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Business Intelligence Infrastructure of Medical Record Data History System to help Doctorin differencing rare and dangerous disease in patient

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ABSTRACT

Historical data is beneficial for company development, and it uses to make decisions about the data processed. Using Business Intelligence (BI) technology can help various kinds of analysis on large amounts of data, with BI we can do data analysis to be the right decision based on the history of the stored data. This study mostly talks about the implementation of BI. And this paper uses a BI approach to help doctors dealing with rare and dangerous diseases such as Coronavirus, Sars, Mers, Von Hippel-Lindau syndrome, Fibrodysplasia Ossificans Progressiva, and Paraneoplastic Pemphigus, so they can find solutions to deal with the disease appropriately. Historical medical record data obtained from hospitals that have a medical history of rare and dangerous conditions for doctors in diagnosing diseases in patients. This research will use the OLAP method to describe data visualization. This system is a solution for decision-makers to be able to decide the diagnosis of the disease that occurs in patients in patients.

Key words : Bussiness Intelegence, OLAP, Disease, Bussiness Intelegence Services, Dangerous Disease

1. INTRODUCTION

Organizations face essential challenges in an increasingly competitive environment, where information is the primary source of competitive data in business today in the world. The main objective of BI is to support managers in the decision making the process of a problem faced (Nedelcu, Sgarciu, & Jigau, 2019). Put, managers need better information to make better decisions. BI has increased interest in companies as a way to improve service quality, reduce promotion costs, and also be a tool for making decisions precisely according to the desired results (Anwar Lashari, Ibrahim, Senan, & Taujuddin, 2018)

At present, the world of health has increasingly advanced in applying information technology in the field of medicine. The health care sector is one of the most dynamic industries because the health and economic sectors have become one of the top priorities of the European Union (EU) and each country. By using sophisticated medical information technology, such as mobile devices or connected devices, its to compare the patient's vital signs in the hospital, making it easier for doctors to diagnose patients in the hospital. Using business intelligence systems (BIS) to process hospital medical big data, can improve administrative efficiency to make better decisions, most related studios in the medical field have approved funding assistance and BI system development, and some have supported the development of BI maturity and his decision on the quality of the decision (Chauhan & Jaiswal, 2016)

In this paper, we focus on utilizing BI in making decisions on one's medical record to assist doctors in diagnosing patients' illnesses. When considered dangerous or not, the system will provide a patient diagnostic decision based on data processed from medical record report data. BI can determine one decision-making tool in which this application offers choices for organizations to choose the best from the options listed to apply in the organization.

1.1 Bussiness Intelligence

The term Business Intelligence is the most topic talked today, present in about 1990, which is to review activities and tools related to reporting and analyzing data in a data warehouse. BI uses an extensive volume system and inserts it into the data warehouse (Hatta et al., 2015). This system has helped organizations determine complex processes and relationships by providing the right decisions about organizational data.

Once archived, the data to produce reports that can get used for business analysis which may require an evaluation process that can drive business decisions or allow organizations to

reach decisions about events (Rezaie, Mirabedini, & Abtahi, 2018). Some consider BI as reporting data and visualization. It is more appropriate if business intelligence is a term used in business management to describe applications and technologies used to integrate, access, and analyze organizational data and information to help make better business decisions.
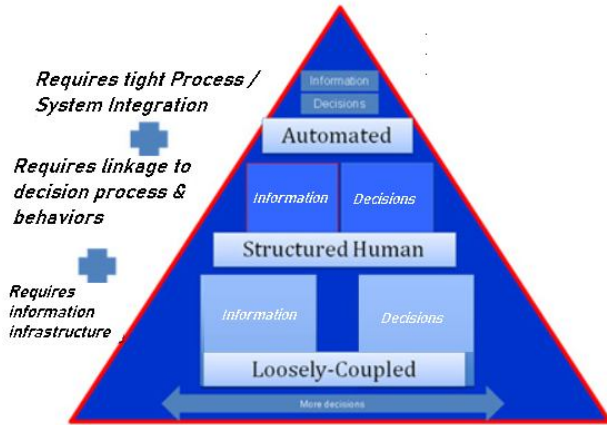

