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DEVELOPMENT OF APPLICATION SOFTWARE FOR GENERATING MUSIC COMPOSITION INSPIRED BY NATURE USING DEEP LEARNING

Sapna Jain [1] and M. Afshar Alam [2]

[1,2] Jamia Hamdard, New Delhi
drsapnajain@jamiahamdard.ac.in
aalam@jamiahamdard.ac.in

Abstract: Music composition for small-scale gaming companies to generate theme music to generate unique notes for each level of the game demands the requirement of machine learning-based automated nature-inspired music composition. It is worth mentioning that even great musicians usually get inspired by nature to compose the musical notes for the film. In this paper, an attempt is planned to develop the application software to generate musical notes using Deep learning. Deep learning algorithm can help to get predictions, classifications, and decisions based on the data without extracting the features from the data. We propose to use a Deep learning algorithm to hunt tunes from nature.

Keywords: Deep learning, Machine learning, Computational intelligence, Mobile application software, Artificial intelligence

Introduction:

The generative models in Deep learning like GAN (Generative Adversarial Network), Auto encoders are capable of generating the new data that have identical statistical characteristics of the training data.

a) Generative Adversarial Network consists of two blocks. Generator block and the Discriminator block. The Generator block tries to generate the data that follows the intended statistical characteristics (pdf). The data obtained as the output of the generator block (fake) along with the original data are given as the input to the discriminator block. The discriminator block is trained to discriminate between original and the fake data. The generator block and the discriminator block are trained to compete with each other (Adversarial learning) and finally the generator is capable of generating the data (fake) that follows closely the statistical characteristics of the original.

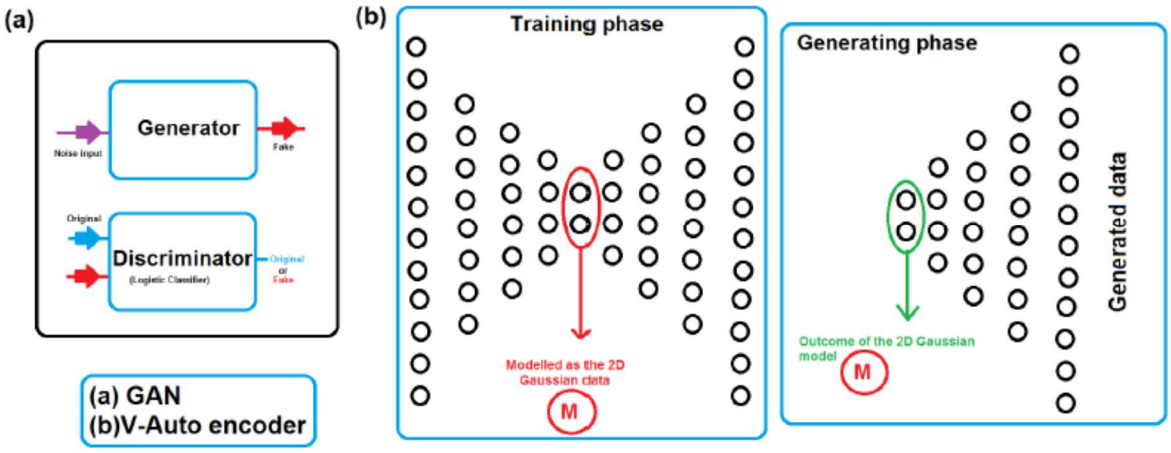


Figure 1 Illustration of (a) GAN (b) Variational Encoder

b) Variational Auto encoder: It is the simple feed forward network, in which the neurons are stacked in the layered architecture. The number of neurons in each layer follows the typical pattern given in Fig 1(b). During the training stage, the weights are adjusted to minimize the auto-associative targets, i.e., the input vectors and the target vectors are made identical. Once training is done, the outcomes obtained from the innermost hidden layer (in this illustration, it is the 2D random variable) are collected and modelled as Multivariate Gaussian density function. During the generation stage, the outcome of the random vector from the modelled Gaussian density function is obtained and hence the corresponding output of the auto encoder model is obtained. This is the newly generated data having almost identical statistical characteristics as that of the training data.

Literature survey:

Related work: In 2016, Enrique Muñoz; Jose Manuel Cadenas; Yew Soon Ong; Giovanni Acampora [1] witnessed the production of artwork (music composition) using computational intelligence. Steve Engels, Fabian Chan and Tiffany Tong (2015) [2] developed the software that imitates the composer's larger music structure for Automatic Real-time Music generation for games. The statistical approach on Melody composition was attempted by Roig C, Tardn Lorenzo J, Barbancho I, Barbancho (2014) [3]. The parameters were extracted from the Music using Hidden Markov Models and were used to generate music generation [4] The results on using Genetic algorithm for composing Music were reported by Dragan MATIC (2010) [5]. The book "Evolutionary Computer Music" (2007) [6] summarizes the evolutionary computation techniques to create music. There was an attempt made on music generation from statistical Models by Conklin.D. (2003) [7]. The frame work was developed for the Music composition evaluation was done by Pearce.M. Wiggins G (2001) [8]. The various perspectives of different researches on Musical composition using evolutionary computation were summarized by SantosA,Arcay B,Dorado J, Romero J, Rodriguez J (2000)[9].

