ISSN: 0975-3583, 0976-2833 VOL 12, ISSUE 04, 2021

Automatic Tool Generation for Diagnosing Blood Anemia

K. S. Vijaya Lakshmi[1*],K. Suvarna Vani[2]
[1,2]Velagapudi Ramakrishna Siddhartha Engineering College,Vijayawada, AP, India
[1*]vijaya@vrsiddhartha.ac.in, [2]suvarnavanik@vrsiddhartha.ac.in

ABSTRACT
The development of new computer software techniques and erudition systems must emerge the creation of new systems in several fields especially in the field of Bio-medical sciences, where new data frameworks have been made to speak to innovative and initiating capacities to the degree application and uses are concerned. Sketch and carrying out of a computer-based erudition operation by appropriating a detailed line of attack are bestowed for enhancing the interpretation of blood anaemia. This approach incorporates a lot of strategies and procedures to investigate blood misdirection images. Basically, a proficient strategy utilizing the picture handling procedure (picture upgrade, division, and highlight taking out) has been developed which can be utilized to examine blood spread pictures shouted with photomicroscope. Generally, blood spread imagery includes red blood cells, white blood cells, and platelets. This system is used to classify the abnormal cells present in the blood sample. The framework checks the general blood platelets and figures the level of various sorts of tallied anomalous cells like macrocyte, target cell, howel-jolley body, sickle cell, elliptocyte, tear, spherocyte, etc. The presence of a few strange sorts and the related rates show the kind of blood anaemia. The continuation of this strategy has a precision of 83%.
Keywords Blood Anaemia, Image Processing, Photo Microscope, Smear Images, Red Blood Cells

Introduction

The widespread of workstations and the evolution of current erudition systems have performed an advanced performance while the progress of advanced software. The usage of such programming has usually spread, particularly in the arenas of Biomedical Science [6] wherever novel info structures encompass prepared to address imaginative and leading capacities to the degree material and exercise are alarmed. The goal of previously mentioned job is to confirm the result of computer-based erudition system by means of picture preparing at the areas of Biomedical Sciences making help of the knowledge and readiness of PC methods to inspire data of unmistakable criticalness to expert and to expert.

The objective of grouping of the red platelets utilizing picture preparing is to find morphological highlights of RBC's in the blood smear (Amit Kumar Biswas, 2015). This will promote their added preparing to characterize RBC's in typical cells and strange cells (Hypo chromic, Microcytic, Target Cell, Nucleated RBC's in Normal cells polychromatic and sickle cells)[7].The dissected cells in the blood smear will give valuable data about sickliness. The fringe blood film originally arranged in the Laboratory, and after expertly re-colored the examiner used to peruse and break down the picture of blood flick below the magnifying lens through exact focal points.

Literature

Alhadidi et al. [1] [2] proposed an algorithm for identifying iron deficiency by using the intestinal villi tissue slide images. They have used a multiple stage approach where the image is processed and enhanced step by step. In the first step RGB images are converted into greyscale. They have eliminated the hue and saturation channels. Greyscale thresholding is then performed on the image to enhance the image. Finally, ROI is used to determine the count.

Anoraganingrum et al. [3] segmented the cells using image processing techniques. Median filter and Morphological operations are used in combination to segment the regions. Pan et al.[4] recognized blood and bone marrow cells from RGB Images. Kernel PCA is used to extract the important features for the classification and then SVM is used to recognize the edgy plane that separates the different classes. Hamghalam et al.[9, 12, and 13] proposed an algorithm for segmenting the Leukocyte from Giemsa-stained images. The approach includes thresholding and active contours for final segmentation map.

The inventive conclusions kinds of iron deficiency could help in brief cure; blood paleness is a consistent blood issue that assaults an assortment of individuals by keeping them from getting a charge out of a solid life, brilliant kids and ladies. This frailty is required to need orpiment, which permitted a red shade of hemoglobin, a material situated inside red platelets, fortify and circulate oxygen to entire body cells. Red Blood Erythrocytes (RBC) [5] in depiction representation in blood deception is actually significant to conclude the type of anemia; a standard blood spread contains white blood cells (WBC), RBC and platelets.

