A CORONA RECOGNITION METHOD BASED ON VISIBLE LIGHT COLOR AND MACHINE LEARNING

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ABSTRACT

Can we detect electric discharge states in gases based on the information on visual images? This article proposes a new kind of method where we build several detection models for different states of corona discharge by applying four kinds of machine learning algorithms to extract color, brightness, and shape information characteristics of visible images taken by a digital camera. Every model is then tested on a new set of images to measure its performance. The four different machine learning algorithms are support vector machine (SVM), K-nearest neighbour regression (KNN), single layer perceptron (SLP), and decision tree (DT) algorithms. The prediction results show that the color features perform best among all three types of features and the KNN algorithm performs best among all four algorithms. This article also presents a discussion on how to choose the optimal detection areas of images for better detection performance. Our approach shows consistent results across different cameras and camera settings. The results demonstrate that even if only the visible light spectrum emitted from a plasma is captured, the color method can provide sufficient discharge information for economic and convenient use in discharge state detection because the species producing visible radiation are affected by radiation in all bands.

1. INTRODUCTION

Electric discharge is widespread in nature and is commonly used in the operation of industrial equipment. In an effort to understand the properties of electrical discharge, researchers have investigated several physical quantities of discharge, including the voltage, current, optical spectrum, ultrahigh-frequency electromagnetic waves, number of discharges, phase angles (for ac discharge), etc. However, such research works have been carried out without considering the relevant optical characteristics of discharge images even though the initial studies were based on the image, such as that of the original meaning of corona. As a matter of fact, optical measurements are better suited than electromagnetic measurements for the purpose of determining discharge geometries. If the optical characteristics of the discharge image can be incorporated in the diagnosis, the reliability of traditional recognition methods may be increased.

In the past, the traditional research of the discharge image was conducted from a qualitative point of view, such as morphology description, strong or weak light intensity, etc. . However, only a few studies focused on quantitative evaluation can be found. With the development of computer techniques, the digital image processing methods have been applied extensively to study

discharge characteristics, such as breakdown paths, discharge area, etc., especially in ultraviolet (UV), which can help tackle complex problems by using statistical techniques or the fractal theory. Although the images obtained by a high-speed camera (nanosecond time scale) can provide some details of a single discharge , the essence of gas discharge remains random under the same macroscopic physical conditions. On the other hand, the discharge used in some industrial applications is a collection of a large number of microdischarges. Therefore, a statistical evaluation of discharge images covering a large number of stochastic processes on a long time scale is still of great significance, compared with the research methods of high-speed cameras.

The colour information produced by optical radiation has not been widely used in the study of discharge images. In 2000, Russell and Jones proposed the use of chromatic attributes to directly monitor the stability of plasma states. However, the studies were then limited only to the use of optical-electrical detection techniques, which can only be applied to a relatively large area for achieving a general understanding . In 2009, Koppisetty et al. attempted to establish a correlation of colour information of the visual images with the progress of partial-vacuum breakdown. In 2016, Serrano et al. used colour information to monitor arc welding. Developments in nonthermal plasmas have stagnated. We conducted research on the colour difference in corona and surface discharge and filed for patents on using colour information to detect the discharge state. In 2017, Prasad and Reddy introduced a method for extracting colour information from discharge images, which was then converted to brightness metrics to study the relationship with discharge power, which is an important progress. To summarise, utilisingcolour information in the study of spatial distribution of nonthermal plasma discharge is an emerging area of research, due to the recent development of high-resolution digital cameras.

2.LITERATURESURVEYANDRELATEDWORK

1) An Incremental Analysis Of Spark Paths In Air Using 3-Dimensional Image Processing

AUTHORS: D. H. Qiu, J. M. K. MacAlpine, and Z. Y. Li : A video camera has been used to record the path of spark breakdowns across a positive point/plane air-gap. By using a prism as a mirror, two images were obtained from which the path could be determined in three dimensions by subsequent computer processing and analysis. Images were analysed for each of five angular positions of the point electrode's axis, the gap remaining constant. The fractal dimension of each path was determined and found to increase slightly with the inclination of the pointed electrode. Each spark appeared to have propagated semi-randomly in a direction which included a 'memory' factor, that is, it tended to follow the previous direction while moving monotonically towards the opposite electrode. This was confirmed by an analysis of 400 spark paths which showed that each section has a specific relationship to the previous section, but that there is a wide variation around this mean which leads to the characteristic shape of a spark path. Simulations based on these results yield spark tracks which look similar to those measured and have similar fractal dimensions. These analyses strongly suggest that the development of spark paths in air is by successive steps and in a direction suggested by an angular probability distribution which is related to the field at the tip of the propagating leader.

