**Chapter 2**

**REVIEW OF RELATED STUDIES AND LITERATURE**

This chapter presents the related literature and studies after a thorough and in-depth search done by the researchers. This will also cover the related literature for topics relevant to the method. These related studies helped the researchers in determining the appropriate approach or technique in predicting or getting the efficiency of the data to predict he grade and performance of the student. These studies supported the need for the research objectives. These related studies and literature helps the researchers know the comparison about other NoSQL database and MySQL database which helps the researchers study more about the big difference of the research about comparison of Firebase and MySQL database. These related literature and study also helps provide the formula or solutions on how to solve logical and analytical problems regarding the research that is a big help in determining the process and outcome of both Firebase database and MySQL database. These related studies and literature also helps in determining what database is better to be used in real-time database and could help other problems the researchers and future researchers will encounter in the future.

**Review of Related Studies and Literature**

The following study and literature are concepts which can help the proponents of the study and helps on determining the outcome of the research.

According to Kumar and et al., the difference in both databases about NoSQL Databases that allows data persistence in nested state and have the ability to query the nested data and undefined fashion with embedded queries. They also concluded that the application that storing such a big data, it's more reliable to choose NoSQL than MySQL from query speed comparison and complex query time. On the other hand, NoSQL can handle to store big data, queries lots of data, and general lives database on mobile application. The NoSQL database like firebase, MongoDB etc. is automatically converted as JSON format while MySQL still goes to a document store function which stores it and convert it to JSON format which is a big factor that affects the speed of MySQL which makes a NoSQL database speed of showing the result.

This study it benefited the researchers with the following because, the research did a big help to determining the speed and process of both databases and determine which database is better at storing data when the data is more than it can handle.

According to Raut (2017), The NoSQL is the alternative to be the most widely used relational database for storing data which does not replaces the SQL but, instead it compliments it in such a way that they could both co-exist. The NoSQL database has a mechanism for retrieves and stores data that is formed in a tabular relationship that is used in relational databases. There are many advantages on NoSQL which RDBMS cannot be solve properly such as, the scalability is better, high availability for it can be used to any type of application and has also a low latency, it is affordable or cheap in price than other RDBMS and is also high on control over the performance characteristic. RDBMS Users have to scale relational database on powerful servers that are expensive and difficult to handle and to scale the relational database it has to be distributed on multiple servers. In SQL it has to fit into tables and if the user does not fit into the tables, then will be required to design the database structure that will be complex would be difficult to handle. NoSQL is has a big advantage in solving data availability problems and it is more of a fast data than up-to-the-minute just updated data and that’s needed to scale it based on its requirements that are changing.

This research benefits the study because, it helps the researchers define the main starting point and strongest aspect of using NoSQL database like Firebase which is also a type of NoSQL and the comparison of using MySQL that could improve our knowledge and ways of using each databases.

According to Sareen and Kumar (2017), NoSQL can provide a zero-admin solution it is also gives a more flexible data model which doesn’t restrict much. NoSQL key value stores and documents also allows applications to store data virtually in any structure it wants in a data element. Unlike SQL databases it restricts to only a fixed data types and structures and in order to store information about a new data item, the database will need to be altered and it must be done in an offline. NoSQL is a preferable DBMS because, it can store more data, scalability and performance is better. NoSQL lacks true ACID which is not standardized and there is a particular apps that it does not work because of compatibility problems. NoSQL systems are sometimes called “Not only SQL” to emphasize and may support SQL-like query languages. Most NoSQL stores lack true ACID transactions, although a few recent systems, such as FairCom-TreeACE, Google Spanner and many more. NoSQL has a some problem on partition tolerance, but in most cases such as experiments with network partitioning often exhibited lost writes and other forms of data loss but, some NoSQL have a “write ahead logging” concepts which could avoid data loss.

The researchers and future researchers can benefit from this study because, it explains the functionalities and features of both kinds of databases which only not help improve the researchers or future researcher knowledge but will have an insight on what NoSQL(Firebase, MongoDB etc.) database such as Firebase and a MySQL database is all about and it also shows that there are some aspect that MySQL database cannot handle that NoSQL could and some aspect that MySQL is better than NoSQL which gives the researchers a solution when dealing with this problems and helps the researchers easily compare it with which is better than the other.