Figure 1: The Basic Principle of Business Intelligence

1.2 Deployment Model

Business intelligence helps managers to make decisions about their organizations and the informed decision made from historical data processed so that it is more efficient in creating substantial competitive advantages. In determining organizational decisions, BI has described as one of the top 10 priority Chief Information Officers over the next five years (Hina, 2017).
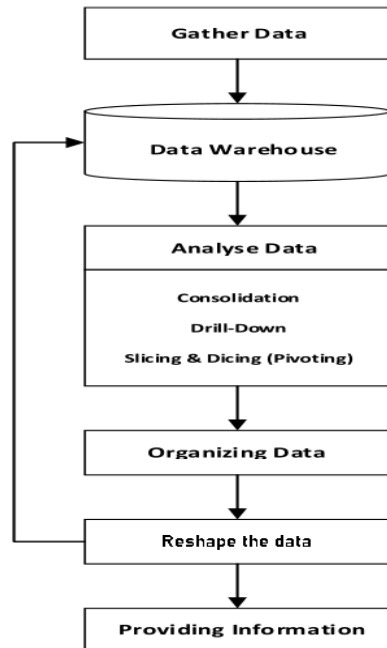

Figure 2: BI concept of processing data in general

1.3 Data Real Time Business Intelligence

The meaning of BI realtime depends on its understanding of what agreed within realtime for business. There is no resolution approved here, agreed with realtime in BI, that is, every user needs a decision on the data they want so that the data can accept at any time.
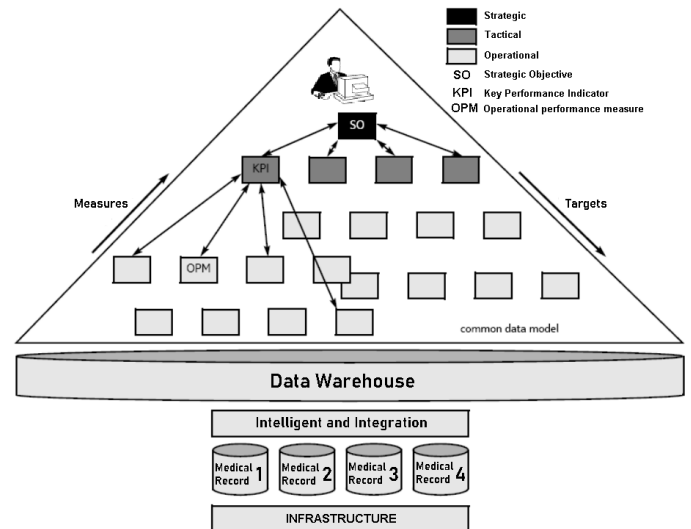

Figure 3: BI real time processing i hospital system

The meaning of BI in real-time depends on understanding an agreeing with things with real-time for business. There is no resolution approved here, agreed with real-time with BI, that is, each user needs a decision on the desired data so that the data decides at any time. BI can be used to improve decision making at the level of profitability of health organizations (Hina, 2017).

2. BUSINESS INTELLIGENCE SERVICES IN HOSPITAL

BI serves various departments that require extensive in the health sector; the benefits that bind BI in the health care environment are extraordinary. All health workers need adequate data and information management tools to make the right decisions inpatient status, improve patient care, provide appropriate care, and educate patients and families about the clinical management of various conditions (Rezaie et al., 2018)

BI must be used to facilitate decision making through the integration of information with business processes. This integration is becoming increasingly important in the health sector. BI Health Services must help management understand the capabilities of companies and facilitate clinical and administrative decision making defining the benefits of implementing BI in an already exceptional health care environment (Hui et al., 2020). Several BI benefits for health care organizations viz :

a. The ability to optimize resources (including physical space, equipment, and devices, staff, and competencies) in each department, such as surgical services.

b. The ability to develop and improve key performance indicators and clinical indicators to improve performance and quality.

