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Global Journal on Innovation, Opportunities and Challenges in AAI and Machine Learning
http://eurekajournals.com/IJIOCAAIML.html
ISSN: 2581-5156

# IoT based leukemia detection using Fuzzy C-means clustering Technique

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## Abstract

In children and adults, acute lymphoblastic leukemia (ALL) is the most severe blood disease, affecting both simultaneously and in equal proportion. Microscopy image processing software is used to perform image processing steps on microscopic images, such as improving the quality of images, segmenting images, and extracting features from them. In order to perform image processing steps on microscopic images, image processing software must be used. In addition to being a quick and inexpensive method of detecting pathogens, image-based detection does not necessitate the purchase of expensive laboratory equipment. The mathematical programming language has developed an easy-to-use tool for identifying and segmenting white blood cells. This feature makes user interaction with the white blood cell detection and segmentation program easier. The FCM (Fuzzy C-Means clustering) algorithm has been used to detect and extract blood cell features from images.

**Keywords:** IoT, Image processing, Healthcare, Leukemia.

## Introduction

Image manipulation is the kind of signal processing to change the way an image looks or how it behaves. There are a lot of applications for imaging where standard signal processing techniques are used[1][23]. The image is assumed to be a two-dimensional signal by default. It takes time (or the z-axis) for 2D images to turn into a 3D signal[2]. A picture can be changed in one of three ways: optically, digitally, or analogically. No matter how specific they are, the techniques in this article can be used in this situation. The process of getting images is called "imaging" (or, more specifically, the process of creating the input image in the first place)[3]. Computer graphics and computer vision are both important parts of image processing, but they don't work alone. Most animated films use a camera to record real-world scenes[4]. On the other hand, computer graphics images are created by hand from physical models of objects, settings, and lighting[5]. Based on an image's structure, machine learning can determine what it contains (e.g., videos or

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3D full-body magnetic resonance scans).Today, science and technology are becoming increasingly dependent on scientific visualizations (often of large-scale, complicated scientific or experimental data)[6][24]. There are two types of real-time data: microarray data that is used in genetic research and multi-asset portfolio trading in the financial sector.

Image processing is taking a picture and turning it into a digital file. Then, you can do things to it to make it better or get more information. It can also be used to improve the look of an image, but it can also be used to get important information from it[7]. A video frame or a picture is used as the input signal. The output signal is a copy or a feature of the input signal, and it is the same thing as the input signal[8]. Most of the time, images are processed as two-dimensional signals, and then they go through a number of well-known signal processing steps. Technology that is one of the fastest-growing globally can be used for many business things. Image processing is an essential field of study[9].

Among those who are taking part in the study are engineers and computer science majors, among other things. At first, take a picture with an optical scanner or digital photography, you can put images on your computer[10].Among the techniques used for image analysis and manipulation are data compression and detecting patterns that the naked eye can't see[11].At the very end of the process, the output stage lets you change the image or report that was made by the image analysis software. Image processing techniques are used to make images from satellites and spacecraft look better and images from everyday life[12]. There have been a lot of changes in how images are processed over the last 50 years or so. It is being done with uncrewed spacecraft, space probes, and military inspection flights to try out these new things. As powerful computers, large memory devices, and graphics software become more common; more people are turning to image processing systems to meet their needs[13]. Image processing techniques can improve the quality of data (raw images) from sensors that are mounted on everyday things[14]. Comparing this image to the original sensed image has better quality because more objects can be seen. Images need to be processed or shown in several ways. When you make an image, the pixels are put together in rows and columns. This is called the array or matrix of the image[15]. Every time an eight-bit grey scale image is made, the intensity of every single thing changes from 0 to 100-25. Grayscale implies that a grayscale image has more than just black and white pixels.

Human blood contains platelets, red blood cells, and white blood cells (WBCs)[16]. Each one has a specific role in our bodies. RBCs and WBCs help with blood clotting as well as oxygen delivery. The bone marrow's hematopoietic stem cells come from here. Color, size, and shape set them apart from WBC[17]. White blood cells (WBCs) are classified as neutrophils, lymphocytes, monocytes, basophils, and eosinophils. This information is vital when performing a Differential Blood Count (DBC). If a suspicious object is found in a blood smear, it must be examined immediately under a microscope. Manual microscopy of blood samples takes time and requires highly trained lab technicians, but it is a valid testing method[18]. An analyzer can perform a "differential count," but these devices are expensive and thus unsuitable for rural hospitals. It can't tell irregular from regular cell shapes and sizes. Using an automated system to examine blood samples will help pathologists identify different white blood cells (WBC) faster, more accurately, and efficiently[19]. The shape of hemoglobin-rich red blood cells is more important

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than their size in diagnosing blood disorders. This image has been enhanced using segmentation, edge detection, and edge smoothing techniques. Hu men (blood cells) means "men of blood" in Chinese[20]. Mature red blood cells lack most organelles found in other mammals, including a nucleus. Every second, roughly 2.4 million RBCs are produced. Blood cells transport oxygen (O2) throughout the body[21].

