RSGAN: Recurrent Stacked Generative Adversarial Network for Conditional Video Generation

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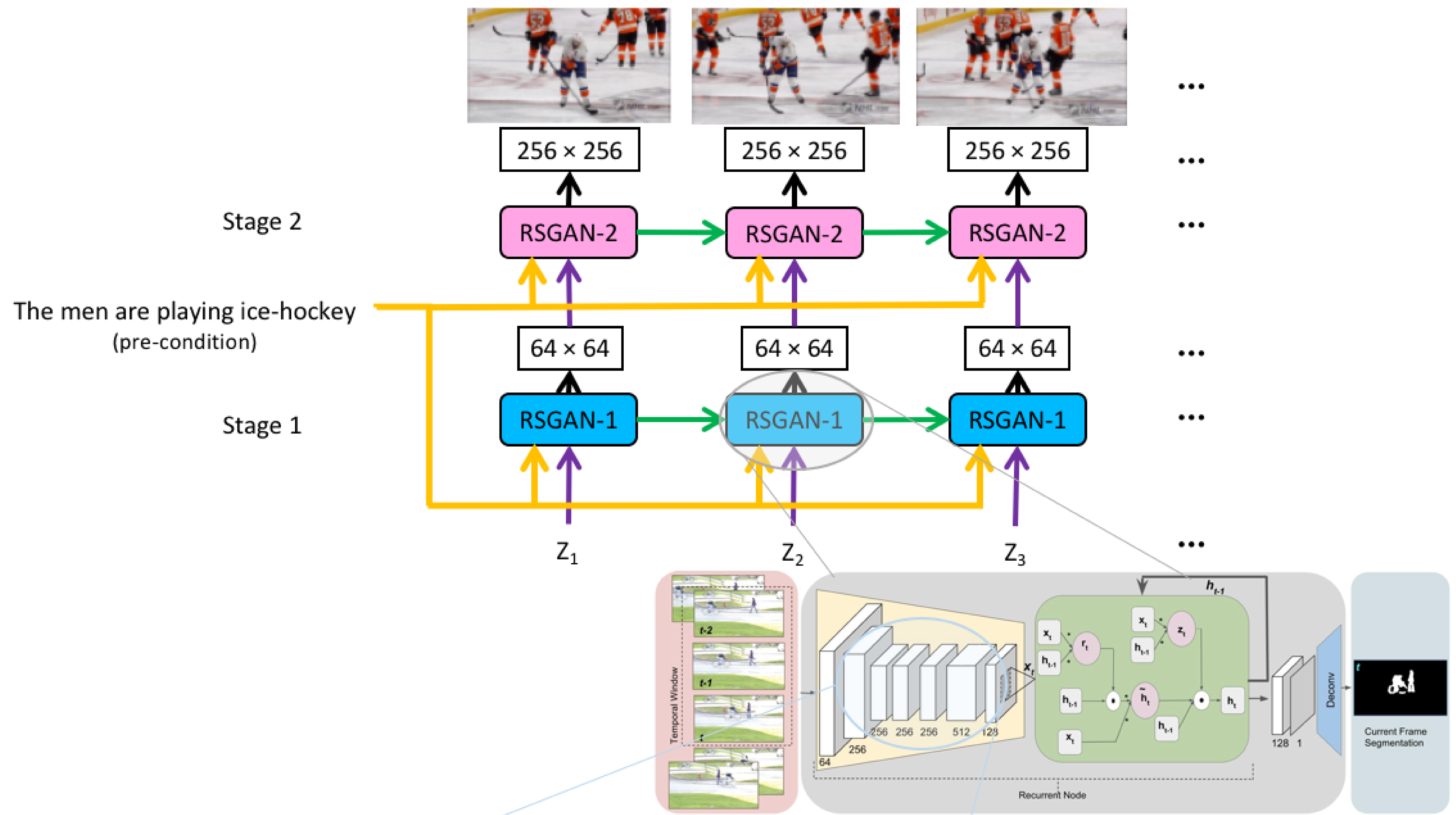
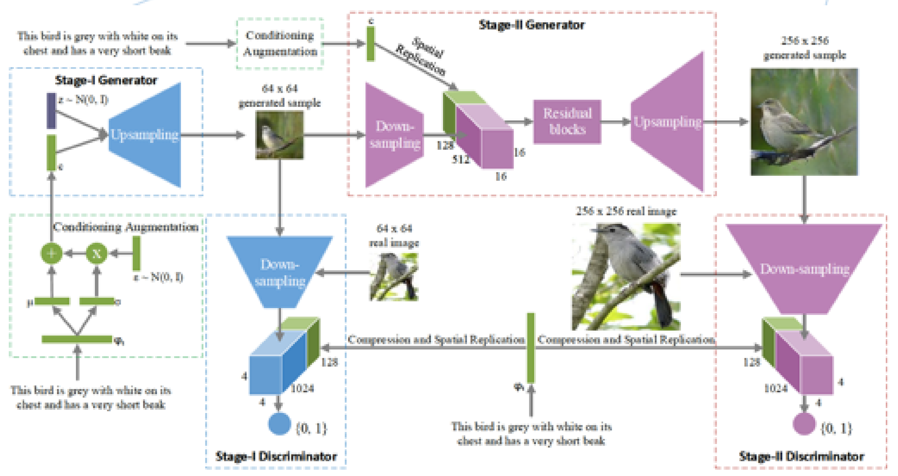
Introduction