c. The ability to plan, budget, and estimate more efficiently and accurately in all large organizations. The Implementation of BI can make it better for ensuring patient safety through efficient diagnostics and identification and best practice care. The ability to withstand costs and improve performance and quality through human resource management and physician profiles.
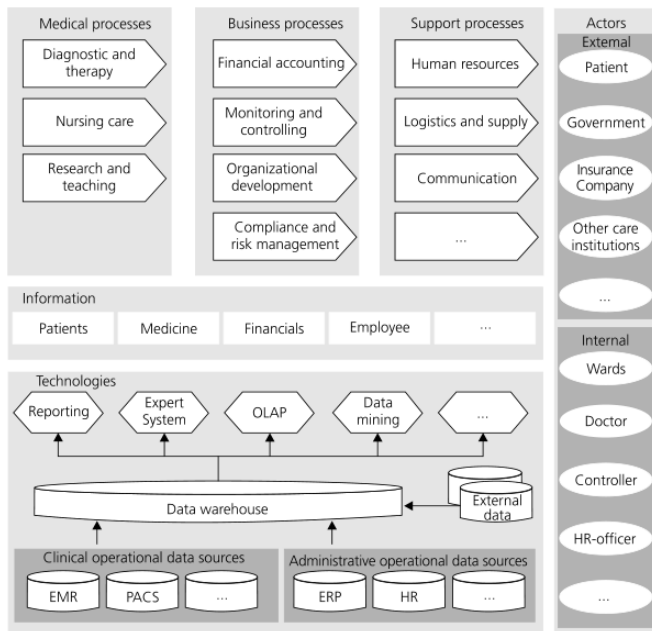

Figure 3: BI Framework in Hospital

2.1 Patient Medical Record Information

Patient data usually scattered throughout the department of health service organizations with a different system architecture in each information system built. Some of these are operational systems that run health service businesses. The date usually uses for health business intelligence and reporting purposes, such as data marts, data warehouses, where all patient information obtained, stored, and can be accessed (Tang et al., 2010). The data warehouse is a separate transactional data repository that provides patient-related information, and strategic infrastructure for decision support for data that is processed .

Most operating systems can complete patient data. Over the last several rounds, health workers have collected patient data in the database of health service organizations to make better

health care decisions. Patient data always stored in a relational database, such as Oracle, Informix, Sybase, DB2, or SQL Server. Data can also be stored in flat files, log files, or other structure files. Data mining is usually done by taking data on separate platforms and even different architectures but requires patient data approved by other systems. Data mining is a process of exploration and analysis, by automated means of extensive patient data to find patterns and rules that contribute (Azvine, Cui, & Nauck, 2005)
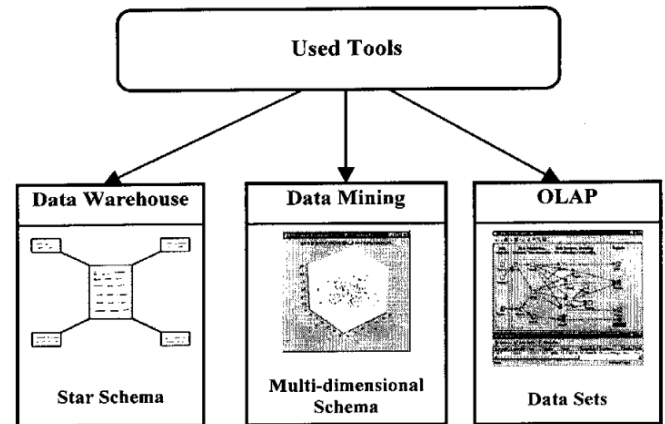

Figure 4: The type of data needed for BI

The database, as described, is a shared collection of logically related data that design to meet the information needs of health care organizations. The database is also a central repository for all information about the relationship between health care organizations and their patients. Patient data analyzed for BI use comes from internal and external sources. Internal sources such as administration, medical, and pharmaceutical departments (Kim et al., 2020). External causes such as data, government, demographics, geographical. Data purchased externally includes data created by local users, graph and map-based data, statistical data, web-based data, direct mail, and critical economic indicators produced by the government.