ISSN: 0975-3583, 0976-2833 VOL 12, ISSUE 04, 2021

The outer blood film previously arranged in the Lab, and after expertly made recolor, the investigator accustomed to peruse and dissect the picture of blood film below magnifying instrument with exact focal points [10]. Anemia is often perceived by the strange analysis facility screening analysis. Generally, victims present amidst indications and suggestions distinguished with anemia. These side effects of iron deficiency rely upon its enormity and the velocity of its origin. Serious pallor with steady beginning can go unnoticed though a one that is less extreme yet of intense beginning can prompt sensational hemodynamic flimsiness. Indications compared with mild anemia combine pallor, fatigue, the impairment loss of stamina, breathlessness, and throbbing [11].

Methodology

Algorithm

Input: Blood Sample Image

Output: Classified Anemic feature value, Resultant image

Input parameters: Image values

1. Read the blood smear image generated at the laboratory using the blood sample of the patient from the photomicroscope and save it as a readable format of image(.jpg or .png).
2. Improve the eminence of the depiction and generate an elevated disparity depiction.
3. Alter the RGB image (Red-Blue-Green scale image) into gray scale image.
4. Create a binary depiction from the obtained gray scale image using predefined functions under OpenCV module.
5. Alter the binary depiction into complemented binary depiction using simple bitwise operation over the image generated.
6. Remove small objects from the complemented binary image by calculating the contours for all the objects and assigning pixel values of all the objects having smaller contour area to zero.
7. Remove the boundary objects and incomplete objects present in the image by computing the region properties i.e. width and length of the bounding box for each object and assigning its pixel values to zero if the length and width are less than 3 for the respective bounding box.
8. The above process completes the image preprocessing of the sample image and now we move forward to feature extraction of the objects in the image.
9. To extract the features of the objects, we use the bounding circles and bounding rectangles for the contours identified in the image. The bounding rectangles and circle are drawn along the contours for easier identification.
10. Calculate area for the contour and area of the bounding rectangle using area function that calculates the area for each contour and the bounding box of each contour respectively.
11. Calculate diameter and arc length of the bounding circle for each contour detected.
12. Calculate center of mass for the contours which is identified by calculating the moments of each contour identified and also identify the centroid of the bounding rectangle for each contour respectively.
13. Calculate the distance between centroid and center of mass for the bounding box and contour moments respectively for each contour.
14. If distance identified among the center of the bounding box of the area and center of the area either on x-axis or y-axis is large then it denotes abnormalities in the cell and irregularity in cell shape. If distance is small, then shape is regular.
15. If area of the contour is more than the max area of the blood cell or the area is less than the min area then the cell is irregular and is affected by anemia.
16. Based on step 13 and step 14 identify the number of cell objects effected by anemia and display the anemia affected cells.
17. Calculate the percentage of anemia based of the number of cells affected and if the percentage is:
    i. Less than or equal to 6, it denotes normal
    ii. Greater than 6 and less than 10 indicates mild anemia.
    iii. Greater than 10 and less than 12 indicates moderate anemia.

ISSN: 0975-3583, 0976-2833 VOL 12, ISSUE 04, 2021

iv. Greater than 12 indicates severe anemia.