2) Fast Imaging Of Intermittent Electrospraying Of Water With PositiveCorona Discharge

AUTHORS: B. Pongrác, H. H. Kim, M. Janda, V. Martišovitš, and Z. Machal The effect of the electrospraying of water in

combination with a positive direct current (dc) streamer corona discharge generated in air was investigated in this paper. We employed high-speed camera visualisations and oscilloscopic discharge current measurements in combination with an intensified charge-coupled device camera for fast time-resolved imaging. The repetitive process of Taylor cone formation and droplet formation from the mass fragments of water during the electrospray was visualised. Depending on the applied voltage, the following intermittent modes of electrospraying typical for water were observed: dripping mode, spindle mode, and oscillating-spindle mode. The observed electrospraying modes were repetitive with a frequency of a few hundreds of Hz, as measured from the fast image sequences. This frequency agreed well with the frequency of the measured streamer current pulses. The presence of filamentary streamer discharges at relatively low voltages probably prevented the establishment of a continuous electrospray in the cone–jet mode. After each streamer, a positive glow corona discharge was established on the water filament tip, and it propagated from the stressed electrode along with the water filament elongation. The results show a reciprocal character of intermittent electrospraying of water, and the presence of corona discharge, where both the electrospray and the discharge affect each other. The generation of a corona discharge from the water cone depended on the repetitive process of the cone formation. Also, the propagation and curvature of the water filament were influenced by the discharge and its resultant space charge. Furthermore, these phenomena were partially influenced by the water conductivity.

3) Statistical evaluation of AC corona images in long-timescale and characterization of short-gap leader

AUTHORS:X. Li et alAlthough the image of discharge in the nanosecond time scale can provide some details of a single discharge, the essence of gas discharge remains random under the same macroscopic physical conditions. Therefore, the statistical evaluation of discharge images including a large number of stochastic processes in a long-time scale is still of great significance. In this paper, a digital image processing method presented in our previous paper is used to research the statistical indicators of AC corona discharge image in the time scale of seconds, and the axial distribution of the average grey level and the grey level standard deviation about corona discharge image are determined. Then, these statistical indicators are utilised to study the long brush-like corona, and a clear "stem" caused by the point electrode and not by the ball head electrode was found, even if they all belong to the highly non uniform electric field. Considering its corresponding current pulse rise time, we believe that the leader discharge also exists in the cm-level short gap. These results indicate that the statistical analysis on the longtime scales can be used in discharge research, and further image information mining will likely be used to provide some new characteristic parameters.

3.EXISTING SYSTEM

In the world of information systems and technology, understanding the existing system is the first step toward meaningful improvement and innovation. This section provides a comprehensive overview of the existing system, shedding light on its functionalities, limitations, and the driving force behind the need for a new and improved system.

Overview of the Existing System:

The existing system serves as the foundational framework upon which the proposed system will be built. It represents the current state of affairs in terms of data management, functionality, and user experience. To gain a holistic understanding of the existing system, it is essential to examine several key aspects:

1. Functionality: The existing system's functionality encompasses a range of features and capabilities. These functionalities are

designed to address specific needs and objectives within the organisation. It is imperative to identify and document the core functions that the existing system currently performs. This includes tasks, processes, and operations that users engage with regularly.

2. Performance: Performance is a critical aspect of any information system. The existing system may have undergone performance evaluations, and it is essential to capture the results of these assessments. This includes metrics related to system response times, data processing speeds, and overall efficiency. Identifying performance bottlenecks or areas where the system falls short is crucial.

3. Scalability: Scalability refers to the system's ability to accommodate growth and increased demands. Understanding the existing system's scalability is vital for assessing whether it can meet the organisation's evolving needs. Considerations should be made regarding data volume, user load, and resource utilisation.

4. User Feedback: Feedback from users of the existing system provides valuable insights. Users often encounter challenges, inefficiencies, or areas where the system could be improved. Collecting and analysing user feedback helps identify pain points and areas where the proposed system can deliver enhanced user satisfaction.