Some of the tools used to achieve this are patient profitability analysis, marketing analysis, campaign management, and sales contact management. These tools are applied to BI databases, enabling hospitals to develop theories about how patients can respond to initiatives and then take patients' actual responses as data sources. The BI system can use all of the tools and applications above to analyze patient information based on the regularity of observed patient behavior (Jiang, Xia, Ying, & Lu, 2020)

2.2 On-Line Analytical Processing

OLAP is a technology that enables analysts, managers, and executives to access data. That is fast, consistent, and interactive with various variations and visualization of

information that supports each row of data that can transform to reflect the dimensions of the company or organization that is easily accessed by users or users. OLAP is a dynamic synthesis, analysis, and integration of large volumes of multidimensional data. Data marts are a subset of a data warehouse, and they are design to support specific business requirements or functions for Online Analytical Processing. (Connolly dan Begg, 2001).

The main characteristics provided in On-Line Analytical Processing are:

 a. The use of the use and use of data warehouses that have multi-dimensional data.
 b. Providing complex interactive query and analysis facilities.
 c. Providing drill facilities to obtain the required information.
 d. Able to produce calculations and compare.
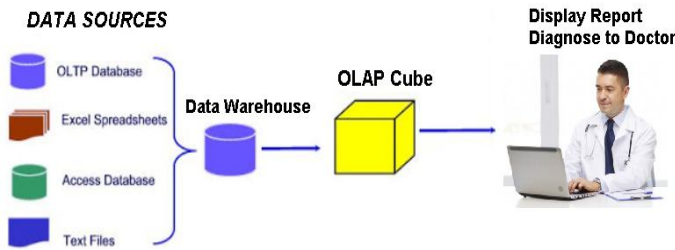 e. Able to present results in the form of numbers that are easily understood and presented in graphical form.

Figure 5: OLAP Concept for Medical Doctor

2.3 Medical Data Warehouse

Edward Devlin first used data Warehouse, but Inmon has received appreciation for introducing the concept of a data warehouse, defining it as a subject-oriented, integrated, non-volatile, and time-varying data collection to support management decisions (Anwar Lashari et al., 2018). In a data warehouse, conventional business is different from the clinical medical data warehouse. The main difference in the data warehouse is the medical data warehouse, which has data sets that are easier to integrate, has small granularity, zero volatility, and always has historical data. However, all the data has one goal, namely to unite in a complex and diverse knowledge base into data that can be useful for use.

	Conventional	Clinical
Integration	Yes (hard)	Yes (easy)
Granularity	Medium	Small (drill back)
Volatility	Low	Zero
History	Sometimes	Always

Figure 6: Difference Conventional and Clinical Data Warehouse

2.4. Medical Data Mining

Data mining is a method of mining data or data discovery and new information by looking for specific patterns or rules of extensive data. Data mining can be a process of completion or collection of added value in search of knowledge that has not been known manually from a data set (Anwar Lashari et al., 2018).

Data Mining has links with other scientific fields such as database systems, data warehouses, statistics, machine learning, and information retrieval. Besides, data mining is also supported by other scientific fields such as neural networks, introducing patterns, spatial data analysis, image databases, and signal processing. Data Mining is an activity or process of looking for a pattern in data and in finding suitable patterns of large amounts of data, data stored in a data house, an important task of data mining is to pre-manage data.

Using data mining algorithms for medical data, when conducting research, a clear understanding of the data must be indicated that the data is unsupervised or supervised. Descriptive mining data group data by determining object similarity and detecting unknown patterns. Descriptive investigative data mining includes grouping, association, summarization, and sequence discovery.
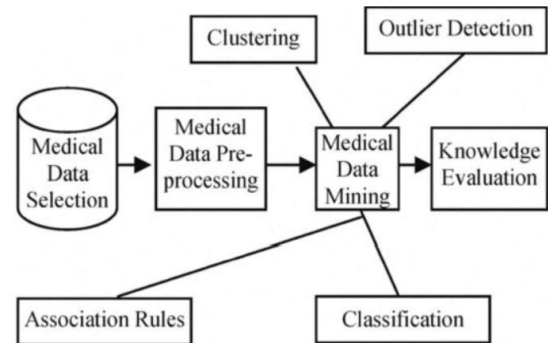
Figure 7: Medical Data Mining Framework

Data Mining Techniques, which are the latest applications in the medical field to find patterns, predictions, classifications and groupings of data processed. Until now, there have been many studies on data mining and decision-making systems developed to make diagnosis and prediction of diseases more accurate, especially in predicting heart disease, lung and breast cancer and remote health monitoring .