Blood disorder is considered among the most dangerous of diseases that can lead to death[22]. Many of these blood diseases are related to white blood cells such as Leukemia. Leukemia is an abnormal condition in the body because it produces excess white blood cells (leucocytes) in the bloodstream and spinal cord. Therefore, these abnormal conditions will disrupt the production of other blood cells and disrupt the flow of blood into the vital organs.

## Proposed System

It is proposed that the FCM (fuzzy C-means clustering) algorithm can be used to detect and extract blood cell features from images using the FCM algorithm. The ability to segment an image can be achieved by dividing an image into semantic regions or by extracting one or more specific objects from an image. One of the most contentious issues in image analysis is how to segment medical images properly. Segmenting microscopic images using clustering is a common technique for extracting regions from microscopical images. Microscopy is based on the segmentation of images, which is a fundamental aspect of the field. It is necessary to distinguish between four distinct areas when viewing a microscopic image. These areas are the background, red blood cells, cytoplasm, and the nucleus of white blood cells (WBCs) (WBCs). For leukemia detection to be successful, it is necessary to go through several steps, including acquiring images of leukemia, processing those images, slicing them up, and extracting features from the segments that have been acquired.

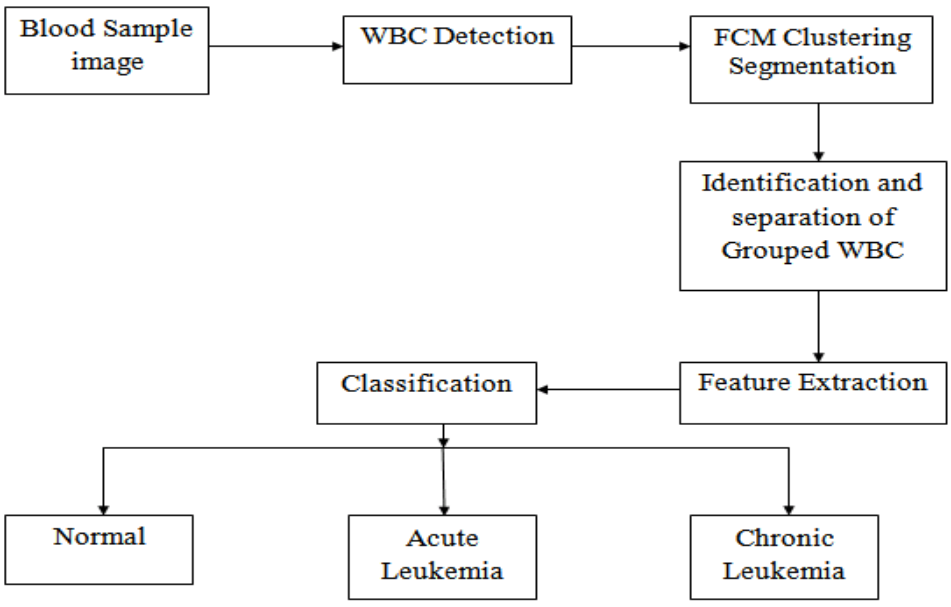


**Figure 1.Block diagram**

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The first step in the procedure is to take a digital photograph of the scene. To describe this process in the technical world, "image acquisition" is the term that has been coined. A camera and a means of recording what it sees on a digital recording device are required in order for this to be feasible. The type of sensor to be used and the image that it produces are determined by the requirements of the application in question. Images of blood cells at the atomic level can be captured with the aid of a digital microscope, which is a type of optical microscope. When it comes to taking digital photographs of cells, scientists are increasingly turning to a digital microscope with a built-in camera for assistance.[27]