4. PROPOSED SYSTEM

The proposed system represents the future of our information ecosystem, designed to address the limitations of the existing system and meet the evolving needs of our organisation. This section provides an in-depth exploration of the proposed system, outlining its key features, objectives, and the anticipated benefits it brings to our organisation.

Overview of the Proposed System: The proposed system is a visionary approach to information management and data processing. It builds upon the foundation of the existing system while introducing novel concepts and cutting-edge technologies to enhance its capabilities. Below, we delve into the core aspects of the proposed system:

1. Objectives and Goals:

The primary objectives of the proposed system are to streamline data management, improve system performance, enhance user experience, and ensure scalability for future growth. It seeks to address the limitations and challenges identified in the existing system while capitalising on emerging technologies.

2. Key Features:

The proposed system boasts a rich set of features and functionalities designed to empower our organisation. These features include:

- Advanced Data Processing: The proposed system incorporates state-of-the-art data processing techniques, allowing for faster data retrieval, analysis, and reporting.

- Enhanced User Interface: A user-friendly interface is at the heart of the proposed system. It offers an intuitive design, simplified navigation, and personalised user experiences.

- Scalability: Built to accommodate our organisation's growth, the proposed system is highly scalable, ensuring it can handle increasing data volumes, user demands, and future expansion.

- Security and Compliance: Robust security measures are integrated to safeguard sensitive data, ensuring compliance with industry regulations and data protection standards.

- Efficient Data Migration: Seamless data migration tools and processes facilitate the transition from the existing system to the proposed one, minimising disruptions.

3. Expected Benefits:

The proposed system holds the promise of several significant benefits for our organisation:

- Improved Efficiency: Streamlined processes and faster data access result in increased operational efficiency and productivity.

- Enhanced Decision-Making: Access to real-time data and advanced analytics empowers our teams to make data-driven decisions promptly.

- Cost Savings: Through optimised resource utilisation and reduced downtime, the proposed system contributes to cost savings in the long run.

- Competitive Advantage: By staying at the forefront of technology, our organisation gains a competitive edge in the market.

4. User Training:

To ensure a smooth transition to the proposed system, comprehensive user training programs will be implemented. Training sessions will cover system navigation, data entry, reporting, and best practices to maximise the benefits of the new system.

5. Implementation Timeline:

A well-defined implementation plan will be developed to roll out the proposed system efficiently. It will include milestones, timelines, and key performance indicators to monitor progress.

5.METHODOLOGIES

MODULE

- **User**
- **Admin**
- **Data Preprocess**
- **Machine Learning**

MODULES DESCRIPTION:

User: The User can register the first. While registering he required a valid user email and mobile for further communications. Once the user registers, then the admin can activate the customer. Once the admin activates the customer then the user can login into our system. Users can upload corona discharge images by browser. On the server side we need to execute two times. First we can enable Matplotlib.use(TkAgg) then the tkinter graph will be displayed. The graphs are grayscale, rgb, glh values are curved in the graph. The user can test the colour features as input for all images and can find the MeanRmse, same we can test Shape and brightness features. Second onwards we can disable the Matplotlib.use(Agg) the next the graph will not be displayed and smooth execution possible.

Admin: Admin can login with his credentials. Once he logs in he can activate the users. The activated user only login in our applications. The admin can view all user uploaded images. By clicking any image he can get the Graph of RGB values, Histograms graph. The image resigning and converted into grey scale also displayed to the admin side.