3. IMPLEMENTATION BUSINESS INTELEGENCE FOR DIAGNOSIS OF PATIENT'S DISEASE

Nowadays, many information technology developers in the health sector utilize business intelligence techniques in determining the outcome of a decision in a health problem. The business intelligence services are in the form of digital data processed on computer machines that connect on a computer network. Previously, if a doctor wanted to diagnose

a patient, the patient would be given a complete medical check-up. Then the doctor diagnosed the results of the medical check-up so that the doctor could find out what was happening to the patient through the characteristics obtained from the patient's medical check-up results who are having an illness.

But sometimes the doctor cannot make the right decision when making a diagnosis because, from the medical results of the patient's check-up, the disease suffered is rare and dangerous. This moment cannot be detected because the doctor has no experience in dealing with the disease.

And finally, the purpose of the BI system of medical record summary is to offer a solution for doctors to quickly diagnose rare and dangerous diseases from the medical record data on order directly. , harmful, or not. With a system that functions like that, doctors need not be confused because they cannot diagnose (Schieppati, Henter, Daina, & Aperia, 2008)

3.1 Research Procedure

In building software models that have the characteristics of a systematic, consider the sequential model in developing software using the Waterfall type. This model is a systematic approach and sequence starting from the requirements level and then goes to the analysis, design, coding, testing/verification, and maintenance stages. This model calls a waterfall because it consists of steps by stages through which must wait for the completion of the previous phase to start the next scene.
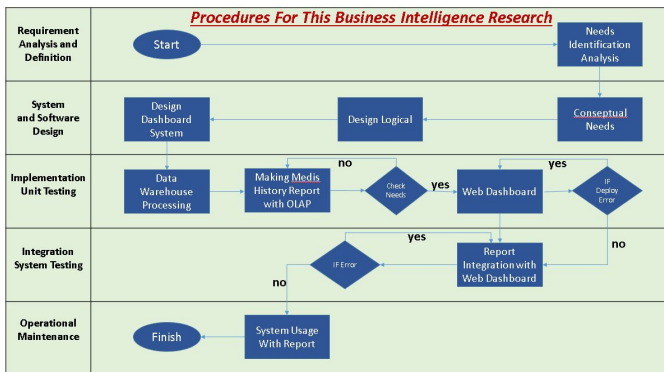

Figure 8: Research Procedure for this BI System

The research procedure shown in figure 8, can discuss as follows:

a. Analysis and approval

The process of analyzing and gathering needs, based on data warehouse sources and the Business Intelligence web portal system process that will build according to user needs. The Business intelligence system (web portal users)

that rely, such as doctors who have access to view data reports, business intelligence systems decide on decision making, information analysis, knowledge management, and human-computer interaction (Mettler & Vimarlund, 2009)

b. System Design

The Conceptual Design Process, at this stage, carries out the process of making design data by the warehouse. This concept will be analyzed the size and dimensions that will use. The Logic Design Process at this stage is carried out the planning and making necessary data by making relation data and disconnecting one attribute from another attribute. This stage also analyzes database storage and database settings. Conducting efficient data design will facilitate the collection of information in the health system and provide better details for the implementation of intricate analytical details (Larson & Chang, 2016)

The Physical Design Process currently explains data cubes that are ready to be used in a data warehouse. This stage also includes a revision that can already be implemented in the data warehouse to build. Before entering into the process of making a data warehouse, data collection, and analysis of values and attributes are carry out to get the right qualities to create a data warehouse (Dedić & Stanier, 2017)

3.2 Implementation and Testing

Process Pre-Process data consists of processes before entering into the data warehouse processing, and data must process first because data warehouse usually has very different requirements from traditional database users (Anwar Lashari et al., 2018). The following data pre-processing stages are:

a. Data integration carry out integrated with the required attributes of the tables that have processed.
b. Data reduction finished in conjunction with the data integration process, which is by sending additional characteristics from the prepared schedule.
c. Data cleaning is data cleaning done on components that are not meet.
d. Data transformation is the process of equating attribute names, generalization, aggregation, and attribute construction. The final stage of this transformation stage is the formation of a data warehouse.

