Problem statement

The first problem is the collection of data extracted from customers in the telecom company has huge amount of data and finding it hard to make meaning out of it [8]. It means the data that telecom companies can access are currently not being used to their full potential as a means of understanding the customers that are served [8]. Telecom must find the right solution to store all information available across the organization to maximize revenue using the analytics. Traditional tools wouldn't be able to support the huge amount of data produced due to limitations of their capabilities. For example, traditional data analysing tools such as traditional Weka & SPSS tools are still widely used despite having limited features including lack in getting accurate data, performance issues and not suitable in handling large amounts of data in telecom companies [9].

The second problem is the quality of data from telecom databases makes poor visibility to analyse. The data quality has an impact on effective business decision-making to the next step in order to improve marketing in the telecom industry [10]. The quality characteristics in terms of missing or redundant values in the dataset after generated from the customer's behaviour on mobile devices will lead to poor outputs after analysing the data [11]. In addition, internal data quality is one of the important things to follow up the mobile analytics from customers [12]. For example, data such as a unique customer ID is missing will lead to a lot of work because it is difficult to extract such data that is considered as key indicator [12] or analysing the dataset will end up producing some errors when getting the result.

The third problem is difficulty in identifying customer segmentation that makes it hard to understand the customer's behaviour. It is difficult when we need to distinguish the customer segments by combining one or more similar characteristics in that particular attribute [13]. Improper clustering algorithms can lead to wrong analysing data and cannot correctly identify each segmentation. For example, studies are concentrating on distinguishing the customers to identify which one that is likely to change to another service provider [11]. Since there are many telecom competitors in the market and

customers are free to choose the best telecom according to their needs, by understanding or having several customer segmentations, telco companies can prepare or suggest a better service plan [11].

The main objectives of this project are:

1) To identify telecom customer segments by using machine learning clustering algorithm (K-Means) to group the customers unlabelled dataset into different clusters.

2) To develop a web-based dashboard which visualizes the clustering results and advances the user with effective cluster analysis in terms of demographic, behaviour and region.

3) To evaluate the usability of the dashboard by conducting usability testing.

Problem Statement

According to the literature, the problems experienced by the telecom industry involves:

- Time constraint:

Hidayati et al. (2018) declared that there are millions of subscribers in the telecommunication industry and each customer has a different mobile behavioral pattern which necessitates the variation of marketing strategies by the industry. As a result, in order to perform telecom customer segmentation, it's time consuming and hectic to analyse and segment the huge amount of data that the company has manually in order to come up with marketing strategies (Namvar et al., 2017).

- Competitive market:

Several telecom companies compete to ensure customer satisfaction, retention and also attract new customers. Briganty (2019) reported that telecom companies cannot

depend on price only to gain and retain customers. Thus, they must guarantee that customers are satisfied and have an impressive experience by providing customized services.

- Insufficient understanding:

The insufficient understanding of customers increases the challenges faced by business industries to furnish their customers with the satisfactory offers. For example, Aheleroff (2011) doubted that telecommunication industries shall gain more understanding of their customers and obtain more knowledge about their interests in order to develop the right services and products. Having an advanced comprehension of different customers behavior and preferences is achieved by segmenting the large group into small homogeneous groups (Namvar et al., 2017).

The major **three objectives** from this project includes the following:

- To identify telecom customer segments by using machine learning clustering algorithm (K-means) to group the customers unlabelled dataset into different clusters.
- To develop a web-based dashboard which visualizes the clustering results and advances the user with effective cluster analysis in terms of demographics, behavior and region.
- To evaluate the correctness of the clustering algorithm and usability of the dashboard by conducting usability testing and heuristics evaluation.

Problem statement

New construction worker who needs to use construction equipment will refer to the user manual for learning how to use the equipment [2]. However, the learning experience of using the existing user manual are less engaging and frustrating [3]. This is due to the lengthiness, verboseness, abstruse technical jargons of the user manual as well as its static content that is difficult to navigate. Eventually, this makes the novice construction tool user (civil engineering student as well as the novice construction worker) reluctant to use the existing user manual. Hence, this affect the learning experience and result more time and effort for them to achieve their goal in using the construction equipment.

Problem Statement

History lesson, although as important as we have mentioned in the earlier section, has always had a stigma of being boring, dull and overlooked by students while studying. A recent study collected opinions from 45 students in 2 groups on perception of history subject in school shows that a staggering of 75% and 64% student do not like history in school and 45% of those dislikes mentioned it as not interesting, 22% mentioned that it is hard to understand [4]. The lack of creativity in delivering the history lesson contributes to the boredom of students [5].

Learning experience can become the hindrance between student and knowledge. A study also reveal that text books ranked amongst the lowest (15.6%) of preferred

learning medium amongst students and ironically it is the primary way of teachers delivering study materials and contents to students [4].

Furthermore, there are currently lack of available innovative solutions for the students to learn history through mobile devices [4]. Most application are just a digital version of exam questions or text book in a mobile or digital format which does not help motivate the students to learn history, because they are essentially doing the same thing on different platform.

In response to the problems mentioned, an augmented reality(AR) mobile application for high school students will be proposed as a solution to bridge the gap between the history subject in school and students.