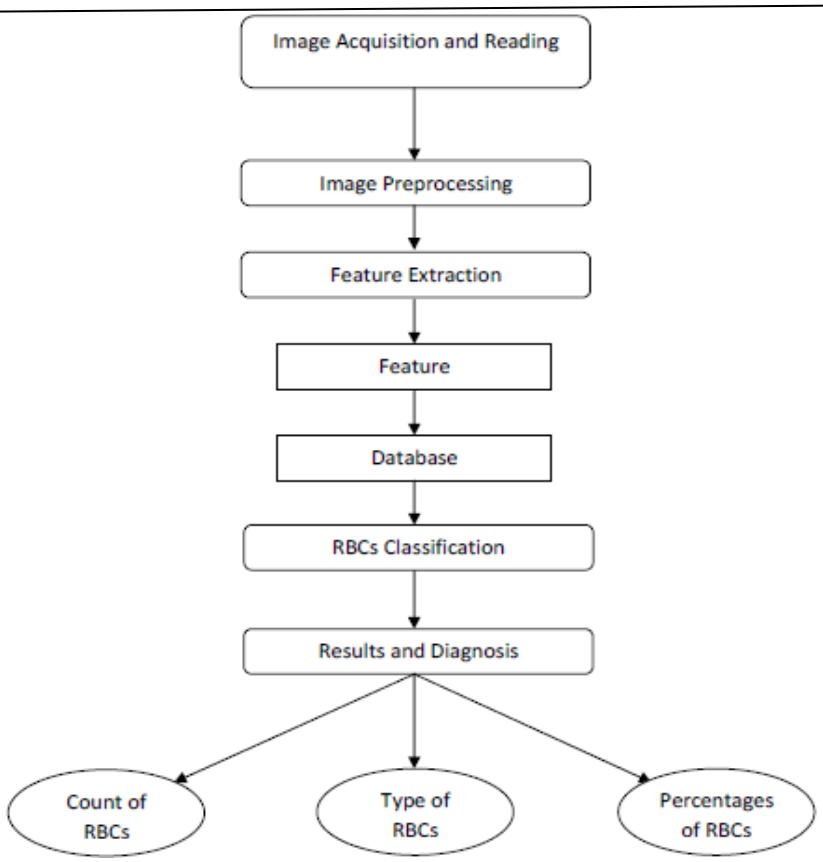

Fig. 1: Architecture Diagram

Implementation Details

Programming for the project related to image processing techniques is preferably performed using Open CV[8] along with C++ programming in Visual Studio. Open CV is written in C++ and its primary interface is in C++, but it still retains a less comprehensive though extensive older C interface. There are also bindings in Python, Java and OPENCV. It is free for both commercial and non-commercial use. It is a library of many inbuilt functions mainly aimed at real time image processing and computer vision algorithms which make developing advanced computer vision applications easy and efficient. The key features of using OpenCV are

- Optimized for real time image processing & computer vision applications
- Primary interface of OpenCV is in C++.
- There are also C, Python and JAVA full interfaces.
- OpenCV applications run on Windows, Android, Linux, Mac and iOS.
- Optimized for Intel processors.

OpenCV also supports a large number of modules that can be used to process and format various kinds of images so as to support the project. OpenCV is installed along with Visual Studio IDE and configured with it so as to run the project.

ISSN: 0975-3583, 0976-2833 VOL 12, ISSUE 04, 2021

Results and Discussions

The created framework produces a report containing RBC's tally, Type of RBC and Percentage of RBC's present in the example. The framework orders cells in the wake of separating properties and looking at them in 12th kinds of cells and furthermore tallies the number of cells for every caring alone which checks allowances.

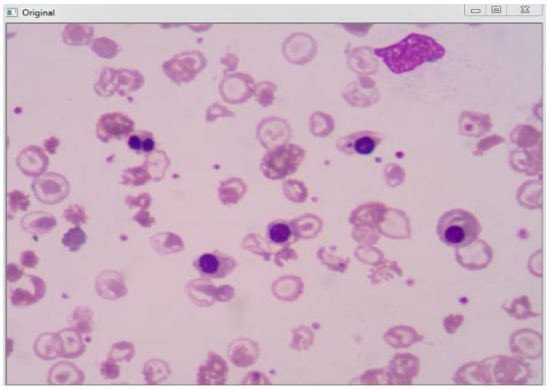

Fig. 2: Original Image

Apply Enhancement

The enhancement of the depiction is achieved by getting better disparity levels, dissemination levels, and vividness. So, whereas to attain a remarkable accuracy demonstration concerning the blood cells.

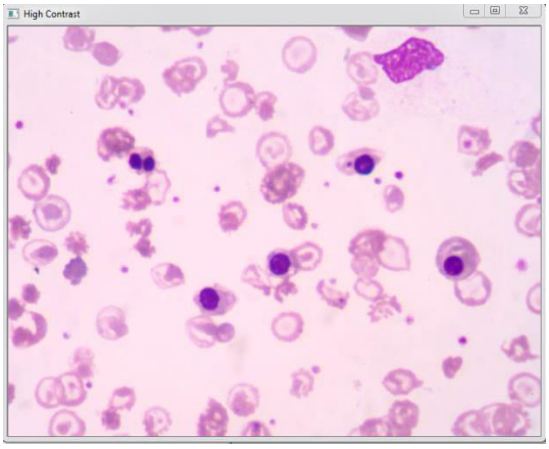

Fig. 3: Image Enhancement

Creating Greyscale Image

The depiction of blood spread ought to be occupied through photomicroscope which remains shaded, yet in a bit of the upcoming subsequent stages for the structure is managed the 2-dimensions image (that just incorporates greyscale), so the picture ought to be transferred over to greyscale.

