

Applications of Artificial Intelligence in the Film Industry

Mavuluri Vamsi Krishna Reddy

Abstract: This paper explores the meaning of artificial intelligence and its applications in the major modules in the process of film making. It outlines the current progress and the developments of this technology in the film industry. The paper concludes by analyzing the future potential of artificial intelligence in the making of films.

Index Terms: Films, Making, Script, Natural Language Processing, Convolutional Neural Network.

I. INTRODUCTION

Artificial intelligence is a way of making a computer, a robot or a system think like a human does, intelligently. Artificial intelligence has seen various applications in the past decade and continues to grow in its development and applications. It will change the way systems work and will define the lifestyle of the upcoming generations. It is a major field of study in today's world. Its application in the entertainment and media field is rapidly taking a leap. Films are evidently one of the major sources of entertainment in the modern world. The film industry is developing itself progressively in terms of the technology used in crafting and making a film into a piece. One of the latest advancements this industry saw is the application of artificial intelligence in the process of producing and making a film. This paper is an attempt to explain how artificial intelligence is being developed in order to meet the needs of film makers and also inspects the possible areas of development of AI in the industry.

II. MODULES

This section investigates the applications of artificial intelligence in the major modules of the film industry in today's modern world.

A. Screenplay/ Script Writing:

In the process of developing a film, the first and foremost element to be finalized is the script. The script is the factor around which all other aspects of the film are based upon. It is the way a director intends to put his story forward to the audience. The scenarios in which each character takes part, the sequence of events and all other important aspects that control the flow of the story and the story as a whole come under the script/screenplay, which manifestly makes it one of the most important aspects of any film.

Director Oscar Sharp in collaboration with an NYU AI researcher, Ross Goodwin has managed to teach a machine, that named itself Benjamin, how to write a screenplay and the dialogues for a film. They 'fed' many scripts to a Long Short Term Memory (LSTM) recurrent neural network, Benjamin. This AI, during its training has learnt to predict letters that usually fall next to each other and the learnt the words and phrases that are often used together. Having being fed an opening line for the film by the Director as a prompt, Benjamin managed to generate an entire screenplay for a 9 minute run-time short film "Sunspring" that has been created for the annual film festival Sci-Fi London and debuted on Ars Technica. Benjamin also generated lyrics for a song which were shown in the short film [1].

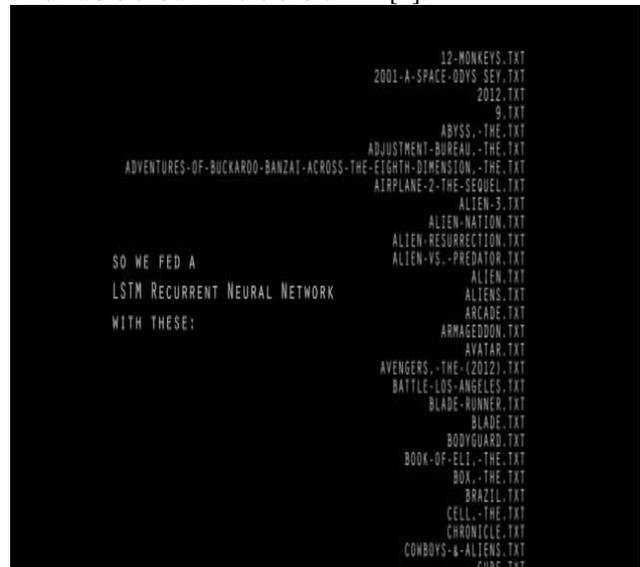


Fig 1: Sample of inputs that were fed to Benjamin (Courtesy: Ars Technica)



Fig 2: Prompts given to Benjamin (Courtesy: Ars Technica)

Manuscript published on 30 June 2019.

* Correspondence Author (s)

Mavuluri Vamsi Krishna Reddy*, Department of Computer Science & Engineering, MVSR Engineering College, Hyderabad, India.

