4.3. *Performance Evaluation of Various Models*

4.3.1 Baseline model

This Model predicts the missing rating based on popularity of a movie. It fills the missing rating based on average rating of the movie. RMSE and MAE values for baseline model are shown in Table 7.

Recommender System	RMSE	MAE
Baseline Model	0.9694	0.75049

Table 7. Results of baseline model

4.3.2 Content based models

Content based model is experimented by following two approaches:

(1). Generating User profile and Movie profile based on genres feature of movies. Using Genres feature user vector and movie vector is generated and Similarity is calculated based on these vector comparison.

(2). Experimented with various machine learning algorithms present in scikit- learn library. Experimental results shows that support vector regression gives better results compared to other models as shown in Table 8.

Recommender System	RMSE	MAE
CBF based on movie genre	0.925339	0.713335
Linear regression	0.965603	0.738663
Lasso	0.943501	0.734317
K Nearest Neighbor Regressor (k=5)	0.971668	0.747365
K Nearest Neighbor Regressor (k=10)	0.939256	0.722360
Random Forest Regressor (RFR)	0.973810	0.746850
Support Vector Regressor (SVR)	0.927255	0.697850

Table 8. Results of CBF models

Content based filtering based on movie genre and SVR have lower RMSE values and will give better results when compared to other models. Therefore we can consider either of the models for building hybrid model.

4.3.3 Collaborative Filtering Models

We experimented both user based and item based CF models by finding user to user similarity and movie to movie similarity using cosine similarity and KNN model is applied for generating nearest neighbors for both users and movies. We experimented by changing the number of neighbors to find the optimal value for K to get better results as shown in Figure 3 and 4. Results shows that for users based approach at K = 20 and for item based approach at K =10 we got lesser values for RMSE and MAE.

Experimental results shows that item-item based CF outperforms user-user based CF in all variation of K values. Similarity between items is much stronger compared to users because number of items are comparatively less than users with less overlapping between items features.

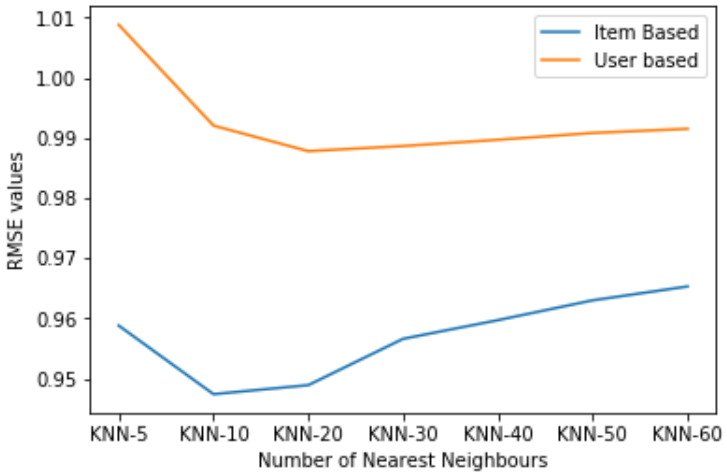

Fig. 3. Effect of K value on RMSE values for user and item based CF

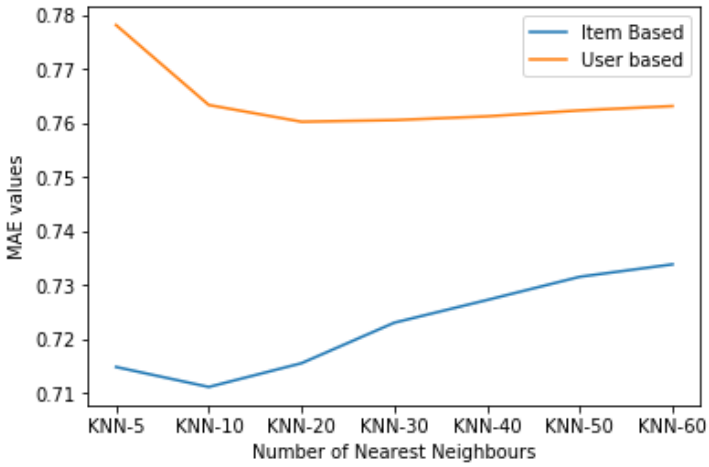

Fig. 4. Effect of K value on MAE values for user and item based CF

Recommender System	RMSE	MAE
Item Based CF with K = 10	0.9474	0.7112
User Based CF with K = 20	0.987820	0.760323

Table 9. Results of CF models

4.3.4 Hybrid model

Weighted hybridization approach is used to build hybrid model. Combined predictions is obtained by considering predictions of each model and summing them by assigning appropriate weights for each model. As per our experimentation, CBF and item based CF models gives better results compared to other models so we considered those two models for hybridization. The proposed hybrid recommender system which is a combination of CBF and item based CF is experimented with weights (0.5, 0.5), (0.6, 0.4), (0.4, 0.6) and (0.7, 0.3). At weights of 0.6 for CBF and 0.4 for CF hybrid model shows the better results in comparison with other combination of weights as shown in Table 10. The proposed hybrid model gives better results compared to all other models at (0.6, 0.4) weights as shown in Figure 5.