The use of Three Tier can be quickly and easily in its design when creating a data warehouse. Therefore in making Data Warehouse enjoyable in three-tier data warehouse architecture, they are:

a. The lower level is the lower layer is a database system that functions as a data processing.

b. Middle Layer, The Middle Layer, is the middle layer that

holds the cube structure storage area, which is commonly called the OLAP Server.

c. Top layer This top layer is a layer for end users that has the function of providing guarantees from the contents of the home database, which are the result of OLAP operations.
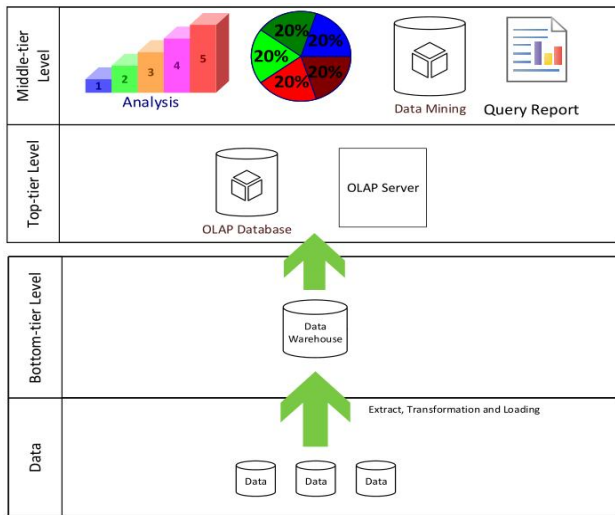

Figure 9: Three-Tier level Data Warehouse Architecture

The design of a web portal system consists of the process of creating a Business Intelligence system portal web interface for access to doctors who want to diagnose patients who are communicating. Tapan consists of a login page and a web-based menu page that will design.

3.3 Integration and System Testing

Integration of Reports and Web Portals succeed by integration between statistical reports and dashboard reports with web portals, then checking for errors. If an error occurs when it is work, it can success repairing the system. System testing is chosen based on its available performance, with testing that will ensure a useful examination of the data.
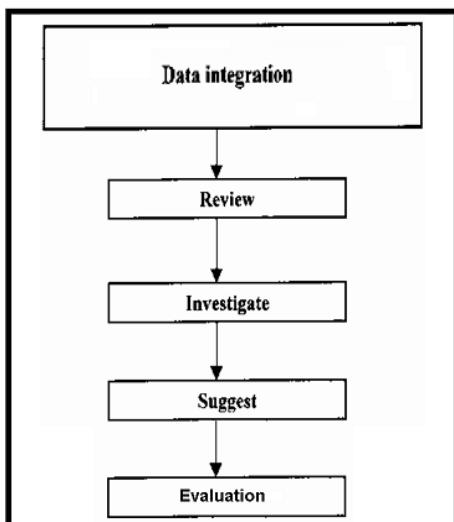