© The Authors. Published by Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP). This is an open access article under the CC-BY-NC-ND license <http://creativecommons.org/licenses/by-nc-nd/4.0/>.

```

INT. SHIP
We see H pull a book from a shelf, flip through it while speaking, and then put it back.

H
In a future with mass unemployment, young people are forced to sell blood. That's the first thing I can do.

H2
You should see the boys and shut up. I was the one who was going to be a hundred years old.

H
I saw him again. The way you were sent to me... that was a big honest idea. I am not a bright light.

C
Well, I have to go to the skull. I don't know.

He picks up a light screen and fights the security force of the particles of a transmission on his face.

H
What do you mean?

C
(smiles)
I don't know anything about any of this.

H
(to Hank, taking his eyes from his mouth)
Then what?

H2
There's no answer.

C
(frowning)
We're going to see the money.

H
(reading)
All right, you can't tell me that.

Steps back. Coffey is still going through.

C
I was coming to that thing because you were so pretty.

H
I don't know. I don't know what you're talking about.

C
That's right.

H
So what are you doing?

H2
I don't want to be honest with you.

He looks at him for a moment, then smiles at him.

H
You don't have to be a doctor.

H2
I am not sure. I don't know what you're talking about.

H
I want to see you too.

H2
What do you mean?

H
I'm sorry, but I'm sure you wouldn't even touch me.

H2
I don't know what you're talking about.

H
The principle is completely constructed for the same time.

C
(smiling)
It was all about you to be true.

H
You didn't even see the movie with the rest of the base.

H2
I don't know.

H
I don't care.
    
```

```

H2
I know that it's a consequence. Whatever you want to know about the presence of the story, it's a little bit of a boy on the floor.

H
I don't know. I just have to ask you to explain to me what you say.

H2
What do you mean?

H
Because I don't know what you're talking about.

H2
That was all the time.

H
I know that.

H2
I don't know.

H
(angry)
It would be a good time. I think I could have been my life.

He starts to shake.

H
(ANGRY)
It may never be forgiven, but that is just too bad. I have to leave, but I'm not free of the world.

C
Yes. Perhaps I should take it from here. I'm not going to do something.

H
You can't afford to take this anywhere. It's not a dream. But I've got a good time to stay there.

C
Well, I think you can still be back on the table.

H
Mm. It's a damn thing scared to say. Nothing is going to be a thing but I was the one that got on this rock with a child and then I left the other two.

H
He is standing in the stars and sitting on the floor. He takes a seat on the counter, and pulls the camera over to his back. He stares at it. He is on the phone. He cuts the shogun from the edge of the room and puts it in his mouth. He sees a black hole in the floor leading to the man on the roof.

H
He comes up behind him to protect him. He is still standing next to him.

H2
He looks through the door and the door closes. He looks at the bag from his backpack, and starts to cry.

H
Well, there's the situation with me and the light on the ship. The guy was trying to stop me. He was like a bully and he was gone. I was worried about him. But even if he would have done it all, he wouldn't come any more. I didn't mean to be a virgin. I mean, he was weak. And I thought I'd change my mind. He was crazy to take it out. It was a long time ago. He was a little later. I was going to be a moment. I just wanted to tell you that I was much better than he did. I had to stop him and I couldn't even tell. I didn't want to hurt him. I had to stop him and I couldn't even tell. I know I know I don't like him. I love him. So I can get him all the way over here and find the square and go to the gym with him and she won't show up. Then I'll check it out. But I'm going to see his when he gets to me. He looks at me and he throws me out of his eyes. Then he said he'd go to bed with me.
    
```

Fig 3: Screenplay written by Benjamin (Courtesy: Ars Technica)

```

ALONG WITH THESE SONG LYRICS:

I WAS A BOY
I WAS A STRANGER
AND I
PROMISED TO BE SO HAPPY
I WAS A
BEAUTIFUL DAY
I WAS A TALLER TALK THAT I WAS BORN
AND I WAS
READY TO GO
AND THE TRUTH WAS SO LONG AGO
I WAS SO HAPPY AND BLUE
I WAS THINKING OF YOU
I WAS A LONG LONG TIME
I WAS SO CLOSE TO YOU
I WAS A LONG TIME AGO
A LONG LONG TIME AGO
AND I WAS
READY TO GO
I WAS
A HOME ON THE ROAD.
    
```

Fig 4: Song lyrics written by Benjamin (Courtesy: Ars Technica)