Generating video frames based on a pre-condition is a challenging problem and requires understanding of per frame contents and visual dynamics and their relevacies to the pre-condition. In this project, we propose a novel Recurrent Stacked Generative Adversarial Network (RSGAN) based model to generate video frames based on a given pre-condition. In our knowledge, this is the first work to address the problem of conditional video generation using adversarial network. We can address the problem of generating videos based on pre-conditions such as,

1. action classes
2. fMRI signals
3. sentence descriptions

Our Approach





Each RSGAN module is - consist of a StackGAN model.
- connected by a Fully Convolutional LSTM Network.

Objective Function

Conditioned on Gaussian latent variables c_0, Stage-I RSGAN trains discriminator D_0 and generator G_0 by alternatively maximizing $\mathcal{L}_{D_o}$ and minimizing $\mathcal{L}_{G_o}$.

Stage-I RSGAN:

$$\mathcal{L}_{D_o} = \mathbb{E}_{(I_o,t)\sim p_{data}}[logD_0(I_0,\varphi_t)] + \mathbb{E}_{z\sim p_z, t\sim p_{data}}[log(1-D_0(G_0(z,c_0),\varphi_t))]$$

$$\mathcal{L}_{G_o} = \mathbb{E}_{z\sim p_z, t\sim p_{data}}[log(1-D_0(G_0(z,c_0),\varphi_t))] + \lambda D_{KL}(\mathcal{N}(\mu_0(\varphi_t),\textstyle\sum_0(\varphi_t))||\mathcal{N}(0,I))$$

Conditioned on the low resulation sample s_0 and Gaussian latent variables c, discriminator D and generator G in Stage-II RSGAN is trained by alternatively maximizing $\mathcal{L}_D$ and minimizing $\mathcal{L}_G$.

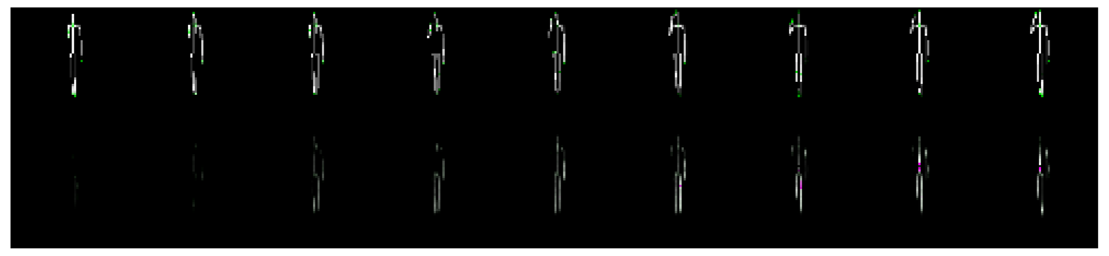
Stage-II RSGAN:

$$\mathcal{L}_D = \mathbb{E}_{(I,t)\sim p_{data}}[logD(I,\varphi_t)] + \mathbb{E}_{s_o\sim pG_o, t\sim p_{data}}[log(1-D(G(s_0,c),\varphi_t))]$$