A pre-processed image can enhance the contrast, remove noise, and isolate specific areas in various image formats such as grayscale, binary, and hsv. There is a lot of noise and staining on all of the images because of this, with a lot of red and white cells grouped together. It is then converted to a grayscale version of the original picture. In this image, blood cells are shown in a variety of hues. Since determining the ratio in colour is more complicated than in black and white, we will convert all of our photos to grayscale. The intensity of an image can be conveyed in a variety of ways using grayscale. The Matlab 16.0 RGB2GRAY function shall be used here. While RGB images retain their luminance, they lose their hue and saturation when converted to grayscale using RGB2GRAY software. After that, what's the next step? The digital equivalent of a pre-processing step. Pre-processing is used to increase the probability that subsequent processes will succeed. Over-staining and manual handling can introduce noise into microscopy images. The shadows cast by nuclei dominate the background noise in this area. After removing artifacts from the image, the nucleus of a blood cell is found. Pre-Images have been improved by using image-enhancing techniques. Enhance your images' contrast and brightness while simultaneously reducing noise and sharpening details with these tools.[28]

An image must first be broken down into parts with similar characteristics before it can be segmented. These characteristics are important for image segmentation in both black and white and colour images. Basically, segmentation is the process of removing all but the WBC-containing areas of an image from the analysis. Stains, RBCs, and platelets can all be removed from an image to make it look cleaner. All pixels below a threshold are assigned a value of zero, and all pixels above the threshold are assigned a value of one in order to convert grayscale images to binary images. Segmentation of image edges and texture can be used to analyze the image further. By analysing microscopic images of blood cells, abnormal WBCs can be identified. Breaking down an image into its individual pixels is known as pixelation in computer graphics. According to a recent theory, the intensity and shape of blood cells may be used to improve nucleus segmentation. FCM must be used to segment white blood cells at a more refined grain in order to achieve this. Segmentation of white blood cells (WBCs) reveals abnormal cell nuclei. Atypical nuclear structures are found in leukemia cells. As a result of edge detection, data is reduced in size and redundant information is weeded out. Image transitions and edges can be detected using the Mean Shift segmentation method.[26]

## Fuzzy C-Means Clustering

Assigning patterns to a cluster is the process of grouping similar patterns together. Pattern

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recognition, classification, data mining, and image segmentation have all been applied to Fuzzy clustering and its derivatives. Additionally, medical image data can be analyzed and modeled for various purposes. Clustering is a computationally intensive method of pattern recognition in image processing. Parallel algorithms can be used to improve the performance and efficiency of such tasks with the development of low-cost, high-performance parallel systems. In this report, we attempted to overcome the computational and memory requirements for FCM. The cluster centre is initialized by FCM using random numbers, and this process takes more iterations to reach its final location. Data or objects are subdivided into groups or clusters using clustering analysis. It should be able to meet two requirements: As much homogeneity as possible within the cluster is required. It is ideal if the data from different clusters are as dissimilar as possible. Membership functions may not accurately reflect the distribution of data in the input and output spaces when used for fuzzy pattern recognition. The data can be partitioned using a clustering technique, and then membership functions can be generated from the resulting clustering. It is the process of dividing an E set of N objects Xi into a partition P. Prototypes or centroids can be found at the center of each cluster in partition P. It is possible to cluster data in a variety of ways. C-means clustering is used in this report. ' For data grouping or classification, this is a simple unsupervised learning method that can be used. The first step is to select a cluster number –K for the research. Set the initial centers of each cluster of c1...ck, and then classify each vector into the closed center c1 using the Euclidean distance between them. The next step is to recalculate the cluster center estimates based on new information. If no cluster centers (c1=1, 2,...,k) change in previous step , then proceed to second step. If no cluster centers (c1=1, 2,...,k) change in previous step, then proceed to previous step. If this is not the case, proceed to the next step.

An image feature is a fundamental characteristic or attribute of an image that distinguishes it from other images. However, while the appearance of an image can define some aspects of an image, other aspects can only be achieved through specific image manipulation techniques. When it comes to a pixel's brightness or the texture of a grayscale image, there is nothing artificial about them. Using image characteristics, it is possible to identify or label portions of an image that share similar characteristics while also distinguishing them from one another. It is possible to reduce a large amount of information contained in an image to a manageable amount that can be displayed on a computer screen when working with images using feature extraction. In this case, the process is referred to as "feature extraction." A property dataset is created as a result of the combination of information from various sources. The most important characteristics of an object or image can be identified and extracted using feature extraction methods. This type of classifier determines which class a person should be placed in based on their physical appearance, rather than their behaviour. By scaling certain properties, feature extraction can help reduce the amount of original data collected. A comparison of two sets of data can be used to achieve this goal. The identification of specific characteristics in white blood cells is critical in the classification of these cells. The selected properties have an impact on the performance of the classifier.