ISSN: 0975-3583, 0976-2833 VOL 12, ISSUE 04, 2021

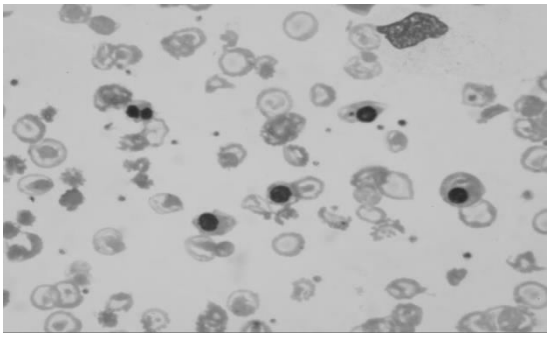

Fig. 4: Generated Gray Scale Depiction

Creating Binary Image

The gray scale depiction depicts a matrix of absorptions condition between (0 - 255), in the period of special charge will persist modified to binary value (0 , 1) by substituting each and every one pixels in the input depiction luminance prominent than inception by the significance 1 (white) and redeeming each and every one residual pixels amidst the value 0 (black).

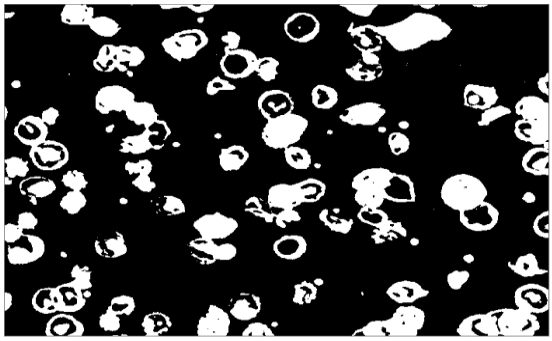

Fig. 5: Generating Complemented Binary Depiction

Removing Small Objects

One of the pre-processing measures be erudition decline and relocating the uproar before effecting depiction processing in the enlightenment of the reality that while expelling every particular little item the picture will be bolder to the investigation.

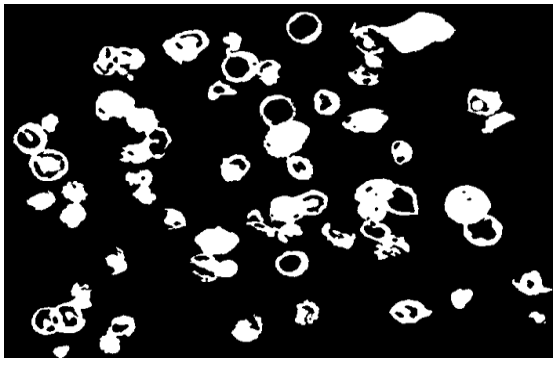

Fig. 6: After Removing Small Objects from theImage and Removing Incomplete Boundary Objects

ISSN: 0975-3583, 0976-2833 VOL 12, ISSUE 04, 2021

Boundary Tracing

This progression is the procedure of division or partition the RBC's from their experience, and remove the fringes contacting cells acquired in twofold pictureand after that playing out the detachment of every last one of the RBC's as a marked areas (sets of pixel) to be into somewhat progressively important and simpler to break down the data's and highlights that as of now be present in the mobiles.

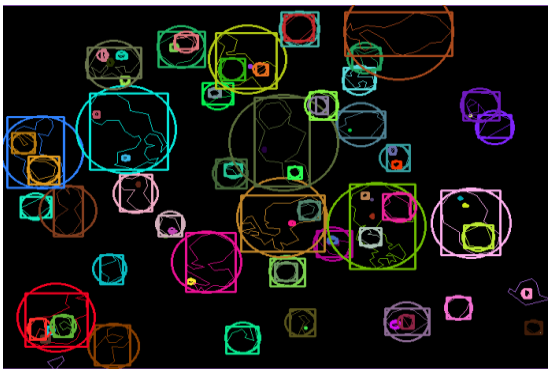

Fig 7: Calculating Bounding Boxes and Bounding Circles

Remove Incomplete Objects in the Image at the Boundary

There exist deficient platelets to this limit of the picture that exists while taking a picture for a field of a blood smear in planning time, which doesn't convey valuable data, so it will be expelled from the image.

