APPROACH USED FOR EMOTION-BASED RECOMMENDER SYSTEM

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Abstract -- In this paper we look into emotion based recommender systems, the approach that researcher have used to build an emotion based recommender system. We review the method used for emotion detection first followed by the method used for building the recommender system. While emotion recommender systems are not very widely used at the moment we believe as we are moving towards a world of automation where most human activities are being automated, emotion based recommender systems have a great role to play. Fields such as intelligent systems and internet of things will benefit greatly with the concept of emotion based recommender system. The concepts of computer vision, sentiment analysis, medical forms of emotion detection are all applicable therefore providing the concept of emotion based recommender systems with a wide variety of promising research areas. The medical world is also not left behind as such automated systems can greatly be build to serve the mental health and non-verbal communities

Keywords : Recommender system, Emotion detection, Machine learning, Computer vision, Facial recognition

INTRODUCTION

Emotions play quite a role in every human daily activities, we can say human preferences tend vary based on emotion felt at a certain moment.

While computer vision is the widely known approach for emotion detection it is not the only method. Natural language processing is another field that can be used to detect human emotions through text and speech. Medically also ECGS can detect emotions due to change in heart rythms with changes in emotion.

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Recommendation Systems are usually categorized into three different categories namely 1) Content-Based Recommendation Systems 2) Collaborative Filtering Recommendation Systems and 3) Hybrid Recommendation Systems. Each type of recommendation system can be implemented using different Machine Learning Approaches. Platforms based on their users and the type of service they provide choose the most suitable and effective form of recommendation system.

This Recommender system could go beyond movies and music it could be used for a wide variety of activities. These will include activities that tend to affect the emotions of human beings. A sample scenario will be showing a clip of a baby laughing at someone angry. A very common dilemma faced by youths today is boredom, having a system that could recommend activities we could do, watch or listen to could go a long way in eliminating this dilemma.

The concept of a hybrid recommendation system combines the concept of a content-based recommendation system and a collaborative filtering recommendation system.

The basis of most of these systems is mostly classification algorithms used to classify emotions into the chosen categories and also recommendations as well. SVM and KNN are algorithms very commonly used

Emotion Based Recommendation Systems usually contain most if not all of these components: User Interface, Emotion Detection Segment, Feature Extraction, Emotion Recognition, Recommendation Segment and Feedback Segment.

THEORY AND LITERATURE REVIEW

DATA SOURCING

For Most of the researchers, the first step before going forth with the system is to obtain a suitable dataset for both the emotion recognition segment and also the recommendation Segment.

While most papers such as [1] and [2] make use of already existing datasets available on the internet some papers make it such that they create a personalized dataset using several data collection methods such as web crawling [3]. Unlike simple recommendation Systems, the Emotion Based Recommendation System requires at least two datasets. One dataset is used for training a model to recognize different emotions which could be in form of human faces, written text and in rare cases ECG signals [4]. The second dataset on the other hand is usually used to train the recommender system. This dataset mostly contains the content which is being recommended to the user such as movies, music, videos and commodities.

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EMOTION DETECTION

The next step after finding a suitable dataset and processing the data is emotion detection and also recognition. In this step papers as previously stated use facial recognition, written text or ECG signal to capture the emotion of the user. Most commonly OpenCV [5] is used to capture the user's face in the case of facial recognition. There exist several well-established datasets on the internet that researchers used to detect the emotions captured on the human face. Emotions such as happiness, sadness, neutrality and sorrow are commonly focused on.

In the case of using written text to detect emotion, natural language processing comes to play as the concept of semantic analysis is used to analyze the text-based input given by the user to determine the type of emotions the user is trying to convey with their words. The semantic analysis aims to interpret the meaning of a word based on the context in which it is being used and also the relationship between the word and every other word around it in a sentence.

The other yet uncommon method used to detect and recognize emotion is the use of ECG signals [6] [4]. This method is still being developed and researched. ECG signals from the user in this case are analyzed to determine the emotions conveyed. This method is most useful in the case of visually and hearing impaired persons as this will be an effective method for them to convey emotions.

RECOMMENDATION MODEL

Building the recommendation model is the core part of the system. Some researchers use either one content-based or collaborative filtering recommendation system for the recommendation model while some deem it fit to combine the two methods and use the hybrid mode of recommendation system. In some unique cases, some papers use personalized methods and randomization for recommendations but this is usually for simpler systems.

CONTENT-BASED-This method of recommendation works based on given features and the similarities between them [3] [7] [1]. Some papers apart from using the detected emotion as a feature also make use of other features such as age [8] and language for a more unique recommendation.

The similarity between these features is usually computed using cosine similarity. It is a concept used to determine and quantify the similarities between vectors in this case the features are represented as vectors

COLLABORATIVE-FILTERING - This method of recommendation depends on what similar users have liked or similar content to what the user liked previously. For emotion-based recommendation systems, this is not a

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very common method used but it is still implemented [9] and sometimes together with the content-based method.