According to Zemzans (2016), learning NoSQL was a big part challenging to understand how it can be a big help today’s generation of huge data especially in real-time. The popularity of NoSQL, the researchers studied about basic database properties and requirements of NoSQL. It revealed a quite difference with SQL. It performed better than SQL in some occasion like integrating many different databases with separate roles that optimal in order to solve a problem in the best way. Deciding which database can be used for application should base on knowledge in database, platform support, language preference and sentiment.

NoSQL is better in every aspect and the main reason is that it is dynamic and there are no forms that makes it flexible and easy to be used while SQL consist of many restrictions such as that it limits data which produce persistent logs when that data is too big. SQL also limits the column data because it is only a single record or a small entity of rows of a table. There is also a big difference while SQL has ACID which make it possible to make it well organized while, NoSQL is more of a BASE and it has a better transition and consistency in the transactions.

This research literature benefits the researchers because, this research helps the not only the researchers but also the programmers and database managers to see the most crucial and essential thing when dealing with NoSQL and MySQL so that it can lessen the time to Identify the different parts of NoSQL (Firebase) and MySQL through this research the researchers could evaluate the pros and cons of using the databases.

According to Győrödi and et al., The most suitable non-relational database was MongoDB, because it can interact with thousands of user and can create private forums each user with its own flexible and dynamic structure. The advantage of MongoDB was provided lower execution of times than when it comes with storing many data and queries. So when it comes to application, it is more convenient to use non-relational database like Mongo DB because of its flexible structure that can shape to user's needs and it does not make a complicated process, designed to store large amount of data and de-normalized database which can increase the performance. It occupy more and more space on the market but SQL and Oracle are still constant so the ever changing needs on data storage and data processing, all of that NoSQL like MongoDB are better than SQL database and its biggest advantage is, its flexibility provides superior performance and their data model addresses several issues that relational model is not designed to address like large volumes of structured, semi-structured and unstructured data, agile sprints, quick iteration, frequent code pushes, object oriented programming, efficiency, monolithic architecture and etc. the research concluded that NoSQL is better in every aspect but, it has too many flaws such as they cannot properly sort out the relationship of the data and has yet to fully develop but it is a database that could exist in different platform.

This research helps and benefit the researchers because, it explain the way what non-relational database function and what it gives and provides the different flaws such as its relationship on each data and it’s design on which both database perform better and know the comparison between MongoDB and MySQL database.

According Teese (2015), everybody is building mobile applications and for web application and part of the value of almost any non-trivial application relates to the ability that can store data for the user. Rather than storing a data on a single device, users expect to make their data quick and easy to access across all other devices. Firebase is an API for storing and syncing data. Firebase provides client-side libraries for android, IOS, JavaScript frameworks and java. Firebase platform is a fully-hosted service that stores JSON format in a tree accessed via RESTful URLs. Firebase allows data to be shared between users. It also provides a server side rules that could restrict how the data can be accessed by a particular users. Firebase is simple querying capabilities. Firebase is live or real-time so if the data changes after, the query has been run it will automatically update. Meteor is also a platform that is used to build mobile applications and web applications. It is very similar to firebase that also has an impressive data synchronization capability, including live queries. However, it allows the developers to write codes that can run on both the client and server side. Meteor uses MongoDB as a data store. Meteor also provides command line tools for automatically data store. Meteor’s live-updating view library (Blaze) is designed to integrate seamlessly with its remote data syncing capabilities. The only downside of the integration is that developer have to learn the entirety of the framework.

This study helps the researchers because, the research compares the two NoSQL database on which is better in some aspect in building a mobile application. It is almost very similar but, in terms of integration it is hard in meteor because the user needs to first learn the entirety of the meteor platform unlike firebase it is easy to learn.

According to Jorge Vergara (2017), A SQL database is uses tables to store data. Those tables have columns and rows where the data is stored. Firebase is like a big JSON object that can store whatever developers want inside. Firebase is not like SQL because, it has no schema for the database, no models, no columns, it`s just a combination of key or value pairs. Firebase has a different flow because SQL has normalization while firebase has De-Normalization. Firebase also supports deep nesting for their data which has up to 32 levels. It is flexible and allows fast reads and minimal querying because developer can add just any information on the user’s node to help ensure the integrity of the data.

This study helps the researchers because it shows the structure and processes of Firebase and SQL. The advantages and disadvantages of using firebase and MySQL, the flexibility of firebase that could handle big data and supports deep nesting for the data in different levels.