Figure 10: Process Data Integration

4. PROPOSED BUSSINESSUSSINESS FOR HOSPITAL

The Business Intelligence system framework is a complete depiction of the components that form the foundation. Using the basic structure will facilitate work in a supported system.
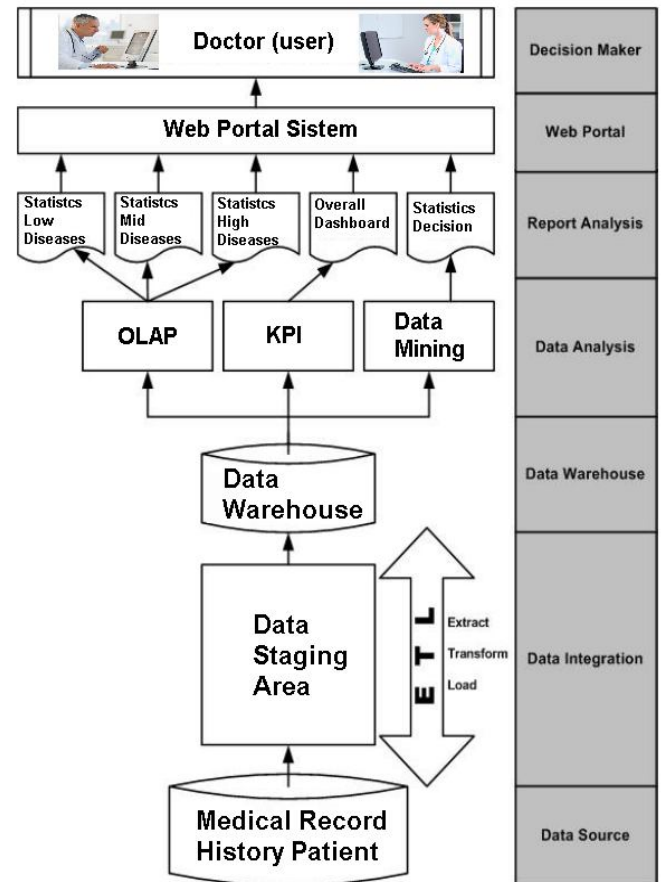

Figure 11: Basic Framework for System

Penjelasan pada Figure 11, sebagai berikut :

4.1 Data Source

The data source took from a database of patient medical records in hospitals that have a medical history of rare and dangerous diseases. Furthermore, the tables to be made are selected according to the needs of the data related to the specific patient diagnostic data.

4.2 Data Integration

It is a process of integrating data from data obtained and then processed and made into one combined with other data and becomes data that can be a source of user decisions (Kolowitz & Medical, 2011). The following description base on the process:

a. The preparation of data to integrate, namely the process of collecting data to be integrated, can be a data set that is ready to be processed by the system.

b. The integration of data from the transition process is needed; this table has functions that suit the needs of the results.

c. Data reduction, this process is carried out in conjunction with the data integration process, which is removing the attributes that will not use from medical distribution data that has done previously analyzed.

d. Data cleaning of data from the process carried out on attributes that do not have consistent data. This is done by removing or equating perceptions using minimal values.

e. Data transformation is the process of moving data and loading data from data staging into a data warehouse by executing packet execution.

4.2 Data Warehouse

The data warehouse used is a relational database whose data is ready to be processed before it is described in analyst statistics for users to determine the results to be processed by the system to be processed.

4.3 Data Analysis

Process data analysis here is conducting a process analysis to make the data displayed, and it consumes by users. The following components are used, namely:

a. OLAP in this study uses cubes or squares such as Rubiks, to create statistical analysis reports with a browser to see the final results of the request process from the cube containing the news deployed to the analytics server.

b. KPI are used to generate the main dashboard report on the system. In this research, the KPI build after the cube process, and the results of deployed to the analytic server.

c. Data Mining the process of applying data in this study uses a decision tree algorithm, and the tool used is the mining structure. The data uses more specifically to see the decision tree tracking graph. This processed data will produce prediction reports based on training data based on historical data input. The results of the drilled data mining will deploy to the analytics server.

4.4 Report Analysis

Analysis of the Implementation report is a report created as support in decision making because the report format is related to the analysis and dashboard of the portal web page. In this study, statements made in the form of graphs and indicators from OLAP data sources that are analyzed by the server. The results of the report are published or developed in the way of a report on the application.