Fig 5: Selected pictures from “Sunspring” (Courtesy: Ars Technica)

B. Script Breakdown:

The root of pre-production of any film is the script breakdown [2]. The script is that element of a film that needs to be converted into a physical product. The script breakdown is where all the production elements are reduced into lists. This helps the movie makers to estimate their budget and also

to comprehend what precisely they need, to bring their product to the audience. Usually film makers spend a relatively large amount of time in breaking down the script, which in turn delays the process of the actual making of the film. End Cue's Agile Producer platform developed an AI that uses Natural Language Processing methods to extract all the elements in the script such as the main characters, the dialogues of each character, the props/elements required for a scene, visual or audio effects, the type of scene, the length of each scene and the number of shots required. This AI has been trained with a human annotated dataset that helps it to learn which entities have to be physically actualized and which ones do not [2].

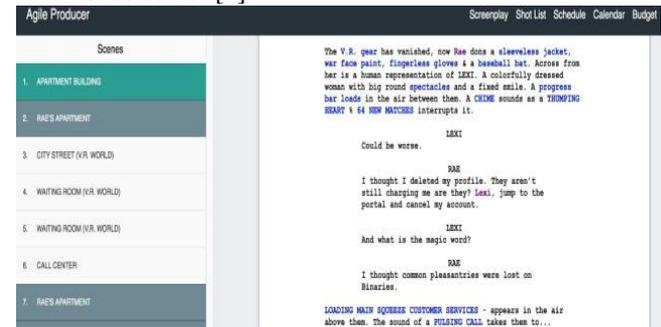


Fig 6: Script Analysis (Courtesy: RivetAI)

C. Story Writer Visualization:

A filmmaker before finalizing the script has to visualize the screenplay and decide the sequence of the scenes and reorder them to make the product better, if required. In certain circumstances a scene may have to be omitted from the movie. In that case, all the scenes that are correlated to the one that has been omitted have to be removed too. In addition to that, the script writer requires a complete and detailed analysis of each character's traits and emotions in every scene to bring out the best from each scene filmed. In order to achieve this, an AI machine has been developed that orders and visually represents all the scenes in form of a graph in which each node represents a scene and the concentric circle around the node represents the characters in that particular scene.

Using both Natural Language Processing and Sentiment Analysis, this machine's algorithms gives a detailed representation of percentages for traits of characters such as “agreeableness”, “conscientiousness”, “openness”, “extraversion” and “neuroticism” in a particular scene [2],[3].



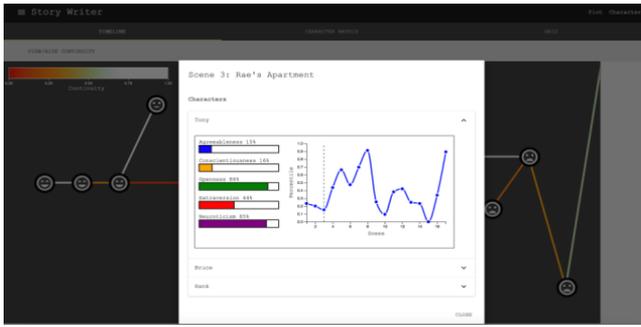


Fig 7: A narrative generated from a script (top), A character matrix produced from Script analysis (bottom) (Courtesy: RivetAI)

D. Storyboarding:

Every director has to pre-visualize their movie in order to get the best output. A storyboard is the graphical organizer which is in the form of graphics and illustrations that are set up in sequence. Each scene may need to be filmed in multiple shots and multiple angles. By storyboarding the script, it helps the makers visualize the scene.

An AI system created to storyboard a film, infers the number of shots from a script and then using a text-to-image classifier, and classifies the different aspects of the shot. Then it searches for images in the archival database that best match the requirements of the shot hence generating a storyboard. To make this AI system work, the makers created a training compilation of scenes and corresponding shots from a collection of movies. Computer vision, that is trained by human annotated data runs through all the movies frame by frame and generates the shot description for each frame. Each production house can feed their own archival footage to create training data for the system. However, it is the director's decision to accept the suggestions given by the system or make their own storyboard [2].

