IASST scientists develop software to detect cervical cancer

Researchers from Institute of Advanced Study in Science and Technology (IASST), Guwahati an autonomous institute of the Department of Science & Technology (DST), Govt. of India have designed a robust fully automated software-based solution using Pap smear images to detect abnormal growth or development of tissues in the cervix — the lower part of the uterus that connects to the vagina. The current work has been recently published in the journal 'Tissue and Cell'.

Cervical cancer is one of the most prevalent cancers among women in North-East India. Compared to the 2018 incidence rate of 13.1 worldwide and 14.7 in India, in NE, it is more than 24.3, thus posing an alarming health problem for the region. With the unavailability of adequate treatment facilities, patients have to move to urban cities, mainly New Delhi, Mumbai, and Chennai.

Having taken on the challenge in and around 2012, a survey by Dr. Lipi B Mahanta and her team revealed that lack of availability of automated systems hampered timely diagnosis of the disease. It was evident to Dr. Mahanta that an effective early diagnosis structure called for a software that would be rapid, accurate, robust, and which could be delivered at the doorstep.

Pap Smear is the most popular technique for early diagnosis of cervical cancer. Diagnosis is done by critically analysing the slides prepared from the smear collections, under a microscope. In India, the slides are prepared using two methods: conventional as well as Liquid Based Cytology (LBC).

The researchers put together a database of two types of indigenous Pap smear images databases, one each for conventional and Liquid Based Cytology (LBC) and used it to create algorithms with the images of different qualities, being prepared by different technicians and captured from different microscopes. The algorithms helped develop robust software to detect cervical cancer.

Hypothesizing that the software will be sturdier if based on an indigenous dataset, rather than publicly available datasets of patients belonging to other countries, one was generated with help from Dr. B. Borooah Cancer Institute, Gauhati Medical College and Hospital, Ayursundra Healthcare Pvt. Ltd, and ASMI in Guwahati, and from Babina Diagnostics in Imphal, Manipur. The Bethesda system for Pap Smear diagnosis was adopted by the group.

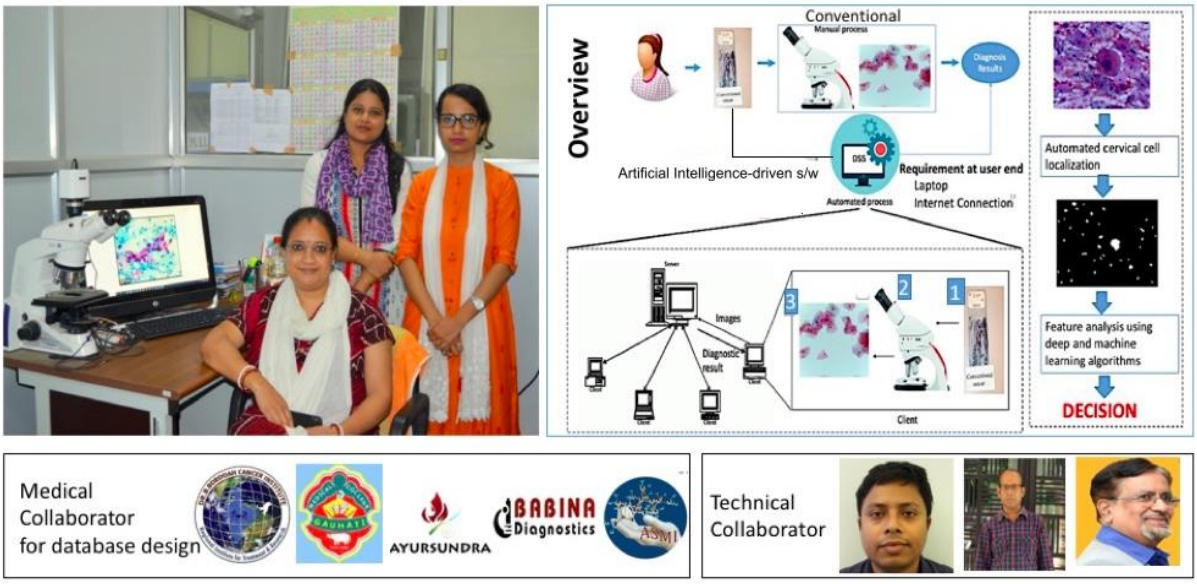
The team then adopted two AI approaches, Machine Learning and Deep Learning. Applying the first approach on the conventional dataset, the group reported a novel algorithm for automatic segmentation of cervical cells, removing debris like inflammatory cells and red blood cells from a whole slide image, including improvement towards dealing with poor stained images which are some of the major challenges faced by researchers. The group achieved 96.5% accuracy using an ensemble machine learning algorithm where shape, colour and texture features of the Pap smear images were analysed for automated classification of cervical dysplasia.

Exercising the second approach, the team reported one of the earliest studies, using the conventional dataset, proposing a novel classification technique adopting a modified Convolutional Neural Network. Having created a significant LBC dataset by then, the team next explored very recent state-of-the-art deep learning techniques like simultaneous instance segmentation and classification algorithms for efficient Pap smear image interpretation, analysis, and prediction on it. The team has developed a novel classification algorithm, with

98.8% accuracy, which can identify the pre-cancerous and cancer lesions while precisely localizing the cervical cells, removing the debris including overlapping cells and then finally classifying them based on the Bethesda system nomenclature, to maintain uniformity with the current reporting system.

The team plans to create a pocket-friendly diagnostic kit, to be hosted and marketed on a web-based platform, after conducting substantial field trials.

"The use of Artificial Intelligence tools such as Machine Learning and Deep Learning is the next big frontier in rapid, inexpensive and accurate medical diagnostics for a variety of pathologies. This is a focus area in the Cyber-physical Systems hubs established by the Department of Science and Technology in IITs," said Professor Ashutosh Sharma, Secretary, DST.



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