Hybrid Model (CBF & Item Based CF)		RMSE	MAE
Weights of CBF	Weights of CF		
50%	50%	0.8837	0.6767
60%	40%	0.8803	0.6722
40%	60%	0.8932	0.6855
70%	30%	0.8831	0.6718

Table 10. RMSE and MAE values of hybrid model

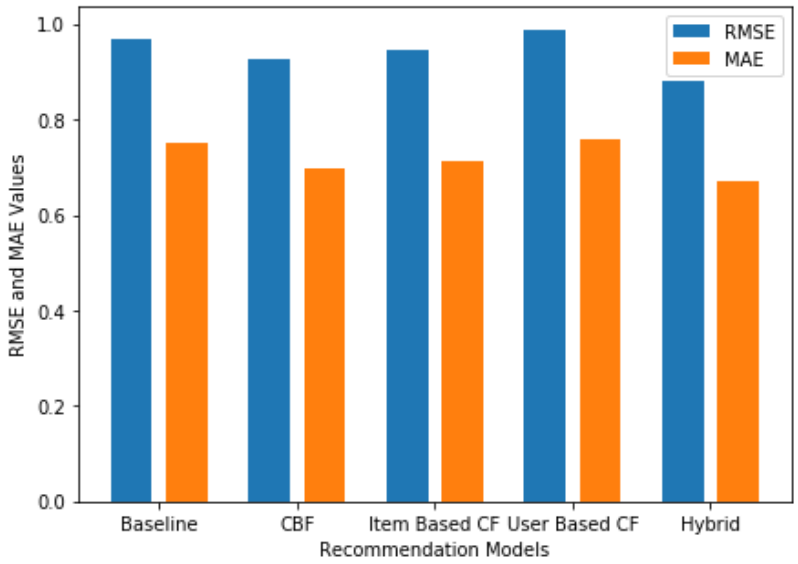

Fig. 5. Performance of various recommendation models

5. Conclusion

Recommendation System involves filtering suitable information for the user based on their interests and preferences. Content based and collaborative filtering are two traditional methods of RS both have certain limitations in tackling user's interests. In recent times, Hybrid recommendation systems are of greater use compared to traditional models because of its capability of combining best features from traditional models. In this work, we implemented various recommendation models including CBF, CF and Hybrid models.

Based on empirical analysis it is observed that, In CBF approaches based on genre and SVR gives better results compared to other models and In CF models item based approach outperforms user based approach. At k=10, item based approach gives better results whereas at k=20 user based approach gives better results. The proposed system has lesser RMSE and MAE values than the individual models.

Currently, we used Movie Lens ml-small dataset for implementation it can be replaced with larger dataset for better results. CBF model is implemented based on the vectors developed by genre feature of movies. As an enhancement of the work, single dimensional feature can be replaced with multi dimensional feature set by considering other features of movies like overview, tagline, and cast by combining the MovieLens dataset with TMDB dataset. Sentiment of users can be embedded while developing user and item profile by considering reviews of users and movies. CF model can be developed by applying model based approaches like Matrix factorization, SVD and Neural networks. Further, other hybrid approaches can be experimented with different combination of models by learning the importance of weights for each model.

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Authors Profile

Raghavendra C K is currently working as an Assistant Professor in the Department of Computer Science and Engineering at B N M Institute of Technology, Bangalore and pursuing the Ph.D degree in the Department of Computer Science and Engineering at S J B Institute of Technology, Bangalore under Visvesvaraya Technological University, Belagavi, India. He obtained his B.E degree in 2009 and M.Tech degree in 2011from Visvesvaraya Technological University, Belagavi, India. His current research interests are in the area of Data Mining, Web Mining, Big Data Analytics, Recommendation systems Social Networks Analysis and Image Processing.

Dr. Srikantaiah K C is currently a Professor in the Department of Computer Science and Engineering at S J B Institute of Technology, Bangalore, India. He obtained his B.E from Bangalore Institute of Technology, M.E from University Visvesvaraya College of Engineering, Bangalore in 2002 and Ph. D degree in Computer Science and Engineering from Bangalore University, Bangalore. He has authored a book on Web Mining Algorithms. His research interest is in the area of Data Mining, Web Mining, Big Data Analytics, Cloud Analytics and Semantic Web.