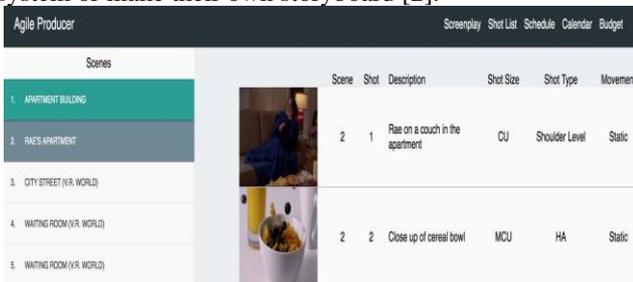


Fig 8: Storyboarding of the script (Courtesy: RivetAI)

E. Scheduling:

Shooting a film in the order of the sequences as it appears in the final product is an implausible process as the sequences can be adjusted in the final editing process. An effective way to schedule a project is to have an optimized use of locations, props and all the other elements that are involved in the making process.

An AI machine has been developed that takes an input of all the elements that have an impact on the schedule. Once the inputs are taken, they are processed upon to generate a schedule. Optimization of the schedule is also largely based on the number of scenes. If there are 'n' number of scenes, there are 2ⁿ ways of ordering them. Given the type of inputs, this AI using techniques based on Mixed Integer Linear Problems finds an optimal schedule [2].

In addition to that, this AI enables production houses to provide inputs of the scheduling of their previous projects to

this machine to know where they could've done better which would in turn help them to save more time and money in their upcoming productions.

F. Budgeting:

The budget of a movie is indeed one of the most important aspects that decide how efficient the money is going to be spent and how well the output would turn out to be. An AI has been developed that can estimate the number of shoot days and predict the project's total budget and generate a bill that is classified department-by-department [2], [3]. This can help a producer of a movie to extend his limits and venture in multiple productions.

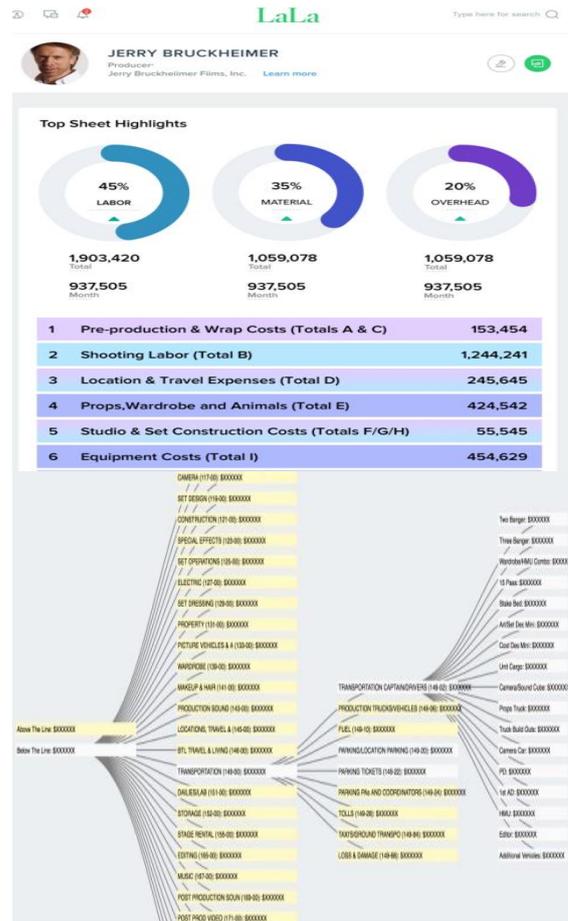


Fig 9: Budgeting of a film, sample budget of Lala Land(top), sample budget breakdown made by the system(bottom) (Courtesy: RivetAI)

G. Story Modification:

A director can change a part of their script or add something to the existing script at any point of time. This raises the question of 'what if' in a director's mind.

An AI machine has been developed that can run through the different versions of the same script and find out the most impactful one in the lot. This can help movie makers omit scenes with high budgets if needed, which in turn saves a lot of money for the makers [2].