According to Pore et al (2015), The SQL database is just a table base that is Relational Database and there are important concepts that were laid out by Codd that could overcome disadvantages of previous linked lists implementation in databases. Relational databases have a variety of limitations due to a constant growth of stored and analyzed and restrictions on scalability and storage. Because of this limitations the NoSQL database is formed to overcome problems and one of its important features is that it has no fixed schematic structure, records can have different field as per the requirement, this was called dynamic schema. NoSQL databases could provide has features that other databases doesn’t have and it is called “sharding” which takes database partitioning to a newer level and in a form could form a horizontal scalability and availability. RDBMS is better at manipulation of data and standardized queries. NoSQL Databases are most widely used in online applications and it concludes that NoSQL has many aspects that is way better that MySQL, but it needs better query and data manipulation to totally replace MySQL.

This research study shows that it benefitted the research because it explains how the NoSQL and MySQL differentiate with each other. MySQL has a feature such as; sharding which performs to divide into multiple servers, replication which reduces the heavy work. NoSQL is schema-less which provides data can be inserted without pre defining database schema. It is a structure of a data being inserted can be modified anytime.

According to Jamshidi (2016), NoSQL is a database that could deal with the problem of Big Data which they strive to be solved and improving how to handle Big Data. NoSQL is an approach to managing data and database design that comes handy when people are dealing with a very large sets of distributed data which gives persistent logs and it also consist of a wide range of architectures and technologies which are seeking to solve the problems in the performance and scalability issue with Big Data, which are not adequately addressed by relational databases. There is no specific definition on what is NoSQL at all it is, but it has a good definition on what is its characteristic would offer. First, it does not use relational models which are restrictions of a certain query which NoSQL solves that problem. Second, it is basically running well in all of the clusters which made it easier to adapt to any kind of application. Third, most of it is open source which made it more useful and available unlike other databases that needed licenses or monthly registration. The most important one is it is Schema-less type because, it is flexible and not that high cost rate. It also does not require confirmation on a rigid schema that one is required to live up through the life of the system. Does not enforce data type limitations on individual values pertaining to one single column type and can easily store structured data and unstructured data. It also eliminates the need to introduce additional layers to abstract the relational model and expose it in an object oriented format.

This research study helps the researcher provide an adequate solution and information about the problems which could occur to both sides of the databases and what is the specific way to produce a better performance and scalability when it comes to picking a database suitable on building an application and could easily know the big difference when it comes to encountering those kinds of problems.

According to Remedios et al (2013), Relational database has been widely used until now in database applications. "However, of late non-relational databases (e.g. XML and JSON) have been gaining ground in usage, particularly among internet-based companies such as Facebook, Twitter, Amazon, and Google; and the NoSQL technology has been adopted especially in applications that require data exchange over the internet" (Remedios et al, 2013, p 1). The research provides a comparative study of about relational and non-relational database involving a simple query in web applications. Relational model is basically a set of tables with rows and columns. The schema of the relational model is quite rigid that required to be designed in advance before data is loaded. A relational model commonly uses of SQL that are simple, easy and efficient to use in an application. While non-relational database such as JSON basically sets of label pairs and nested arrays. JSON is flexible when it comes to schema, it's easy to understand. In order method, JSON ordered by arrays, usually written in files that makes naturally ordered. Researchers developed a project called My Ref: A web-based food recommender system that conducted testing procedure to determine which database are efficient and performance between relational and non-relational database. The Researchers recorded the observation for each test case by the timestamp that records every time a query is submitted and time stamp that record every time the result of the query is returned. In the result of testing procedures of simple query process, the relational database retrieves fastest result sets. Relational implementation performed better because researchers use The MySQL environment to implement the system and run the queries; while for the JSON implementations, retrieved the results programmatically using PHP. But in future works, NoSQL systems like MongoDB will use when it comes in complex queries that are more than one table.

This study helped the researchers proved that when using NoSQL such as Firebase and other NoSQL database there is a big advantage because, it is easy to learn and has a better manipulation through the use of array type format than MySQL type databases which has many restrictions such as the keys and too many processes that undergo through.

