW

An electrocardiogram (ECG) is a physiological signal produced by the electrical activity of the heart. One of the important information that can be taken from the ECG signal is the electrical activity of the heart that forms the PQRST wave. This parameter is usually used to see normal and abnormal heart conditions [6]. In the ECG examination process using Cardio Point without going through a data transformation scheme, the doctor or nurse must manually input patient data into the application when carrying out the examination. This process is not

integrated with the HIS system owned by the hospital, therefore the status of the patient's ECG recording cannot be viewed directly from the HIS system/application. The following is a block diagram to explain the flow of the direct examination scheme without integration into the HIS:

Figure 2. ECG examination process without software integration.

In the ECG examination above, the patient data that has been recorded in the HIS will then be re-entered into the Cardio Point application. From this flow, the ECG examination process from the HIS step to the Cardio Point application is not carried out in one input, but the user must manually input patient data into the Cardio Point / ECG application.

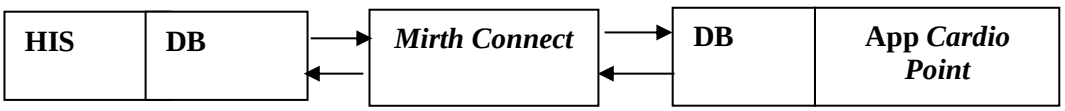

Figure 3. Hospital system communication process to the ECG application with Mirth Connect.

The diagram above describes the communication between software with different protocols, where Mirth Connect is an intermediary application that bridges the two applications between the HIS (Hospital Information System) and the Cardio Point application so that they can send data to each other. This research involves several component elements in order to make this communication can be connected to each other according to incoming and outgoing data.

RESEARCH RESULTS AND DISCUSSION

The discussions that will be described in this section include:
1. Data transformation from HIS to Cardio Point application.
2. Data transformation from Cardio Point application into HIS

Data Transformation from H.I.S into Cardio Point Application

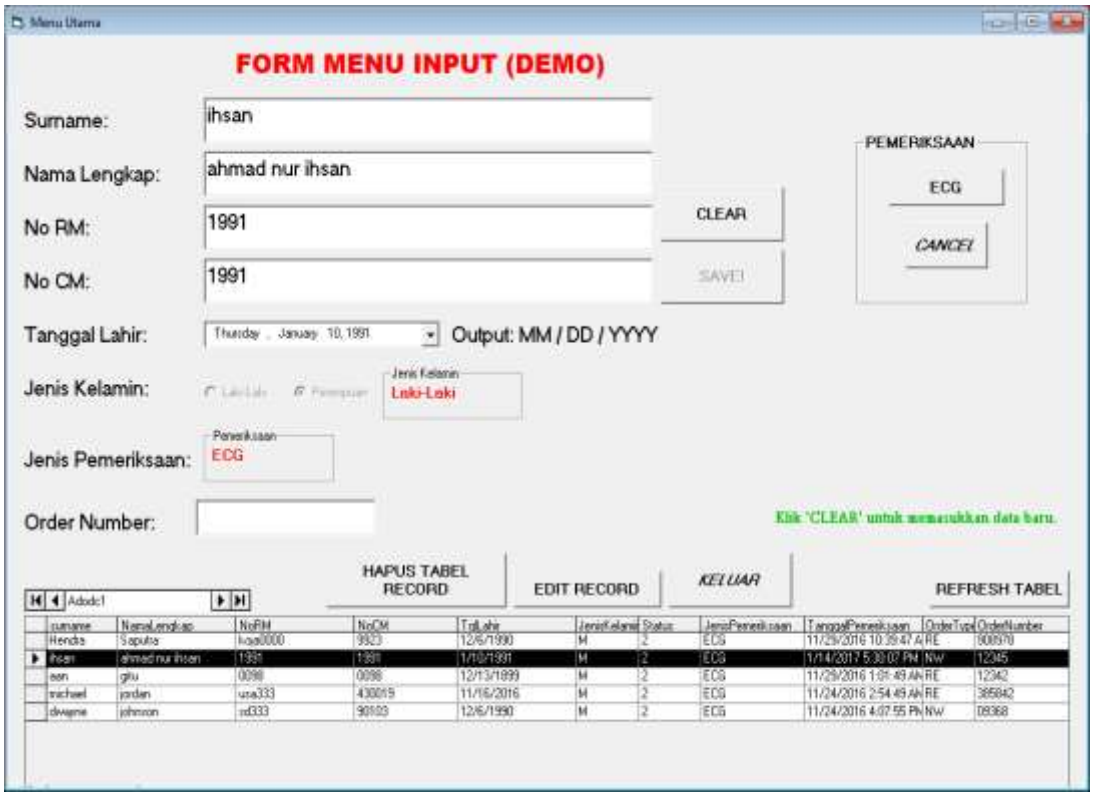

Figure 4. Input a Patient Data Field with HIS Simulation.

