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Word Computational Screening of Green Color Colonies from Petri Dish through Python Tool GD.A1.

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Abstract: The digital image processing and deep learning techniques are considerably applied in the field of microbiology, and it has a countless perspective. Counting microorganism colonies in petri dishes through the necked eye is a time-consuming and slow process. Therefore, the need for a colony enumeration system that counts all colonies and also discriminates against green colonies is the key concern. Counting only green colour in cell profiler through the image processing method is wide area of interest in micro biological estimation, so in Python, a simple algorithm is frim-up to aid in visual discrimination. Thus, it can be concluded that enumeration of microorganisms can be performed automatically and reliably and become easier with the developed GD.A1 software. The acceptable result is 95.1 percent confidence interval.

Keywords: Microbial Evaluation; Screening Colonies; Digital Enumeration.

1. Introduction

The demand for disease diagnosis and healthcare services has been high, but there have been significant challenges. Cost, time, and location barriers limit the quality of service. For microbiology evaluation like algae, bacteriology analysis, estimation of pharmaceutical, environmental evaluation, food, beverage and water[1] to be considered functional, it is necessary to prove that it has microorganisms in it. In order to determine the presence of microorganisms, laboratory analyses can be carried out using the petri dishes procedure to identify microorganisms[2].

Technology plays a crucial role in providing smarter and powerful solutions and can overcome the barriers. Artificial intelligence , machine learning, and deep learning offer a wide range of solutions [3]. Counting microorganism colonies in petri dishes with the naked eye is a time-consuming and slow process[4]. Therefore, the need for a colony enumeration system that counts all colonies and also discriminates against green colonies is the key concern. Through the image processing method in Python, a simple code is written to aid in visual discrimination. For this, an algorithm was developed based on digital image processing techniques capable of identifying microorganisms. The key idea offers a software system for determining the number of microorganisms populated in petri dishes. Picture of the petri dish are captured by a camera and reused image processing techniques to detect total colonies and green colonies.

Bacteria are in different colours; most can appear green[5]. The green colour of bacteria depends on the pigments they produce. Cyanobacteria are blue-green algae[6]; the Chloroflexi phylum can appear green due to chlorosomes. Sulfur bacteria, like some species of Chlorobium, appear green. Pseudomonas aeruginosa bacterium is not green, but it has the green pigment pyocyanin under certain conditions[7]. The green coloration is often associated with their ability to perform photosynthesis[8] or protect themselves from environmental stressors. Python, a versatile computer programming language, finds several applications in microbiology due to its capabilities in data analysis, visualization and automation, Python is extensively used for analyzing biological data. So authore choose this to make simple and easy tool[9].

2. Description

Counting microorganisms through images is called digital image processing. Capture a digital image of the patri- dish containing the microorganisms. This can be done by 4k camera. Prepare the image for analysis by performing preprocessing steps such as noise reduction, image enhancement, and background subtraction. These steps help improve the quality of the image and make it easier to identify and count the microorganisms. Segmenting the image to separate the microorganisms from the background is one of the most critical steps in the process of thresholding, edge detection, and contour analysis, depending on the characteristics of the microorganisms and the image.

There were two main steps in this algorithm: developing an image labelling system in graphic user interphase and generating metadata about the state of each label. Also, develop a green colour recognition system that would be able to recognise only green colonies in every image and generate metadata about the state of each green label. Extract relevant features from the segmented regions, such as size, shape, and colour, which can be used to identify and classify the microorganisms. Once the microorganisms are counted, the results can be analysed and reported[12-15].

3. Work flow

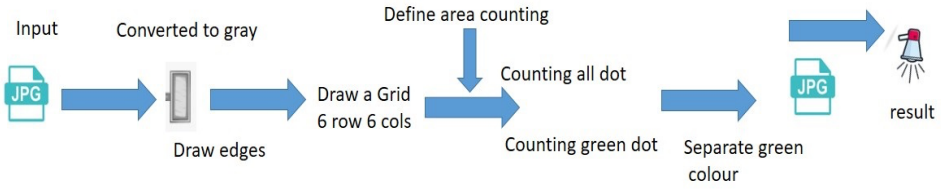

Figure 1. A pictorial representation of tool.

When the tool starts, a welcome page appears and asks the end user to "Enter the path of the image file." If the path not found warning appears invalid, on the other hand, "found Image 'xxx.zzz' found. You can proceed to obtain" after this pop-up window appears one with the original image and virtual grids on it to understand more easily. Other pop-up windows show only green objects from the uploaded image and auto-save in the same folder with the name green.jpg. After this result appears in text format, as shown in figure 2, when the task is complete, the command will appear "Enter to exit".