According to Belleza (2016), Databases are the core of the today’s day to day operational and analytical business systems. They are commonly used on their application or projects which is the Oracle database which was a type of RDBMS. She stated that when the rise of the web era and other advancements in business systems, they saw that the RDBMS insufficient to help and provide the needs of the day to day analytical business systems and other operational systems. When NoSQL was discovered it was set to handle problems and thing like; unstructured data and data sets. RDBMS supported the table oriented data model while, NoSQL doesn’t use relational data model and basically have no trace of SQL. NoSQL permits a large amount of sparse data elements and it has a very flexible schema on the database. NoSQL has a schema less data model and doesn’t have a predefined attribute which, limited to query by keys. This is a good thing if it needs to have fast access. There are many more features on NoSQL which far better than any RDBMS like the Document store which is data is stored in a structured format (Document). The Wide-column stores which are extensible records that have the ability to hold very large number of dynamic columns. Graph DBMS such as Firebase is a type of database which helps represent the graph structures. There’s flaws that can be seen in NoSQL and is hard to populate the data.

This study helped the researcher provide the information about the difference of NoSQL and MySQL in terms of day to day operation. This research is all about the attributes, structures and process of MySQL and Firebase databases. Belleza, stated in the research that NoSQL type databases are better and at writing a query and unlike MySQL. But, Belleza also stated in the research that the flaws of NoSQL has is its problem at populating data and there was a lot of so called “empty space” between actual values.

According to Rozdoum (2017), Firebase is a platform which is intended to develop mobile application quickly and contains a diversity of tools that implements features for apps. It is used for purposes such as; data hosting, data analysis, data storage and many more. It stores and synchronize data in real-time catch me most.

Couchbase is a type of NoSQL database that keeps JSON document the same as firebase and couchbase provides security access and background synchronization between all clients. Firebase is a cloud based service which provides cloud messaging, hosting, notifications, remote configuration, app indexing, dynamic links and other helpful for developing the growing of the application. The research concludes that Couchbase is better at the server side because it can handle large amount of data and firebase is better on small and medium projects which make it easy to access and it also has a very simple functionality.

This study helps the researchers because it shows the difference in both NoSQL databases which helps the researchers determine which is better in building a mobile when it comes to storing real-time data. Firebase has much functionality that makes it better to couchbase such as dynamic links, cloud messaging, cloud hosting and many more.

**Benchmarking Analysis**

Database have an important role in business, especially in mobile application. Consumers nowadays are highly reliable and reliant in their mobile application. So, developers choose and evaluate which database are more reliable to handle such as big data. Upon in deeper research about the database, researchers came across in various database structure, libraries and frameworks in which researcher tried to use in their study, also to gain which database are most efficient and effective when applied in mobile application. Researchers focus about comparison of two database to analyze which database are best suited in mobile application. The study conducted testing procedure to test the two databases in basis of the query process, speed and accuracy in simple query to large query. GARDGIA application, a mobile application respectively chosen MySQL and Firebase. MySQL, a most popular open source database. The researchers take this as a benchmark because of unicode support, information schema, updatable views and query caching which helps researchers to understand and easy to use by users. While Firebase, a cloud-hosted database. Data is stored as JSON and synchronized in real-time for every connected client. Firebase stores in cloud storage at Google Scale. Researcher used Firebase because of its features, like real-time database which can retrieve and store the data in short time.

Firebase

MySQL

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| --- | --- | --- | --- | --- |
|  |  |  |  | |
|  | Widely used open source |  | Cloud hosted  Realtime document store | |
|  |  |  |  | |
| Relational DBMS | |  | Document Store | |
| Data Scheme | | User  Friendly |  | |
|  | |  | Schema free | |
|  |  |  |
| Open Source |  |  | |
|  | |  |
|  | Commercial | |
|  |  | Android Support |  | |
|  | ADO.Net  JDBC  ODBC |  |
|  |  |  |  |
|  |  | Android  iOS  Javascript API  RESTful HTTP |  | |

**Figure 1. Venn Diagram**

The figure shows to identify which of the two database is more reliable and efficient to use in mobile application depending on the situation and needs of the researcher. The Venn diagram illustrate the relationship between MySQL and Firebase. It helps to analyze the conflict of the two databases. As shown in Venn diagram, the MySQL and Firebase have similarities to each other that can be used by the researchers in their study. It shows that Firebase have different way to store and retrieve data than MySQL. It also shows that Firebase has cloud storage that can access and retrieve data that can be advantages over MySQL.