H. De-noising:

Noises in images are the random variations of brightness or color information. In general images that are shown in a movie are worked upon and computed by rendering systems which simulate the flow of light in a particular scene. The computation of a number of light rays is a very difficult task. To minimize the effort, an alternative way is to compute only a few light rays. Researchers from Disney Research, Pixar Animation Studios, and the University of California have developed a machine that helps to discard the noises in the image. Using the concepts of Artificial intelligence and Deep learning, the machine discards noise and henceforth enables production-quality rendering at a faster rate. To achieve this, the group utilized a large number of precedents from the Pixar film ‘Finding Dory’ to make a profound learning model known as the Convolutional Neural Network. The system learned to convert the noisy images to more clear noise free images that look like those processed with processed with altogether more light rays. Once trained, the system could successfully remove noises on test images from other Pixar movies such as “Cars 3” and “Coco” despite the fact that they had their own unique styles and color palettes [4].

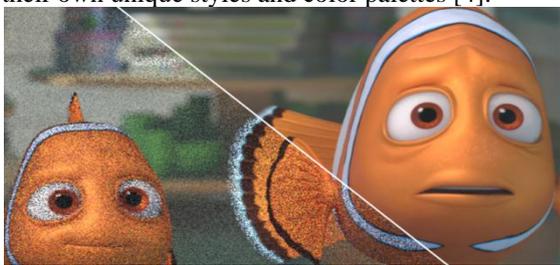


Fig 10: An illustration of De-noising (Courtesy: Disney Research)

I. Trailer Making:

In 2016, the film studio 20th Century Fox, managed to deliver a trailer for the movie Morgan that was made with the help of Artificial Intelligence by the supercomputer IBM Watson. The system was fed with over 100 horror films trailers segregated into different moments and scenes. It then carried out vigorous analysis on the visual, sound and compositional elements of every scene to understand the trailer completely [5]. Finally, it processed the 90 minute film Morgan to cut 10 best scenes suitable for the trailer of the film summing up to 6 minutes. Although a human editor was needed to put the scenes together, Watson made it possible to achieve a task that would take at least 10-30 days in just 24 hours.

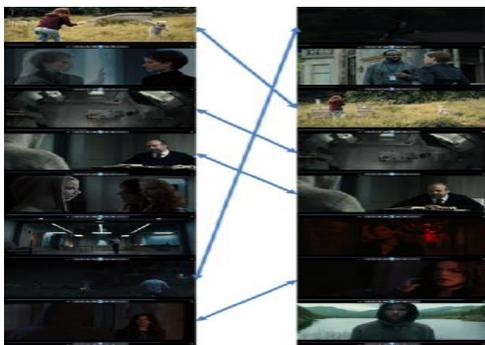


Fig 11: Selected scenes from the Morgan trailer. The AI generated scenes (left), scenes from the actual trailer (right), the arrows indicate the common scenes. (Courtesy: Harnessing A.I. for Augmenting Creativity: Application to Movie Trailer Creation, Conference Paper • October 2017)

J. Box Office Predictions:

The revenue generated by a movie is the foremost and most important criteria for any film producer. Any film that doesn’t generate revenue is a loss to the producer in all forms. Start-up companies have started working on AI that predicts box office success having being fed on the script of the movie and considering other crucial aspects of the film such as the star cast. Although the accuracy rate of the model is 65%-70%, it is very helpful for the filmmakers as the current statistics show that only 20% of the movies make their money back [6].



Fig12: Actors market analysis (Courtesy: VaulT)

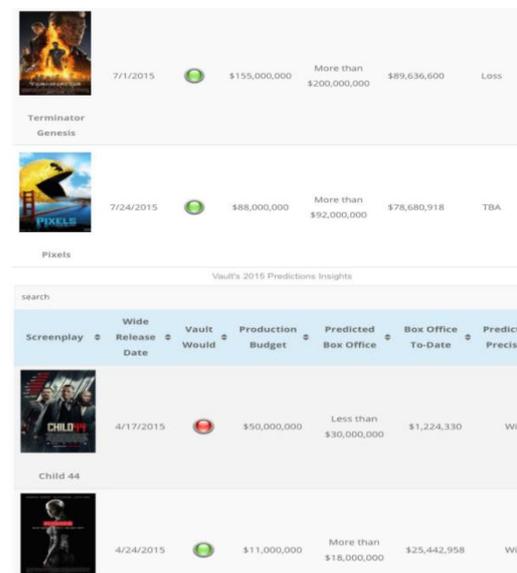


Fig 13: Selected samples of Box office predictions made by a start-up (Courtesy: VaulT)

III. FUTURE WORK:

The usage of artificial intelligence in the film industry will see a great rise in the years ahead. Although the current applications of artificial intelligence and the ongoing research is being applied limitedly, it will see a great improvement in the near future both in terms of usage and accuracy. Artificial intelligence can be applied in the following aspects in the film industry.