The picture above is the process of inputting patient data into the HIS, where at this step is the stage of storing patient data only and has not been sent to the Cardio Point application.

surname	NamaLengkap	NoRM	NoCM	TglLahir	JenisKelamin	Status	JenisPemeriksaan	TanggalPemeriksaan	OrderType	Orde
Hendra	Saputra	koja0000	9823	12/6/1990	M	2	ECG	11/29/2016 10:39:47 A	RE	9089
test	his	wef54	wef54	11/10/2016	M	2	ECG	12/7/2016 3:02:21 PM	NW	0987
xiaomi	redmi	321	321	11/16/1991	M	2	ECG	12/20/2016 9:15:13 AM	RE	3214
les	sis	12343	12343	11/9/2016	M	2	ECG	1/10/2017 2:10:30 PM	CA	321
hhh	aaa	123	123	11/6/2016	M	0		1/12/2017 2:33:09 AM		000
ihsan	ahmad nur	1991	1991	1/10/1991	M	0		1/12/2017 3:27:38 PM		1234

Figure 5. Stored Data Patient (Highlight).

The status column above will be filled in automatically by the program where the initial status given is 0. To perform an examination, the steps taken are to select one of the data records as shown above, then click the type of examination button.

When the button is clicked and the message is sent to Mirth Connect, the order type field will be filled with the NW notification. This NW type is a notification sent to the Mirth Connect application that there is a new examination request sent by the HIS application, where the meaning of NW here is new. When the data is in Mirth Connect to be sent to the Cardio Point, the data sent by the HIS will be transformed / formatted into an HL7 message so that it can be received by the destination application.

surname	NamaLengkap	NoRM	NoCM	TglLahir	JenisKelamin	Status	JenisPemeriksaan	TanggalPemeriksaan	OrderType	Order
Hendra	Saputra	koja0000	9923	12/6/1990	M	2	ECG	11/29/2016 10:39:47 A	PE	90897
rest	hs	we54	we54	11/10/2016	M	2	ECG	12/7/2016 3:02:21 PM	NW	0987
xiaomi	redmi	321	321	11/16/1991	M	2	ECG	12/20/2016 9:15:13 AM	CA	3214
tes	sis	12343	12343	11/9/2016	M	2	ECG	1/10/2017 2:10:30 PM	CA	321
hhh	aaa	123	123	11/6/2016	M	0		1/12/2017 2:33:09 AM		000
ihsan	ahmad nur ihsan	1991	1991	1/10/1991	M	2	ECG	1/14/2017 5:30:07 PM	NW	12345
uji	coba	222	222	12/5/1899	M	2	ECG	1/14/2017 5:24:48 PM	NW	0909

Figure 6. The Transformation of Record Status and Examination Type.

There is a change in status, type of examination and type of order (order type) in the column above. Where the status changes its value from 1 to 2, then the check type column is filled with ECG, and the order type here is NW.

The next process is data transformation which is connected to the HL7 connector. In this Mirth Connect application, patient data will be received and processed on the configured channel, namely the db-HL7 channel. This channel will connect the originating database of the HIS database and the receiving application of the HL7 connector.