The classification accuracy is determined by the number of features and the characteristics of each feature. It is possible to identify specific characteristics of white blood cells that can assist you in determining whether or not you are dealing with a blast. FCM simplifies the process of

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identifying and removing blood cell features from photographs (Fuzzy C-means clustering).To train the classification algorithm, leukemia-specific characteristics are taken into consideration. Classifiers give new images names based on their prior knowledge of other images in the database. The Factor Component Model is used to determine the classifications in this system (FCM). Look for things that don't seem to be entirely correct. It is included in this category the process of assigning a name to an object based on its descriptors, which is also known as recognition. Part of this section also includes a discussion of the process of associating meaning to a collection of well-known facts. All objects in the project database must be able to be identified as World Bank Contributions in order for them to be considered (WBCs). The term "WBC" must be included in the description of the object. What is the definition of interpretation? It is the process of attempting to decipher the meanings of a group of objects that have been labeled. By counting the number of white blood cells (WBCs) in an image and comparing it to the typical number of WBCs, we can determine whether or not a patient has leukemia. This information can be used to determine whether or not the patient has leukemia.

## Results and Discussion

The experiments described in this paper were carried out with the assistance of the MATLAB computer programming environment. The graphical user interface (GUI) layout was developed as part of the design process and is based on a menu system. When you select an item from the menu, it will take action on your behalf to complete the task at your disposal.

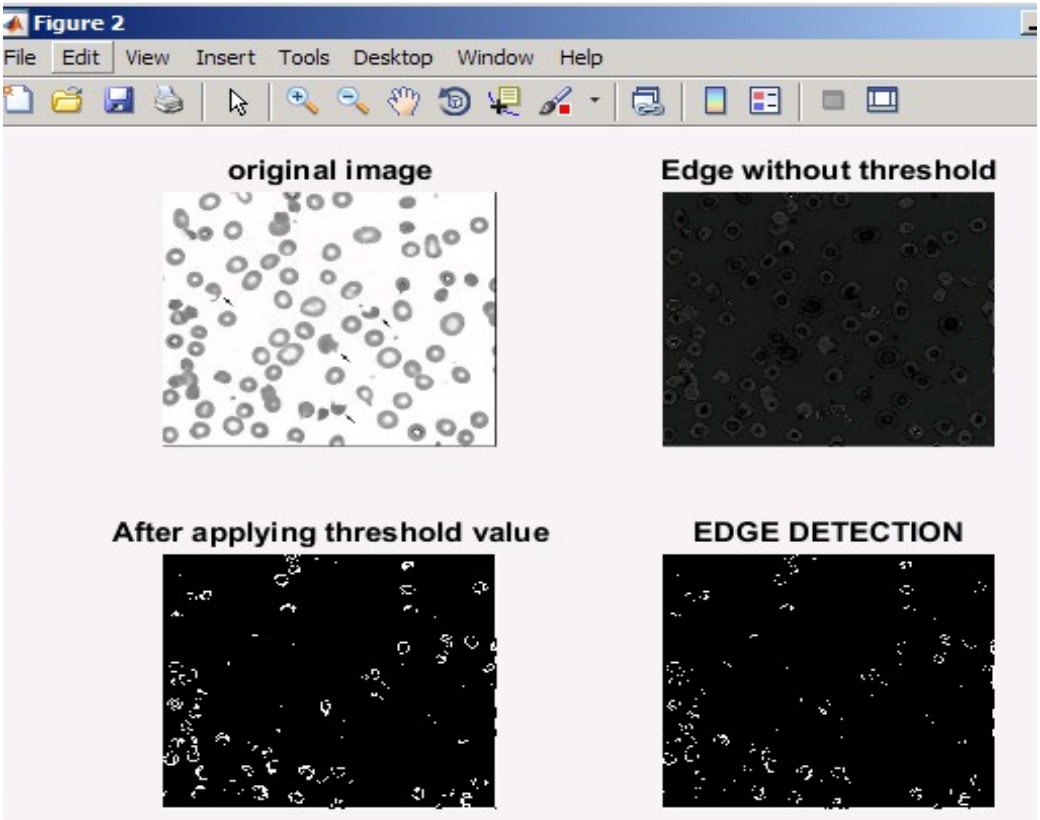


**Figure 2.Input image with segmentation process**

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In order to train the classifier, we will use data extracted from the various types of leukemia as inputs for the classification task. Classifiers identify images by comparing them to known classes that have previously been trained on the image in question. The computer program FCM determines how this system should be classified in this case.