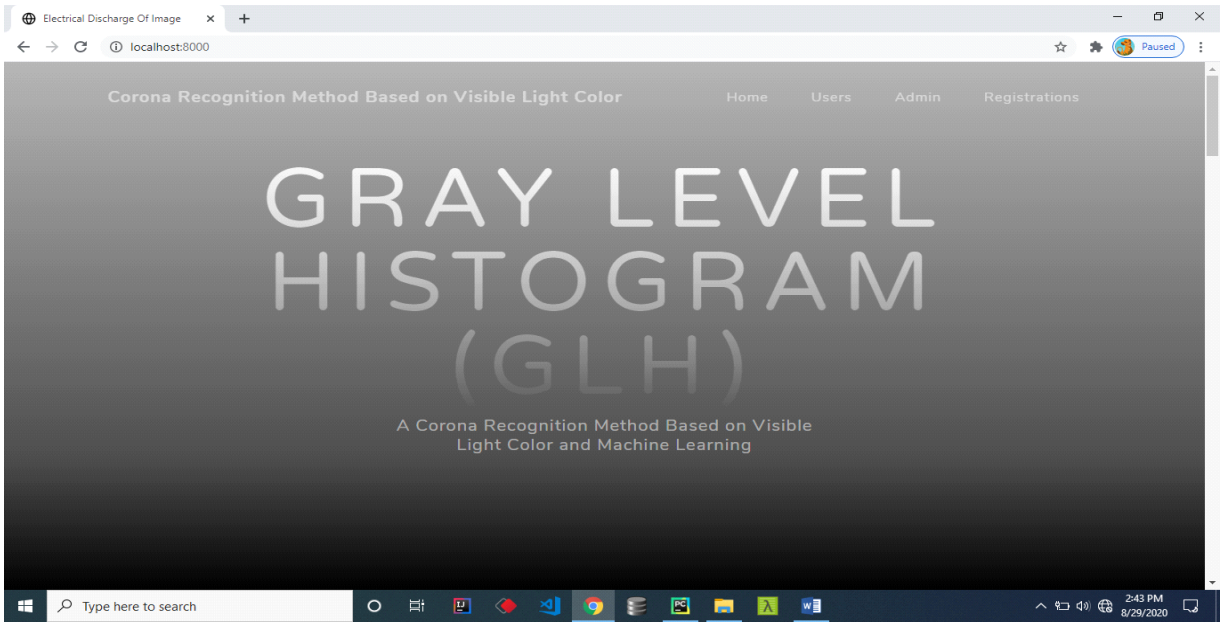
Data Preprocess: We need to prepare our image library taken by a digital camera at first are upload the images by code folder which is taken from github to test the code, then select the feature quantities, such as colour, brightness, and shape information characteristics of visible images, and finally establish several detection models for different states of corona discharge. We looked at the shape information of the black-and-white image and experimented with related features by using histogram-oriented gradients (HOG). HOG computes histograms for gradients within each pixel block to determine the local orientation/shape. In our case, we applied HOG algorithms with (orientation bin size, pixels per cell, cells per block) = (8, 8, 4) on our image of 150 × 950 pixels. We ended up with a matrix of (number of blocks per row, number of blocks per column, number of cells per row, number of cells per column, number of orientations) = (115, 15, 4, 4, 8) for each image. This is then flattened and used as a feature vector.

Machine Learning:

