I. INTRODUCTION

The anime industry is growing rapidly with an average of 2 trillion yen market size from 2013 to 2018. In 2018, the overseas market exceeded 1 trillion yen or around 46.3% of the overall Japanese animation market size [1]. With this trend of growth every year there will be a new variety of anime works being produced for users to consume and with lots of variety of anime works it will be overwhelming for users to find anime works that match with their preferences.

Recommender system can be used to resolve this problem, with recommendation system users can be matched with works that meet their preference without searching manually [2]. The methods of recommender system can be roughly divided into the following categories: collaborative filtering (CF), content-based filtering (CB filtering) and hybrid methods [3]. CB filtering is a design of recommendation systems, which use the content of items to create features and attributes to match user profiles [4]. In the CB, two techniques have been used to generate recommendations. One technique is to use traditional information retrieval methods (such as cosine similarity measures) to generate suggestions heuristically. Another technique is to use statistical learning and machine learning methods to generate recommendations, mainly to build a model that capable learn user interests from users' historical data (training data) [5].

CF may be the most outstanding and successful technology in modern recommendation systems. Unlike CB that recommends a product similar to the product that the target user liked in the past, the CF method uses preference suggestions from other similar users to target users [5]. CF more successful than CB filtering is because it relies only on past user behavior (for example, previous transaction or product rating) without the need to create an explicit profile of a user while generally more accurate [3]. But, when there is a new item or new user CF will be at disadvantage, given it needs information that linking an item and user [4]. To overcome these setbacks on the CF-based method and CB filtering method, it is possible to combine both methods into a hybrid method that leveraging the benefit of the CF-based method and CB filtering method. Such as using CB filtering advantage on giving recommendations on new items and using CF to find a user with the same preference [6].

In this paper, we implement a hybrid recommender system based on the deep neural network method for recommending anime works to users that utilize both rating data and side information of users and anime especially the synopsis data, given it generally exist even with new items and it gives an overview of the story of the anime works. Hence, in our method synopsis will be used as a primary source of side information and incrementally add other side information. With this method we seek to answer the following questions:

1) How synopsis affects the accuracy of the model?
2) How user side information affects the accuracy of the model?
3) How anime side information affects the accuracy of the model?
4) How all side information affects the accuracy of the model?

In our proposed method, we used different model embedding for users and items to transform each of their side information into dense features of a user or an item. Specific for synopsis text we add 2-stack of LSTM after the embedding to extract more meaningful features from the text. We then feed it to a deep neural network, to predict the rating given pair of a user and item.

The rest of the paper is organized as follows: in Section II we detailed the problem formulation, in Section III we detailed the proposed method, as well as the data structure. In Section IV we detailed the performance of our approach. We than concluded our report in Section VI