The collaborative filtering method can be further divided into Model and Memory based.

HYBRID BASED - The hybrid method is simply the combination of previously stated methods [10], Content-based and collaborative-based. The hybrid method enables the recommendation system to provide unique and personalized recommendations for the user as it covers all areas of similarities.

The Hybrid Method first performs independent recommendations on both Content and Collaborative methods then the output of this method goes through hybrid recommendation and provides a final output.

USER AND FEEDBACK

Creating a user interface is usually the final step in making the systems. Papers mostly used HTML, CSS, and JavaScript and times Django and Flask frameworks to create web apps and API so that the systems can be used easily. Databases are also established to store user information. The database can also be used to store previous recommendations for better optimization and better future recommendations.

Feedback was also added as a feature for testing, accuracy review and also optimization of software. The developers usually ask the user for feedback after they have used the system in form of ratings and feedback.

RELATED WORKS

[1]In this paper, the authors aimed at creating an emotion-based recommendation system using a content-based recommendation method and classification algorithm for emotion detection. This research focused particularly on music also a personally gathered database was used. For future scope, they hoped to add more music-related features to their system. [2] [3]In these papers the authors used a rather unconventional approach. To detect the emotions they utilized ECG signals and made recommendations based on that. A method still being researched. They also used well-established datasets and algorithms for their research. [4] The authors of this paper also utilized personally gathered data and even though for this paper content-based method was used, the authors mentioned wanting to use a hybrid method of recommendation for better efficiency. [5]The authors of this paper used the hybrid method of recommendation for their research. They also used the KNN algorithm along with a personally gathered dataset. [6]This author used a dynamic source for their content and also included randomization in their recommendation. [7]In this paper, the authors focused mainly on classification algorithms such as SVM.

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S/N	CATEGORY	RESULT
1	Most Used Classification Algorithm	SVM Classifiers
2	Most Used Dataset for Emotion Detection	FER 2013 Dataset
3	Most Used Method of Recommendation	Content Based Recommendation
4	Most Used Dataset for Recommendation	Self-gathered datasets
5	Most Used method of emotion detection	Facial Recognition

Table 1 Summary of Literature Review
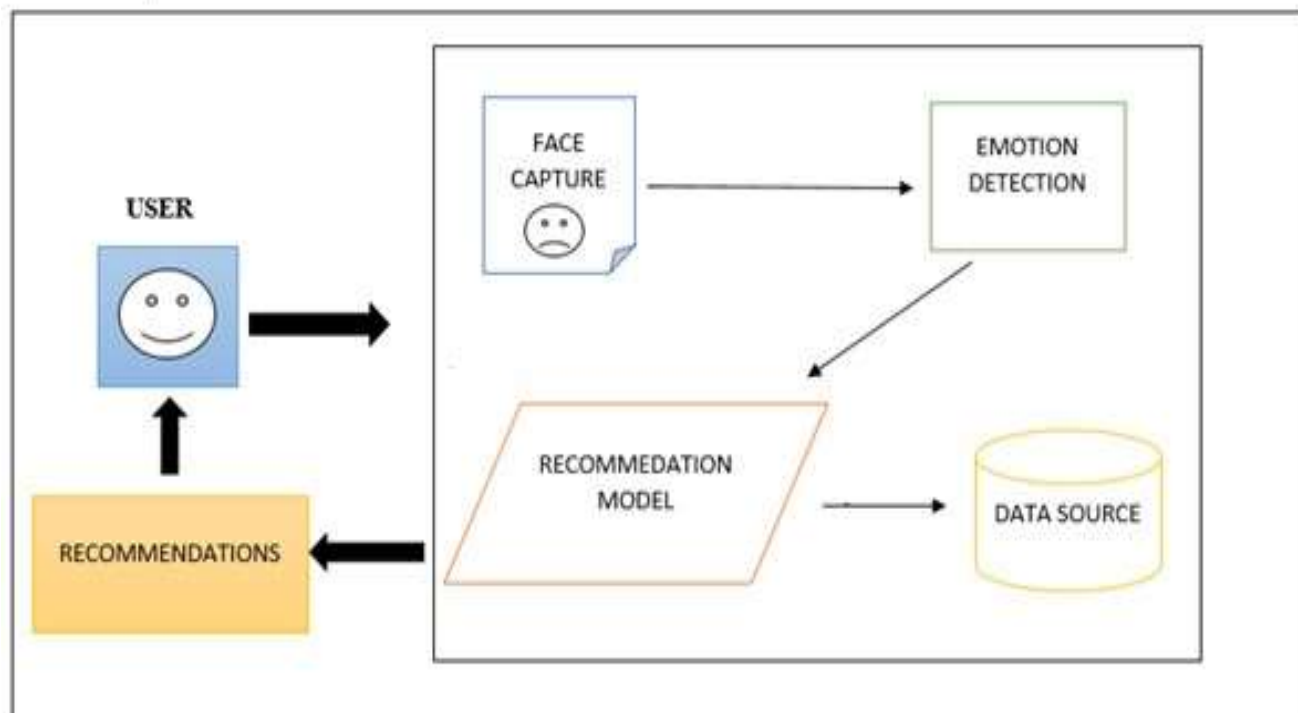
III.   Methodology/ Implementation