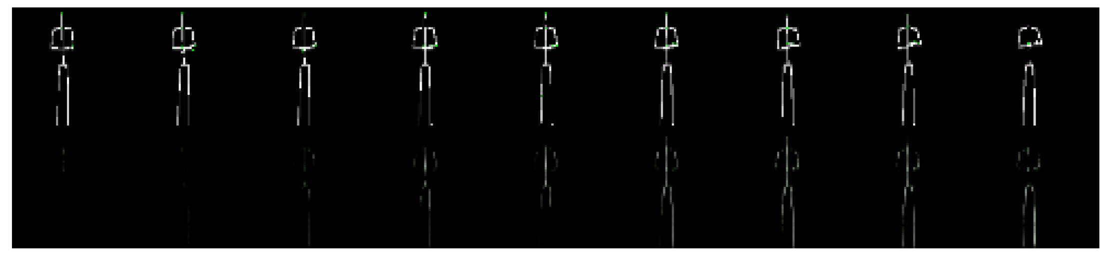
$$\mathcal{L}_G = \mathbb{E}_{s_o\sim pG_o, t\sim p_{data}}[log(1-D(G(s_0,c),\varphi_t))] + \lambda D_{KL}(\mathcal{N}(\mu(\varphi_t),\textstyle\sum(\varphi_t))||\mathcal{N}(0,I))$$

Result

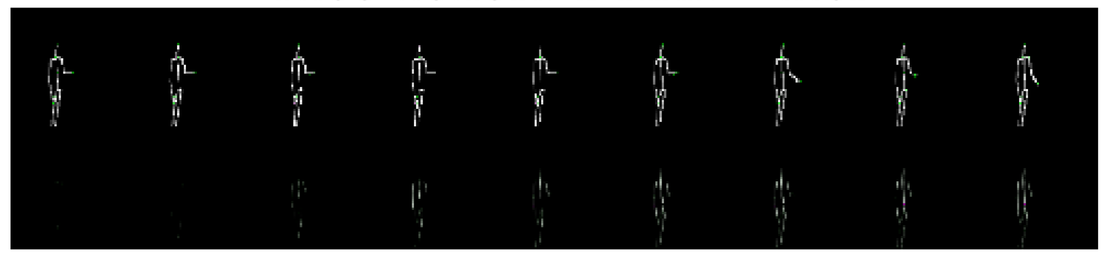
Ground truth (1^{st} row) and the **partial result on Convolutional LSTM** (2^{nd} row).



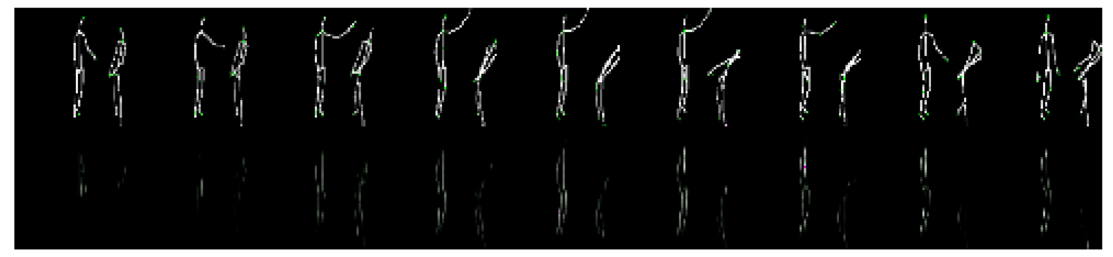
Video action: Drink water



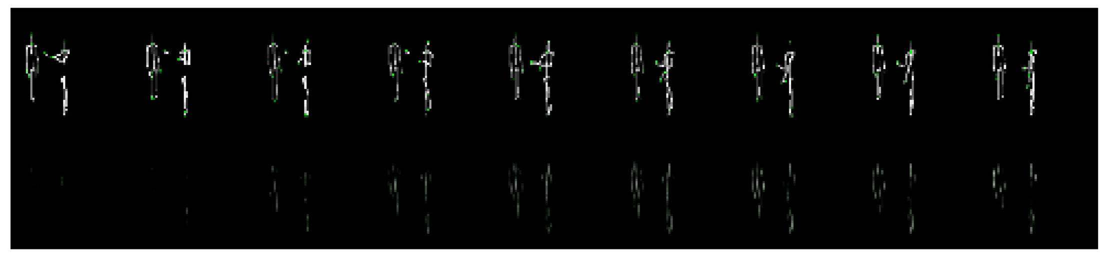
Video action: Reading



Video action: Drop



Video action: Slapping other person



Video action: Point finger at the other person

Video action: Writing

- Right now, we are trying to generate video with simple details. That's why we are using NTU RGB+D Action Recognition Dataset (skeletal data).

Future Research

- Generate video with complex details and multiple moving objects.
- Use fMRI dataset of human brain, to generate video.

References

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[2] S. Valipour, M. Siam, M. Jagersand, and N. Ray. Recurrent Fully Convolutional Networks for Video Segmentation. *arXiv preprint arXiv:1611.09904*, 2016.

[3] O. Mogren. C-RNN-GAN: Continuous recurrent neural networks with adversarial training. *arXiv preprint arXiv:1611.09904*, 2016.