Florintina, E.S.Gopi (2018)[10] attempted in to compose music inspired by sea wave patterns taken as input from beaches. In this technique, the features are extracted from the sea videos and are mapped to the musical notes using thumb rule. The performance promises the scope to extend the idea in the larger scale. LSTM based Deep learning was used to classify the music composition based on the composer index by V.Karthik, E.S.Gopi (2019). The experiments were done and the maximum success rate of 83.6% success rate was achieved. The other related attempts were the following: (a) Jay K.Patel, E.S.Gopi (2015) [11] on "Signal processing approach for Music Synthesis Using Bird's sound": The humming audio signals are collected from different perching birds. The various frames thus collected are mapped to the fundamental musical notes (Sa, R1, R2, G2, G3, MI, M2, P, D1, D2, N2 and N3) based on the normalized frequency match. (b) Hemanth sharma and E.S.Gopi (2013)[12] attempted to extract the musical notes played using the piano using signal processing techniques.

Proposed conceptual block diagram:

Music composition to generate theme music and generate unique notes for each level of game demands the requirement of Machine learning based automated nature inspired music composition for small-scale companies gaming companies. It is worth to mention that even the great musicians usually get inspired from the nature to compose the musical notes for the film. In this proposal, an attempt is planned to develop the application software to generate the musical notes using Deep learning.

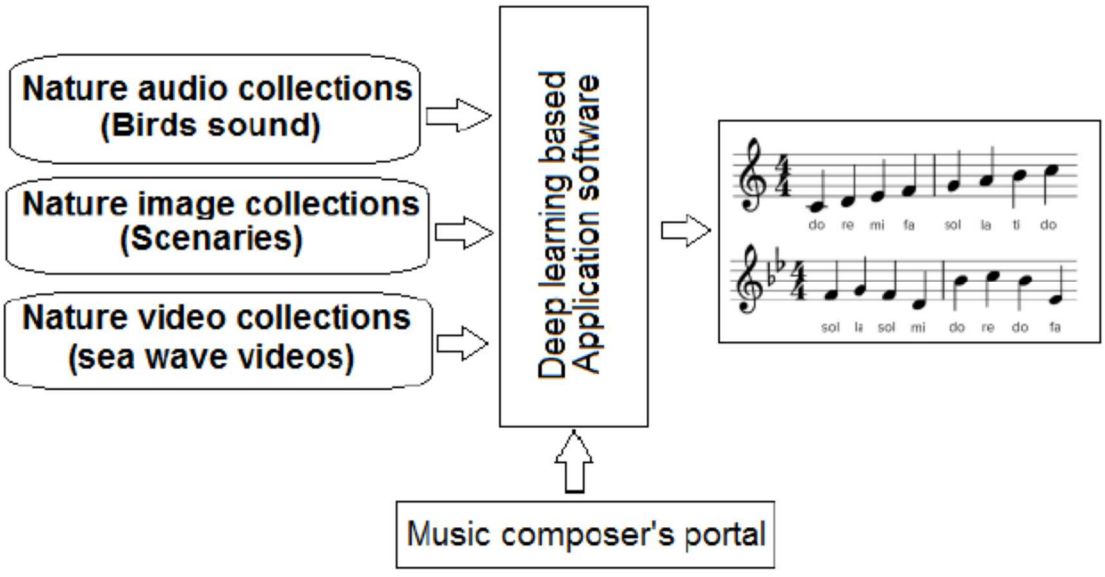


Figure 2 block diagram

Proposed methodology and the Execution steps:

1. Collection of Database: The database is created by capturing the ocean waves, Waterfalls, Birds sound, etc. from the nature.
2. Formulating the Musical notes corresponding to the collected dataset: The earlier proposed methodology [10] will be adopted to collect the features from the natural dataset and are further used to obtain the musical notes corresponding to the features collected.
3. Mobile application sofGenerative models (GAN and Auto-encoders) are used to generate the features that follows the statistical characteristics of the features obtained from the natural database.

The algorithm for proposed methodology: -

The vae-nn framework defined above is used to generate tune based totally on precise styles, along with a sure artist, style, or year. The algorithm
1. Divide the statistics input into 32-step sequences and encode every sequence into the latent area using each tool's vae encoder. Keep the precise sequences in a set for each tool.
2. While producing a song from a beginning sequence, one latent vector consistent with the device is sampled from this set. This sampled latent vector (from our desired track) s is then interpolated with the previous series's latent vector to generate a new latent vector