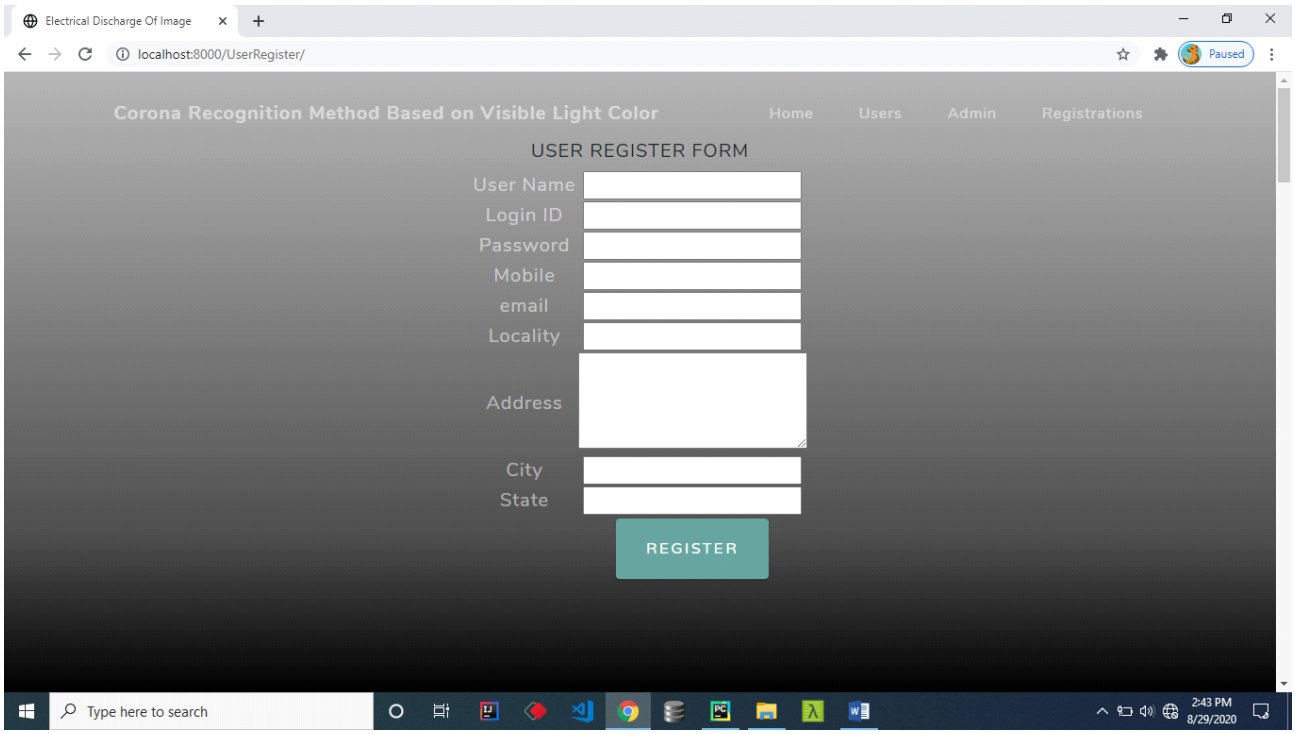
We build several detection models for different states of corona discharge by applying four types of machine learning algorithms to extract the information characteristics of visible images. The four types of machine-learning algorithms are SVM, KNN, SLP, and DT algorithms. SVM is a generalised linear classifier for binary classification of data using supervised learning and kernel methods. It can be used to classify data nonlinearly, and is one of the common kernel-learning methods. The KNN classification algorithm is one of the simplest methods in data mining classification technology. The core idea of KNN is that if the majority of the k-most adjacent samples of a certain sample X in the feature space belong to a certain category, then sample X also belongs to this category and is assigned to the characteristics of the samples in this category. SLP is a type of simple, one-layer, feed-forward artificial neural network. DT is a method to approximate the value of the discrete function. After data are processed, readable rules in the form of a DT are generated by an induction algorithm. Then, when a new data point comes in, it is classified by following the tree structure from top to bottom. All of our algorithms would output one single class per image for prediction.