4.5 Web Portal

Web Portal is a web-based program to connect (links) between users (users) with statistical analysis reports, dashboard reports, and forecast reports. Utilizing a web portal is useful for reporting unauthorized parties' reports and can also help legitimate users access this system to view statistical data on the graph. The design of the display in the form of a portal as follows:
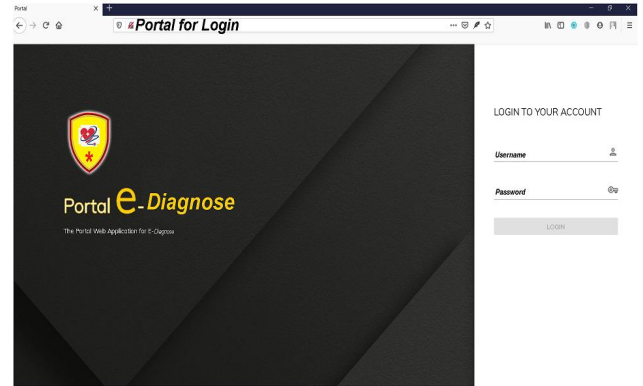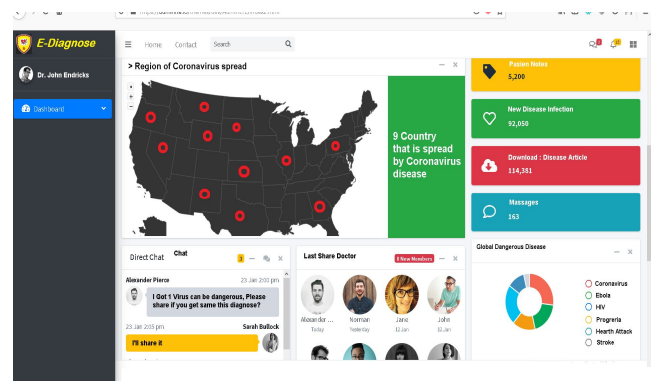

Figure 12: Login Page
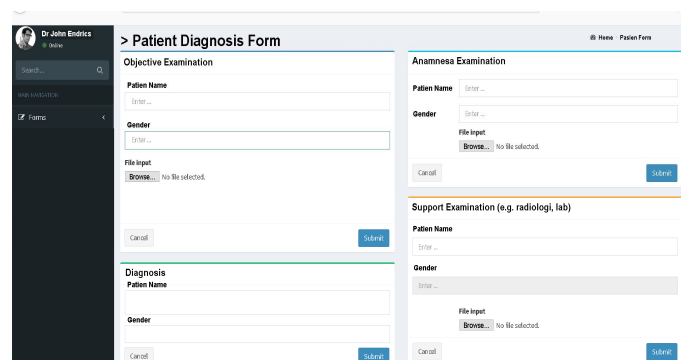

Figure 13: Dashboard trending disease in the world
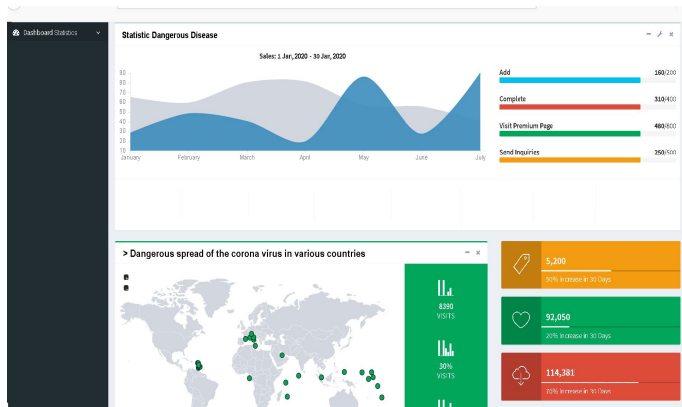

Figure 14: Diagnose Form

Figure 15: Result Form for alalisys and diagnose patien

This page is a display of what diseases are trending in the world, then the chat column, the friendship between doctors, and other menus. By seeing the doctor can see and be alert if there are diseases that are trending and dangerous.

5. CONCLUSION

Business Intelligence uses as a solution for making decisions in making decisions. At the same time, the Business Intelligence system starts with data integration, then makes data analysis, then makes analysis reports and makes a web portal. The statement displays the results of the study and graphs. The Business Intelligence system process flowchart includes data sources, data integration, data warehouse, data analysis, and web portals.

By using these web portals in the world of health, it will facilitate and improve the work of doctors in diagnosing patients. Because all this time, if doctors are unable and able to make a diagnosis, then they must prefer to determine the decision to diagnose the disease that occurs in patients. Because with this system the doctor can not decide on the diagnosis so just by uploading the patient's medical data, the system can easily find the patient's disease, because of the system.

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