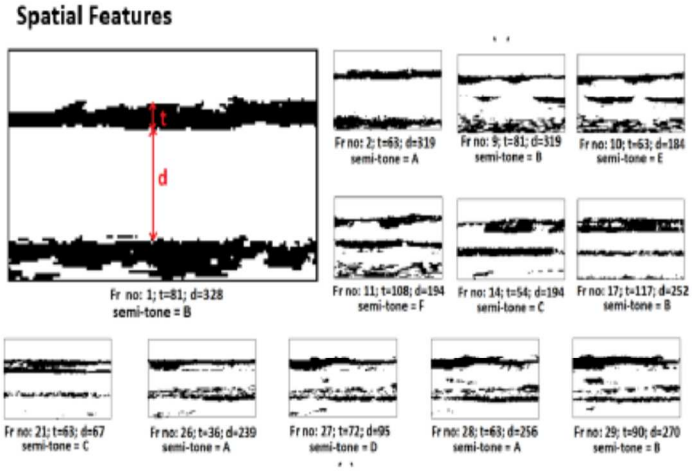
$$z_t' = \alpha \boldsymbol{s} + (1 - \alpha) z_t$$

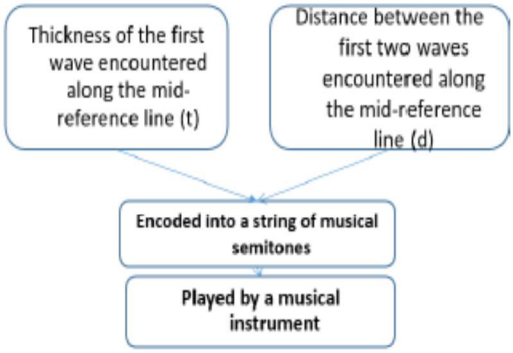
with α being the latent sample factor, which is a hyperparameter that can be tuned. (Choose higher values of α to the generated music to be more significantly conditioned on the desired style)
3. Use z'_t as opposed to z_t as the input for the melodynn to generate the brand-new latent vector and hence the generated tune series. Using this method and α=0.5, we generated a new track conditioned on numerous songs, videos,pix, and tunes

Result analysis

The images extracted from the video of sea waves taken from beach are subjected to classification to detect the foam in the images. The foam part of the image is represented in black pixels and the non-foam part is represented in white pixels. The various spatial and temporal features are extracted from the images (refer Fig.3). The encoding rule is intuitively formulated to convert the spatial and the temporal features into the musical notes. The quantitative validation of the proposed technique was done using the feedbacks collected from 50 people through Google form. The results show that the success percentage of 91.6% revels that the project is worthy of contributing to the music composition domain.

Features to Musical notes conversion

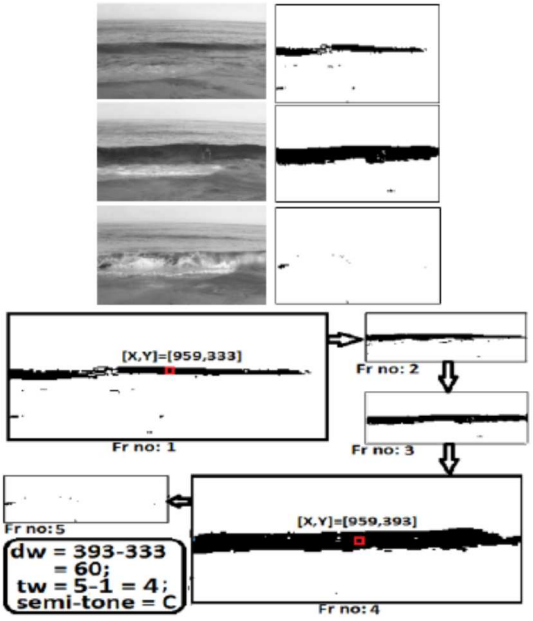


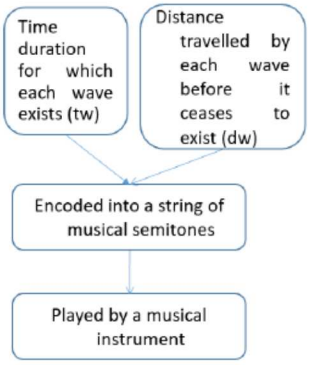


Encoding condition used:

Condition on d	Condition on t	Musical semi-tone generated
d <d1	t <t1	C
	t1 <t <t2	D
d1 <d <d2	t <t1	E
	t1 <t <t2	F
	t >t2	G
d >d2	t <t1	A
	t1 <t <t2	B

Temporal features





Condition on dw	Condition on tw	Musical semi-tone generated
dw <dw1	tw <tw1	C
	tw >tw1	D
dw1 <dw <dw2	tw <tw1	E
	tw >tw1	F
dw2 <dw <dw3	tw <tw1	G
	tw >tw1	A
dw >dw3	tw <tw1	B

Figure 3 result analysis

Conclusion

Collection of Database is created by capturing the natural videos of the ocean waves, natural sound signals such as Waterfalls, Birds sound, etc. from the nature. Generating the Musical notes corresponding to the collected data set using the features collected from the collected data. Development of Deep learning based Mobile application software to generate the musical notes with videos of the nature (example: sea waves), and the natural audio signals as the input data. Mobile application software in which the videos of the nature (example: sea waves) and the natural audio sounds are given as the input and the musical notes are obtained from the developed algorithm as the output. This can be used as the stand-alone software.

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