Figure 1 Diagram Illustration of System View

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Emotion-detection: We worked with a Convolutional neural network trained with FER2013 dataset to create a model that would detect the following emotions: Angry, Sad, Happy and Neutral **.** The model was trained with this data with an accuracy plot of 86%

- Model Type: Convolutional Neural Network

- Dataset Used: FER2013 Dataset

- Training Data Size; 28710

- Testing Data Size: 3587

- Validation Data Size: 3588

- Epoch batch used: 57

- Accuracy 86%

Recommender Model: We trained a content based recommender system using IMBD movie dataset. The model was efficiently trained and was making reommendations based on the concept of cosine similarity.For the purpose of demonstration we stored a portion of closely related movies in a databse for ease of connection with web app and for smooth running on a smaller device in this case a personal computer.

- Content Based Recommender System – type of recommender System

- Cosine Similarity- method of similarity computation

- IMBD Movie Dataset (ratings)- dataset used

- (9099, 25) Size of Data- size of data used

User: To demonstrate the working of the system we created a simple flask app with the following features. An opencv segement to use webcam for facial recognition, a trained cnn model for emotion detection and a connection with mysql to acsess database storing movie posters from trained model.We designed this using Html, css, javascript flask and Mysql

Results and Discussion

  After successfully training the models, we built a simple user interface using HTML, CSS, JavaScript and flask to deploy the models and allow users to try out the system.
The following table tabulates the result from testing the working of the system.

- Five Users tried out the different emotions

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- Emotion include : Neutral, Angry, Sad and Happy
- 1 denotes a positive Result
- 0 denootes a negative result

User	Emotions	Emotion Detection	Movie Recommendation
USER 1	Neutral	1	1
	Angry	1	1
	Sad	0	0
	Happy	1	1
User 2	Neutral	1	1
	Angry	0	0
	Sad	1	1
	Happy	1	1
User 3	Neutral	1	1
	Angry	1	1
	Sad	1	1
	Happy	1	1
User 4	Neutral	1	1
	Angry	1	1
	Sad	1	1
	Happy	1	1
User 5	Neutral	1	1
	Angry	0	0
	Sad	0	0
	Happy	1	1

Table 2 Result from Testing 0: Negative, 1: Positive

Table 2 presents the result of the simple emotion based recommendation system we built to implement the working of two individual models together. These models are the emotion detection model using convolutional neural network algorithm a very popular and effective algorithm when dealing with images. The second model is the recommender system model

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which in likeness is closer to content based recommender system but in this case content is replaced with emotions as the emotion detected will determine the recommendations to be made. We observed that the combination of the two concepts i.e computer vision and recommender system could play a very vital role in automation an example will be an automated smart tv that detects its owners emotion and makes recommendations accordingly or a smart car that detects anger from its driver and takes the appropriate measures. This could be usefull across several industries such entertainment, security and IoT.

CONCLUSIONS

Based on the papers reviewed researchers have used several algorithms and methods to make efficient and working emotion-based recommender systems. Using both preexisting and self-gathered datasets for the recommendations be it music, movies, books or any other content. The concept of combining or integrating emotion with recommender systems is fruitful. It provides great opportunities for automation and can also be used in the field of the Internet of Things (IoT). For now, researchers are working towards increasing accuracy, enhancing personalization and incorporating more features After this technique was put into place, we discovered that angry and sad emotion detection were frequently confused with one another. Otherwise, the system was effective at identifying the mood and providing the right movie recommendations.

Limitations

- Due to space issues from using a personal computer the content dataset was limited to demonstrate the working of the models
- The Personal Computer Camera was also of low quality therefore, hindered emotion recognition
- Only one type of content i.e. movies were included.

Future Scope

- Building the system with more than one content
- Incorporating the system into more advanced devices rather than a stand-alone system
- Making the System more personalized and increasing efficiency

List of abbreviations

SVM – Support Vector Machine

ECG – Electrocardiogram

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KNN – K-Nearest Neighbors Algorithm

CNN – Convolutional Neural Network

1. Availability of data and material

All relevant materials have being referenced
Also paper conclusion does not depend on any data source.

2. Competing interests

Paper has being written as part of requirement for final year project by students as required by department. There are no financial competing interests involved

3. Funding

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4. Authors' contributions

 FM researched and wrote the paper. OF also participated in conducting research for the paper. SC reviewed and gave feedback on paper. All authors have read and approved the final manuscript

5. Acknowledgements
6. Not Applicable

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