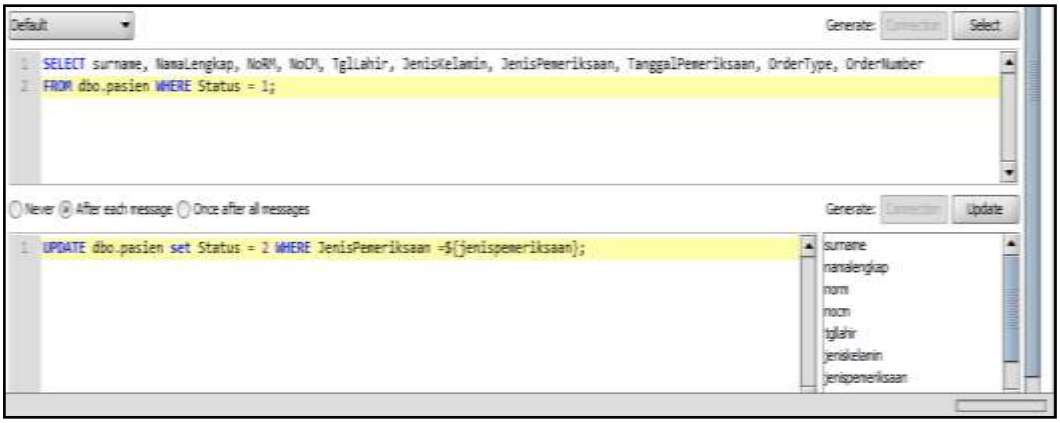

Figure 7. Query Process of Patient Data in Mirth Connect.

Connector	Status	Received Date	Response Date	Errors	SOURCE	TYPE
Source	TRANSFORMED	2017-01-22 14:39:40:023	–	–	–	–
BTL HL7 Connector	SENT	2017-01-22 14:39:40:073	2017-01-22 14:39:40:197	–		ORM-O01

Figure 8. Communication Status Between Data Source and Health Layer 7 (HL7).

The picture above is the information that was notified by Mirth Connect when the message inputted from the HIS simulation application was successfully transformed. The blue selected table column above shows that the status of the message change from xml to HL7 has been successfully carried out, where the status is Transformed. While the white table column shows the status of the message that has been successfully converted to HL7 message format with type ORM-O01. There are also columns received date, Connector, and response date which shows the time the message was received and the origin of the type of connector used to send data and the response time when transforming the message.

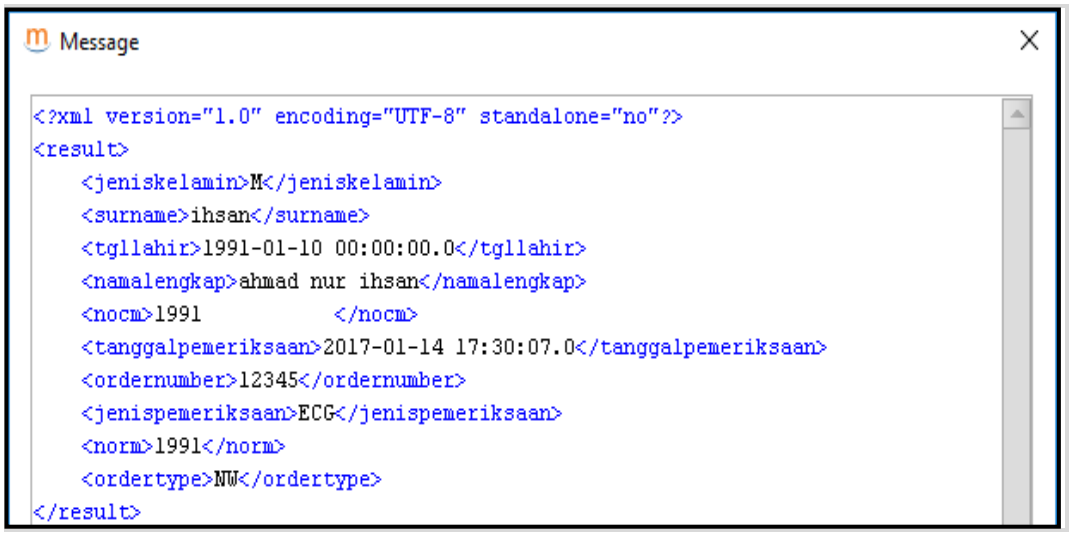

Figure 9. Patient Data mapping with XML Format.

The picture above shows the messages sent from the HIS simulation application are mapped according to the order of the existing records. This mapping is done to make it easier to change the format from XML to ORM type (HL7) with the contents of fields or records that match the original data. There is a process that goes through the XML data when transforming the data into HL7 format in Mirth Connect. To find out the process, it can be seen in Figure 4.5 where there are Source and BTL HL7 Connector columns. The process of transforming XML data into HL7 form begins with the initial Source connector which accommodates XML data then the initial patient data structure is broken down from the original database into XML then the patient data is mapped into HL7 format based on a predetermined index sequence.