There remain two steps in the boundary imitation method. They are:

(1) Finding the zone that contain the locale of the cells at the limit.

(2) Making the pixel index of these regions 0 (black).

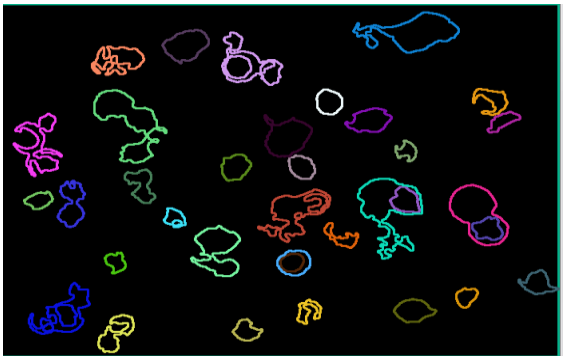

Fig. 8:Calculating Contours for each Object in Image

Removing Intersected Cells

The crossing point of red platelets as a rule arrive in a view with the pictures in a scope of covering degree, evacuating converged cells won't influence the outcomes exactness in light of the fact that the framework can break down different fields of pictures and gathers the outcomes as tallies and rates which raise the precision of the outcomes.

ISSN: 0975-3583, 0976-2833 VOL 12, ISSUE 04, 2021

Creating Red Scale Image.

To perceive some kind of cells that have consideration, so the red scale will be made, the red scale picture speaks to grid of forces an incentive between (0 - 255).

Feature Extraction

Identifying the Geometrical Features

Finding the geometrical features of the cell contours like Area, major/minor axis length, regularity, distance, radius, boundary etc.

Symmetrical Form Features

Region: Region is the amount of pixel on behalf of every district, the variety in region of the locales accustomed to perceive the span of RBCs which fluctuate in the size. The normal size of a RBC is 7.2 μm with a scope of 6.8 to 7.5 μm. At the point when the amplification is processed the zone for every cell will be registered, at that point we can recognize them.

Circularity: it is evaluated through computing this dimension among the main axis length on minor axis length. If the consequence is right throughout one so that shape preference, in general, is done.

Bounding Box:The smallest square box shape area containing.

Centre: The Centre of Mass of the Area. The bouncing box focus: the focal point of the case is the main issue in the crate, which speak to as these conditions:

$$a = x + {}^{w}/_{2} (1)$$
$$b = y + {}^{h}/_{2} (2)$$

Deviation in Erythrocyte Colour

The RGB-picture is a shading picture contain three layers: the clench hand layer red scale, second layer is Green scale, and the third layer is blue scale. The RBCs, each layer has scale between (0-255). The green shading wasn't utilized for all districts just in the objective cells that characterize the objective cell by estimating green size of the inside point which returns three esteem (Red layer esteem, Green layer esteem, Blue layer esteem) for explicit point.

Inclusions and Nucleated Cells

The quantity of RBCs have accumulation (Holy jolly body, Reticulocytes, Basophilic stippling) or nucleated (nucleated cells).

RBC Classification

Red platelets order be described dependent on highlights consent, which order be withdrawn behind frame identification, in aforementioned framework there are assortments of highlights departed in postulation framework that is (zone, significant/minor pivot length, proportion, and circularity, jumping box, focus, variety in erythrocyte shading, consideration and nucleated). The resulting figure confirms each cell with highlights.

Fig. 9: Affected Blood Cells due to Anaemia

ISSN: 0975-3583, 0976-2833 VOL 12, ISSUE 04, 2021

Result window shows the calculation of percentage of anemia based of the number of cell affected

Fig. 10: Result Window

Conclusion and Future Work

The methodology was personalized to make use of the extensive computers technology and depiction dealing out techniques to build the analysis of blood spread more competent; using OpenCV setting, a computer – based information system through suitable software was industrialised to examine RGB blood spread depiction. Here, the investigator effectively recognized a huge amount of irregular RBCs; grouping of those recognized RBCs in assured categories, and calculate the ratios to support the physicians to conclude the associated blood anaemia. The method shows a novelty of latest panorama in getting better diagnosis of anaemia; Anaemia is a especially ordinary situation through altering categories and related situations. Sickle cells, Spherocytes, Elliptocytes, Howell-jolly bodies, target cells and so onwards might completely be part of any of the different anaemia disorders. So, this extensive range of forms can be hard to the inexpert eye and time taking to specialists. A system like this offers innovative method in identifying such conditions.

