Detection of human papillomavirus (HPV) from super resolution microscopic images applying an explainable deep learning network

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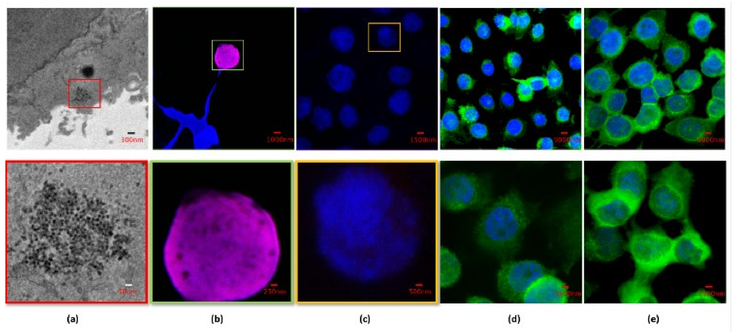
INTRODUCTION

Human papillomavirus (HPV) remains a leading cause of virus-induced cancers and has a typical size of 52 to 55nm in diameter. Hence early detection of high-risk of HPV can not only prevent the further development HPV into cancer but also evaluate the developed anti-HPV drugs

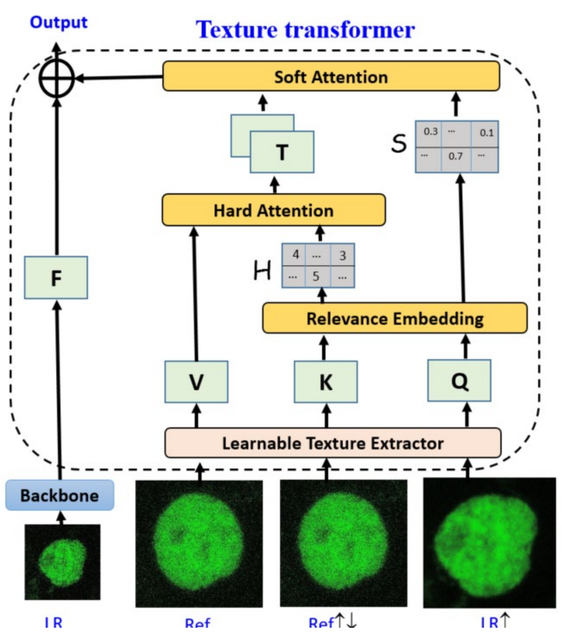
Conventional light microscopy that usually sustains a resolution at ~100nm per pixel falls short of detecting it. This study explores applying computational **super resolution** approach to up sample conventional microscopic images, built upon **texture transformer** network

Figure 1. An illustration of the dataset that is employed in this study.



METHODS

Figure 2 presents the architecture of vision transformer that is employed in this study.



RESULTS

Table 1. The lists of the average PSNR and SSIM for different SR methods together with comparison results on detection of clusters

	PSNR	SSIM	Sensitivity	Specificity
RCAN	25.80	0.7910	79.80	83.33
Pix2pix	18.35	0.5059	65.74	80.26
CycleGAN	30.31	0.8013	74.28	85.98
ESRGAN	28.07	0.6074	74.46	81.63
TTSR	**28.70**	**0.8778**	**83.6**	**83.33**

Figure 3. Demonstration of HPV detection results

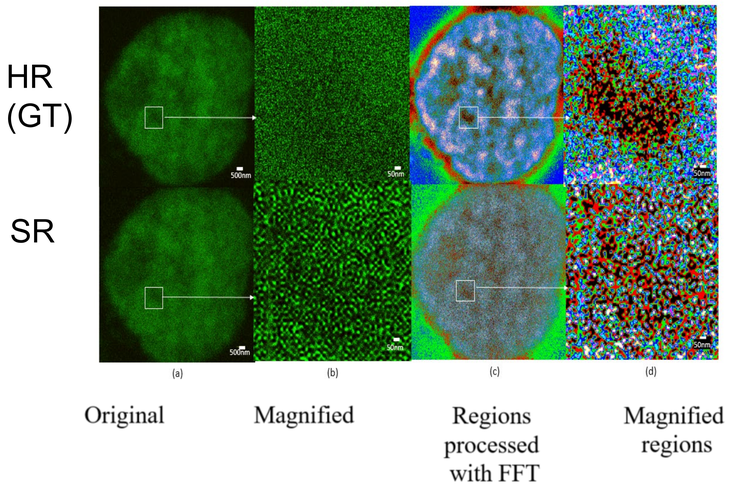
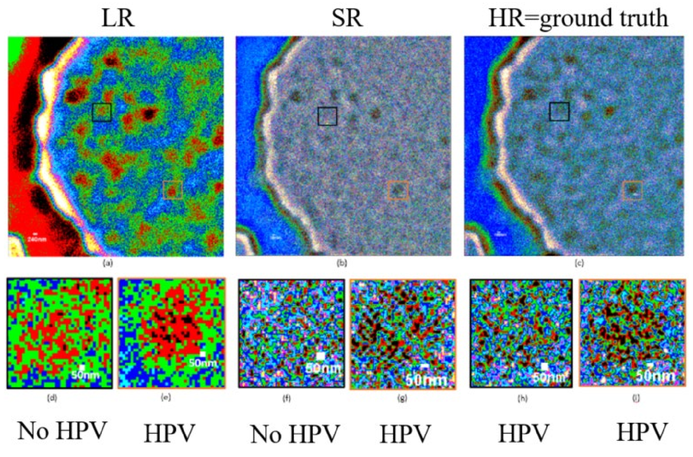


Figure 4. Detection of HPV from varying resolutions.



CONCLUSIONS

- This work constitutes one of the first to identify human papillomavirus (HPV) from conventional light microscopic images
- It developed a computerized system to visualise, detect and monitor HPV like structures.
- It is built upon state of the art **vision transformer** deep learning networks.
- Based on **attention mechanism**, this texture transformer presents features of explainable and performant.
- Preliminary results reveal potentials of such a system in identification of HPVLPs.
- In comparison with anther explainable attention-base network based on very deep residual attention network (RCAN) and three adversarial deep learning networks (GAN) [6], TTSR performs the best.

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