The process of transforming XML data to HL7 can be observed in the explanation of the javascript command for each patient field below:

tmp['PID']['PID.5']['PID.5.1'] = validate(msg['surname'].toString(), '', new Array());

Transforming Data from Cardio Point Application Into H.I.S

To see the status of the data sent from the Cardio Point to the HIS application, all you need to do is observe the changes in the status column below.

Id	Connector	Status	Received Date	Response Date	Errors
66	Source	TRANSFORMED	2017-01-22 15:53:55:813	--	--
	delete-insert-update	SENT	2017-01-22 15:53:55:877	2017-01-22 15:53:56:790	--

Figure 10. Message status that sent in Mirth Connect.

In the source column, this connector aims to transform the data structure sent by the Cardio Point application and then remap the data structure before being sent back to the HIS application. The transformed data will then be sent back to the HIS application and will change the status of the examination results to a value of 3.

The data mechanism that is transformed in Mirth Connect is the same as the delivery flow from HIS to the Cardio Point application, the difference lies in the status and order type that is filled. After the examination is completed and saved in the Close Examination dialog box, only the status and order type are changed in value with the aim of indicating that the examination has been completed. The data type used in this processing is ORU-R01, where this type also has a feature to print the data examination in the form of a PDF document that is stored in a predetermined folder.

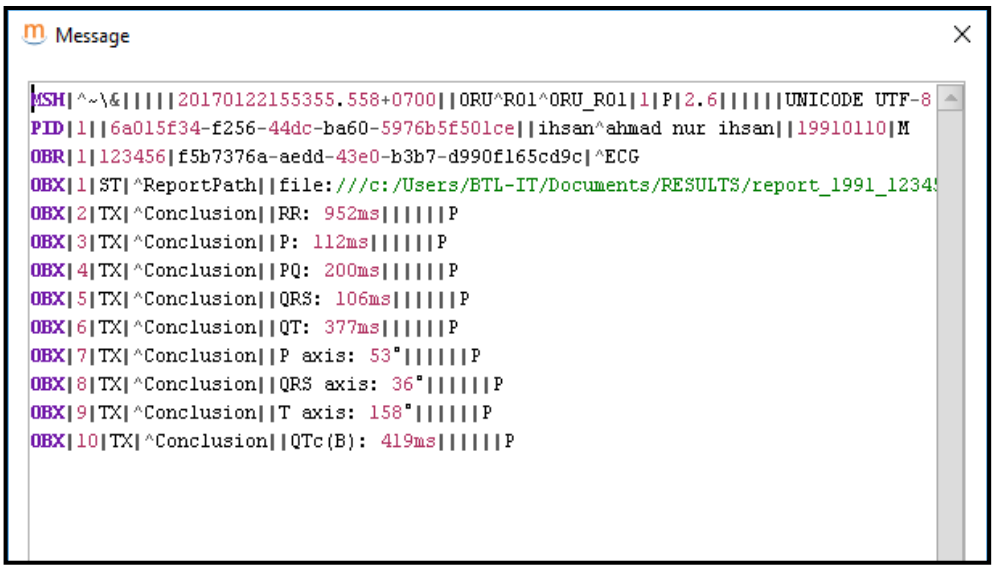

Figure 10. Message status that sent in Mirth Connect.

The results sent by Mirth Connect show data changes in the HIS application table image selected below.

NoCM	TglLahir	JenisKelamin	Status	JenisPemeriksaan	TanggalPemeriksaan	OrderType
9923	12/6/1990	M	2	ECG	11/29/2016 10:39:47 A	RE
333	11/17/2016	M	2	ECG	1/22/2017 2:38:25 PM	NW
1991	1/10/1991	M	3	ECG	1/22/2017 3:53:57 AM	RE
0098	12/13/1899	M	2	ECG	11/29/2016 1:01:49 AM	RE

Figure 11. Data changes in H.I.S simulation app.

The results of data changes can be seen in the status column and the selected order type. In the order type column, the notification will change to RE (Recorded) if the previous examination process at Cardio Point has been successfully saved.

