CLAIMS

1. A computer implemented method for detecting nasopharyngeal cancer, the method comprising:

obtaining an immunofluorescence assay (IFA) image associated with a sample;

processing the IFA image to produce a processed IFA image;

detecting cells in the processed IFA image;

determining numCells, where numCells is the total number of detected cells;

for each detected cell, classifying the cell as either an Epstein-Barr Virus (EBV) Early Antigen positive cell (EA+ cell) or an EBV Early antigen negative cell (EA- cell), and generating a probability index (PI) value for the detected cell using pixel information;

calculating an EA+ Index value based on numCells and numCellsEA+, where numCellsEA+ is the total number of detected cells that are classified as an EA+ cell;

calculating a value for an EBV score, wherein the EBV score is (i) the average of the PI values that are greater than or equal to a predetermined threshold, or (ii) the average of the PI values that are greater than the predetermined threshold;

using a first set of membership functions, mapping numCells to a first set of fuzzy values;

using a second set of membership functions, mapping EA+ Index to a second set of fuzzy values;

using a third set of membership functions, mapping EBV score to a third set of fuzzy values; and

using the first set of fuzzy values, the second set of fuzzy values, the third set of fuzzy values, and fuzzy rules to classify the sample as one of test-negative and test-positive.

2. The method of claim 1, wherein the step of classifying the cells is performed by a convolutional neural network (CNN).

3. The method of claim 2, wherein, for each detected cell, the CNN determines the PI value for the cell and uses the PI value and the predetermined threshold to determine whether or not the cell should be classified as an EA+ cell.

4. The method of claim 3, wherein the CNN classifies a particular cell as an EA+ cell as a result of determining that the PI value for the particular cell exceeds the threshold.

5. The method of claim 1, wherein classifying the cell as either an EA+ cell or an EA- cell comprises:

obtaining the pixel information for the cell;

using the pixel information to calculate the PI value for the cell; and

using the PI value and the predetermined threshold to determine whether or not the cell should be classified as an EA+ cell.

6. The method of claim 5, wherein the pixel information for the cell comprises a set of pixel intensity values, wherein each pixel intensity value in the set of pixel intensity values indicates the intensity of a pixel corresponding to the cell.

7. The method of claim 6, wherein using the pixel information to calculate the PI value for the cell comprises calculating:

$PI = \sigma/\mu$, where

μ is the mean of the pixel intensity values, and

σ is standard deviation of the pixel intensity values.

8. A computer program comprising instructions which when executed by processing circuitry of a disease detection system causes the disease detection system to perform the method of any one of claims 1-7.

9. A carrier containing the computer program of claim 8, wherein the carrier is one of an electronic signal, an optical signal, a radio signal, and a computer readable storage medium.

10. A disease detection system for detecting nasopharyngeal cancer, the disease detection system being configured to:

obtain an immunofluorescence assay (IFA) image associated with a sample;

process the IFA image to produce a processed IFA image;

detect cells in the processed IFA image;

determine numCells, where numCells is the total number of detected cells;

for each detected cell, classify (s910) the cell as either an Epstein-Barr Virus (EBV) Early Antigen positive cell (EA+ cell) or an EBV Early Antigen negative cell (EA- cell), and generate a probability index (PI) value for the detected cell using pixel information;

calculate an EA+ Index value based on numCells and numCellsEA+, where numCellsEA+ is the total number of detected cells that are classified as an EA+ cell;

calculate an EBV score value, wherein the EBV score is (i) the average of the PI values that are greater than or equal to a predetermined threshold, or (ii) the average of the PI values that are greater than the predetermined threshold;

use a first set of membership functions, mapping numCells to a first set of fuzzy values;

use a second set of membership functions, mapping EA+ Index to a second set of fuzzy values;

use a third set of membership functions, mapping EBV score to a third set of fuzzy values; and

use the first set of fuzzy values, the second set of fuzzy values, the third set of fuzzy values, and fuzzy rules to classify the sample as one of test-negative and test-positive.

11. The disease detection system of claim 10, wherein the disease detection system is further configured to perform the method of any one of claims 2-7.

12. A disease detection system for detecting nasopharyngeal cancer, the disease detection system comprising:

processing circuitry; and

a memory, the memory containing instructions executable by the processing circuitry, whereby the disease detection system is configured to perform the method of any one of claims 1-7.