The similar approach could be applied in defining further categories of syndromes (such as malaria, cholera, jaundice etc.) in upcoming work using the same method. Furthermore, improvement in addressing the cells at the borders and intersecting cells could be the entry to an appropriate upcoming presentation of this approach. The addressing of incomplete objects can also be done easily for enhanced images thus predicting whether the incomplete cells in image result in the cause of anemia or not. In upcoming work, the way adopting contemporary techniques with enhanced excellence digital images would indeed improve the final outcome; as the inaccuracy boundary significantly be contingent on the excellence of the processed digital image. The image processing results can be enhanced by procuring high end quality images and this can be utilized for the diagnosis of various kinds of diseases in an efficient and accurate way.

References

[1] Alhadidi, B. &Fakhouri, H. N. (2008). “Automation of Iron Deficiency Anemia Blue and Red Cell Number Calculating by Intestinal Villi Tissue Slide Images Enhancing and Processing.” Proceeding of the International Conference on Computer Science and Information Technology, Aug., Singapore, pp.407-410.

[2] Alhadidi, B., Zu'bi, M. & Suleiman H. (2007). “Mammogram Breast Cancer Edge Detection Using Image Processing Function.” Information Technology Journal, vol: 6, (2), pp.217-221.

[3] Anoraganingrum, D. (1999). “Cell Segmentation with Median Filter and Mathematical Morphology Operation.” In Proc. International Conference on Image Analysis and Process.,Venice, Iataly, pp.1043–1046.

[4] Chen, P. Yan, X. &Zheng C. (2006) “Recognition of Blood and Bone Marrow Cells using Kernel-based Image Retrieval.” International Journal of Computer Science and Network Security .vol.6:pp.29-34.

[5] Diggs, L. Sturm, W. D. & Bell, A. (1985). “The Morphology of Human Blood Cells.” Abbott Park, IL: Abbott Lab.

[6] Fauci, A. S., Braunwald, E., Kasper, D. L., Hauser, S. L., Longo, D. L., ameson, J. L. &Loscalzo, J. (2008). “Principles of Harrison’s Internal Medicine”, (17thed,).The McGraw-Hill Companies.

[7] Gherardi, A. Bevilacqua, A. &Piccinini, F. (2011). “Illumination Field Estimation through Background Detection in Optical Microscopy.” IEEE Symposium on Computational Intelligence in Bioinformatics and Computational Biology.

[8] Gonalez, R. C., woods, R. E. &Eddins S. L. (2004). Digital Image Processing Using OPENCV. New jersey, Pearson, Prentice Hall.

[9] Hamghalam M., Motameni M. &Kelishomi A. E. (2009). “Leukocyte Segmentation in Giemsa-stained Image of Peripheral Blood Smears Based on Active Contour”, International Conference on Signal Processing Systems, pp.103-106.

ISSN: 0975-3583, 0976-2833 VOL 12, ISSUE 04, 2021

[10] G S Pradeep Ghantasala, D. Nageswara Rao, Mandal K (2021) MACHINE LEARNING ALGORITHMS BASED BREAST CANCER PREDICTION MODEL. *Journal of Cardiovascular Disease Research*, 12 (4), 50-56. doi:10.31838/jcdr.2021.12.04.04

[11] Kishore, D. R., Syeda, N., Suneetha, D., Kumari, C. S., &Ghantasala, G. P. (2021). Multi Scale Image Fusion through Laplacian Pyramid and Deep Learning on Thermal Images. *Annals of the Romanian Society for Cell Biology*, 3728-3734.

[12] Kumari, N. V., &Ghantasala, G. P. (2020). Support Vector Machine Based Supervised Machine Learning Algorithm for Finding ROC and LDA Region. *Journal of Operating Systems Development & Trends*, *7*(1), 26-33.

[13] Bhowmik, C., Ghantasala, G. P., &AnuRadha, R. (2021). A Comparison of Various Data Mining Algorithms to Distinguish Mammogram Calcification Using Computer-Aided Testing Tools. In *Proceedings of the Second International Conference on Information Management and Machine Intelligence* (pp. 537-546). Springer, Singapore.