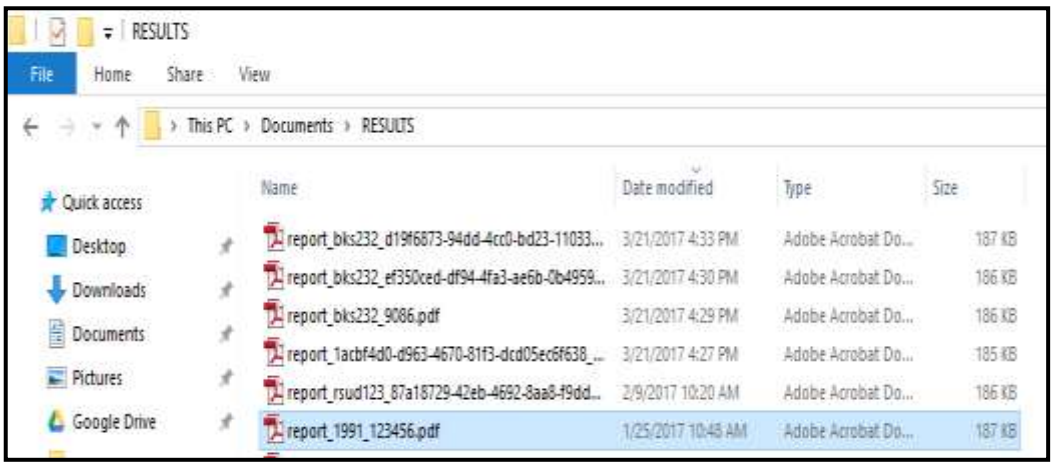

Figure 12. Examination report that stored in folder.

The above is the result of the report from Cardio Point stored in the folder, where the file selected above is the result of the examination test with PDF format output with the file name report_1991_123456.pdf. The file name is composed automatically of the report name (default), year of birth and order type (order type).

The Process of Sending Data From The ECG to The Computer

This design process also involves communication on the hardware between the ECG and the computer. The earliest process usually begins with the sending of an analog signal from an electrode cable attached to the patient's limbs. Then it is forwarded to the device to be processed into a graph that is displayed on the ECG display and computer. The following diagram illustrates the process of sending data from the ECG device and computer.

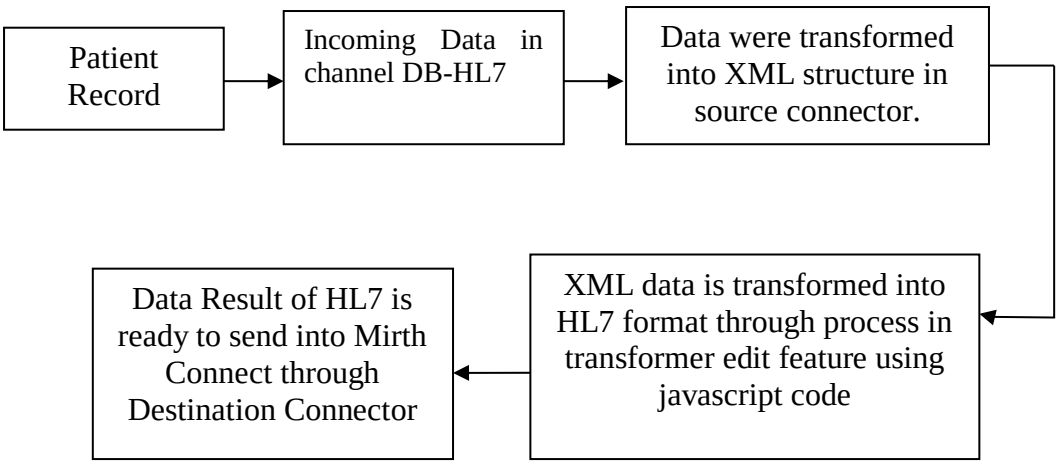

Figure 13. The Diagram of ECG data transmition into Computer.

From the electrode connected to the patient, the signal is transmitted and amplified by an amplifier, then goes to the baseline filter with a frequency of 0.05Hz. Furthermore, the analog signal is processed into digital form by passing through a 13-bit A/D converter. After that, the data from the converted signal will be transmitted via the RS232 serial port and cable into a computer, which of course has the Cardio Point application installed.

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