Work flow steps are as follow

- Image Capture: High-quality images of biological samples, such as petri dishes with microbial colonies, are captured using cameras or microscopes.
- Preprocessing: The captured images undergo preprocessing steps, including:
  Noise reduction
  Background subtraction
  Image enhancement
  These steps are crucial for improving image clarity and making subsequent analysis more accurate.
- Image Segmentation: Segmentation techniques are applied to separate the objects of interest (microbial colonies) from the background. This can be done using ,Thresholding (separating pixels based on intensity),Edge detection and Contour analysis
- Feature Extraction: Relevant features of the microorganisms (such as size, shape, and color) are extracted. For instance, in your study, the focus is on identifying green-colored colonies, which requires detecting specific color ranges.
- Classification and Counting: After feature extraction, machine learning algorithms or rule-based systems classify the microorganisms and count them. In this case, the tool GD.A1 focuses on counting green colonies.
- Result Reporting: Once the microorganisms are identified and counted, the results are displayed for the user in a readable format, with additional options for saving or exporting the data.

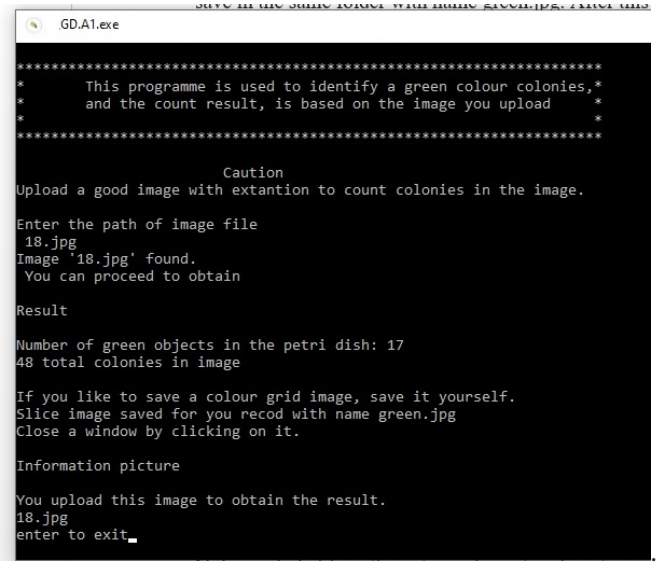

Figure 2. Show the main interphase of GD.A1.exe

4. Support material

The tool GD.A1 comes with support material to help users understand and use. The package includes exe file which can run on any window base operating system.

https://github.com/aziz1sh1/GD.A1/blob/main/GD.A1.exe

Instruction about how to use and download (manual.pdf) that provides training with overview of the software along with license information.

https://github.com/aziz1sh1/GD.A1/blob/main/manualGD.pdf

Video include file with contain information how to use software.

https://github.com/aziz1sh1/GD.A1/blob/main/manual%20av.mp4

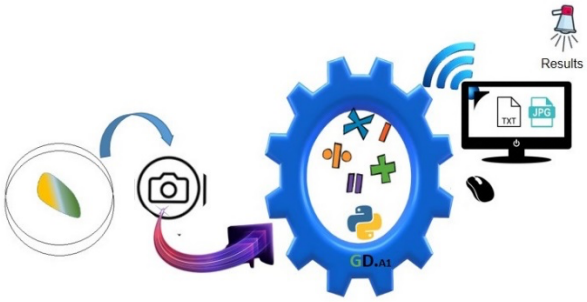

Figure 3. Graphical Abstract

5. Benfit

Counting green-colored microorganisms in a petri dish can provide valuable information for various applications, including research, quality control, and environmental monitoring. The benefits of counting green-colored microorganisms from a petri dish include:

Counting total and especially green microorganisms allows to estimate the microorganisms in a patri-dish. This information is crucial for understanding the level of contamination or microbial population in a specific environment.

Green-colored microorganisms may be used to monitor the growth of specific strains or species under certain conditions. By counting them over time, you can assess their growth kinetics and response to different factors like temperature, nutrients, or inhibitors. In industries such as food, pharmaceuticals, and cosmetics, it is essential to ensure product safety and quality. Counting green microorganisms in petri dishes can be part of quality control measures to detect the presence of contaminants or pathogens. Green microorganisms can be used as indicators for environmental monitoring. For example, the presence of certain green algae or cyanobacteria can be an indicator of water pollution, and counting them can help

assess water quality. Counting green microorganisms is valuable in laboratory research to study microbial behavior, interactions, and responses to experimental conditions. It allows researchers to gather quantitative data to support their hypotheses and findings. Beyond counting, the green coloration of microorganisms may indicate the presence of specific pigments or metabolic pathways. This color information can be used to characterize and identify the microorganisms, as certain pigments are associated with particular species or groups. In certain fields like agriculture and aquaculture, counting green microorganisms can be used to monitor and manage the growth of desirable or undesirable microorganisms. This information can be used to make informed decisions about pest control or fertilization strategies. In clinical microbiology, green-colored microorganisms might be associated with specific infections or diseases. Counting them in patient samples can aid in diagnosing and monitoring illnesses. Through image analysis labor less effort, accurate, less expensive.

6. Method validation

We have tested almost log .5K file and get a Confidence Interval is 95.1 percent.

7. Future work

There is a need for an upgrade version that allows the end user to visualize in 2D format to understand their spatial distribution. There is also a need to develop a batch processing sequel tool, Video analysis tool to identify random moving objects in sample, GD.A1 in an Android app.

Data Availability: The data associated with article available online at: https://github.com/aziz1sh1/GD.A1: DOI is 10.24433/CO.4600734.v1

Declaration of Competing Interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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