A. Music:

The effect of music and background scores in movies is vast. There is a huge potential for artificial intelligence systems to be developed in this area of the film industry. Machines can be developed that take an input of a collection of songs, analyze the given input to compose new and fresh music.



B. Audio- Video Translation:

It is a well-known fact that many actors haven't been able to manage their dates and had to give up on many movies because of their tight schedules.

An audio-video translation AI machine can be developed that takes an input of an audio clip as well as a few archived video clips of the actors to generate a respective video clip of the input audio clip. By doing this, the actors do not actually have to be present for the making of the movie in a few or in the best case all scenes and can just lend their voice.

C. Voice Recreations:

Dubbing is an essential and time taking aspect of post-production of a film. AI machines can be developed that can clone any person's voice just by listening to a few minutes of their sample voice. This aspect could be crucial in film making where the actors do not have to actually dub for their role and could just give samples of their voices. This will save a lot of time in the post production process.

D. Banner Creations:

Marketing with banners is a technique adopted by most of the film makers. Designers spend a lot of time in making a proper design for a banner. AI machines can be created that, on taking inputs of already existing successful designs of banners, generate new and innovative designs for the film. The number of designs made by the machine can also be more than the ones created by humans in a stipulated time period.

E. Piracy Control:

Piracy is one of the major elements that cause tremendous losses to the producers of a film. AI machines can be developed that can sense the recording of the film and block out whatever is being recorded.

IV. CONCLUSION:

In this paper, the current developments of artificial intelligence in different aspects of film making and the possible future developments have been presented. It is evident that AI can bring a significant change in the process of film making by optimizing each and every factor of it, be it time, cost or manual work. Even though the use of AI in the film industry currently isn't to a wide extent, it can be reckoned that it has a great scope in the near future. Although the use of AI in the film making process would reduce human effort as well as time taken to finish the process, the question still remains as to if AI is going to revolutionize the film making process.

REFERENCES

1. C.Macdonald, "Now that IS sci fi! Watch the short film written by artificial intelligence software (which even named itself Benjamin)", Daily Mail, 2016 [Online] Available: <https://www.dailymail.co.uk/sciencetech/article-3634160/Now-sci-fi-Watch-short-film-written-artificial-intelligence-software-named-Benjamin.html>.
2. D.Ray, "Data Science and AI in Film Production", Medium Blog, 2017. [Online] Available: <https://medium.com/rivetai/data-science-and-ai-in-film-production-8918ea654670>
3. K.Wiggers, "RivetAI's toolkit predicts a movie's budget from its script", VentureBeat, 2018. [Online] Available: <https://venturebeat.com/2018/06/28/rivetais-toolkit-predicts-a-movies-budget-from-its-script/>.

4. Disney Research, "Disney Research, Pixar Animation Studios and UCSB accelerate rendering with AI" Disney Research, Pixar Animation Studios and UCSB accelerate rendering with AI. [Online] Available: <https://www.disneyresearch.com/innovations/denoising/>.
5. A.Heathman, "IBM Watson creates the first AI-made film trailer – and it's incredibly creepy", Wired, 2016. [Online] Available: <https://www.wired.co.uk/article/ibm-watson-ai-film-trailer>.
6. M.Calone, "This startup uses artificial intelligence to predict whether a Hollywood film will be a hit or a flop - just by scanning the script", Business Insider, 2015. [Online] Available: <https://www.businessinsider.in/This-startup-uses-artificial-intelligence-to-predict-whether-a-Hollywood-film-will-be-a-hit-or-a-flop-just-by-scanning-the-script/articleshow/48274369.cms>

AUTHORS PROFILE



Vamsi Krishna is an Undergraduate Scholar pursuing Computer Science & Engineering from MVSR Engineering College.