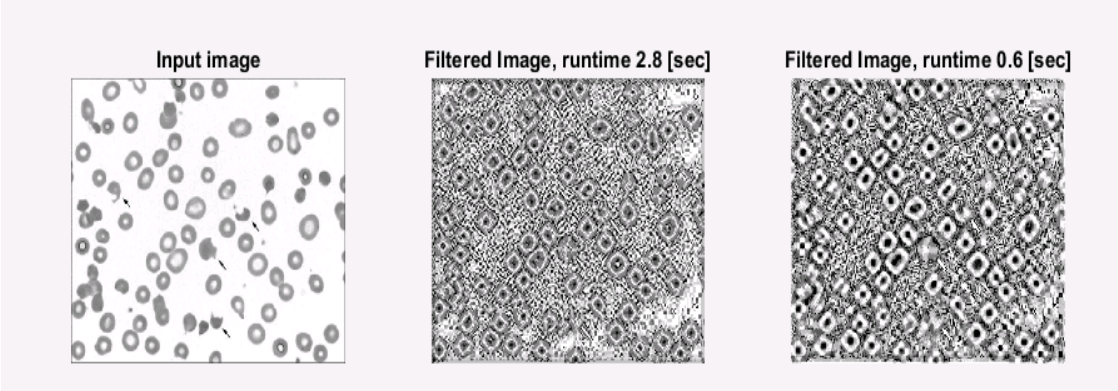


**Figure 3.Feature extracted output**

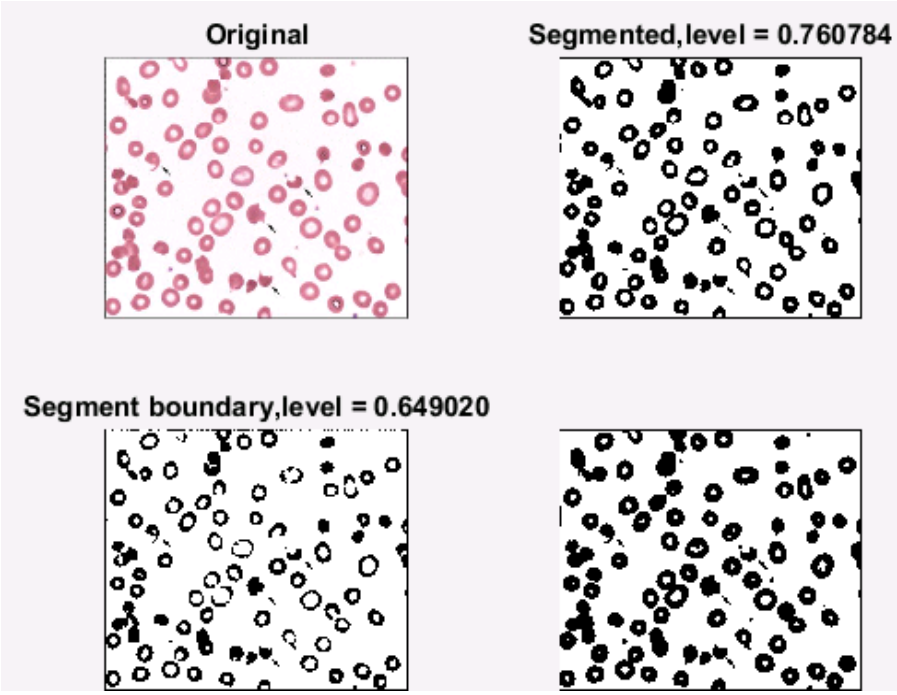


**Figure 4.Output with Image Classification**

Fig. 2. Shows the Input image with segmentation process. Fig. 3 shows the output of feature extracted image. Fig. 4. Shows the output image with classification.

## Conclusion

In this research, the detection of leukaemia in images of white blood cells will be accomplished by applying image processing techniques, which will use the Internet of Things technology to accomplish this goal. Feature extraction from data sets, for example, is frequently carried out using FCM due to the fact that it produces better results even when the input is erratic. Comparing image processing to traditional laboratory testing for the diagnosis of leukaemia,

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image processing is a more cost-effective and time-saving alternative to traditional laboratory testing for leukemia diagnosis than traditional laboratory testing. It will be possible to achieve the automatic classification of white blood cell images through the use of a neural network in the future, which will be extremely useful in medical applications. Used in conjunction with other technologies, this technology allows for the rapid and accurate identification of leukemia types in patients who have been diagnosed with leukemia.

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