6. RESULTSANDDISCUSSION SCREEN SHOTS

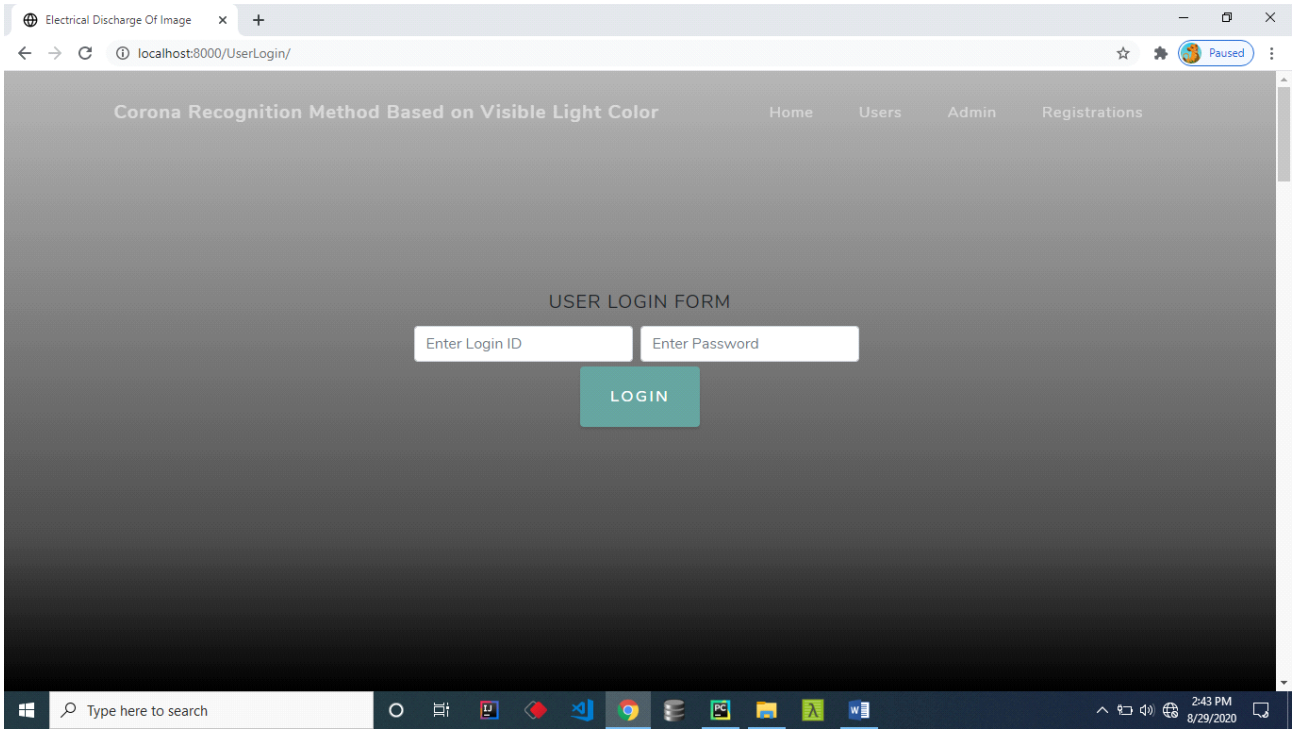
1 Home Screen



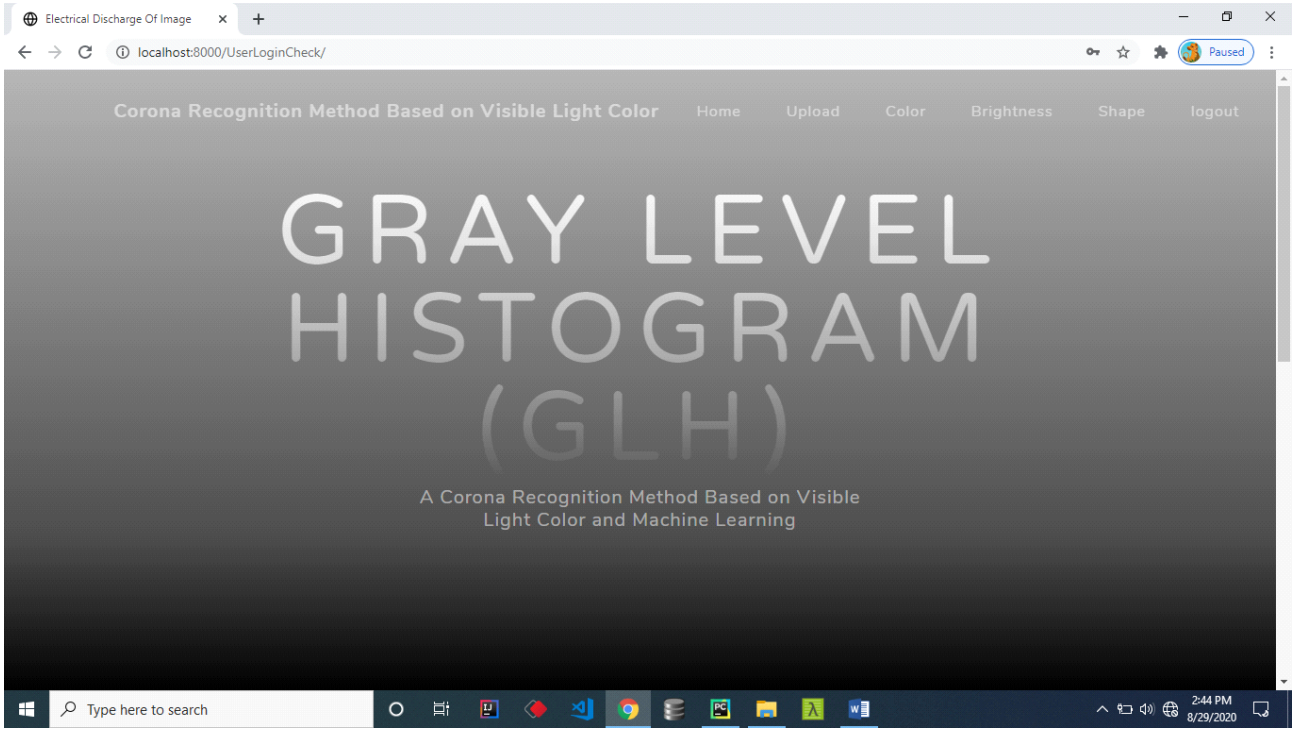
2 User Register page



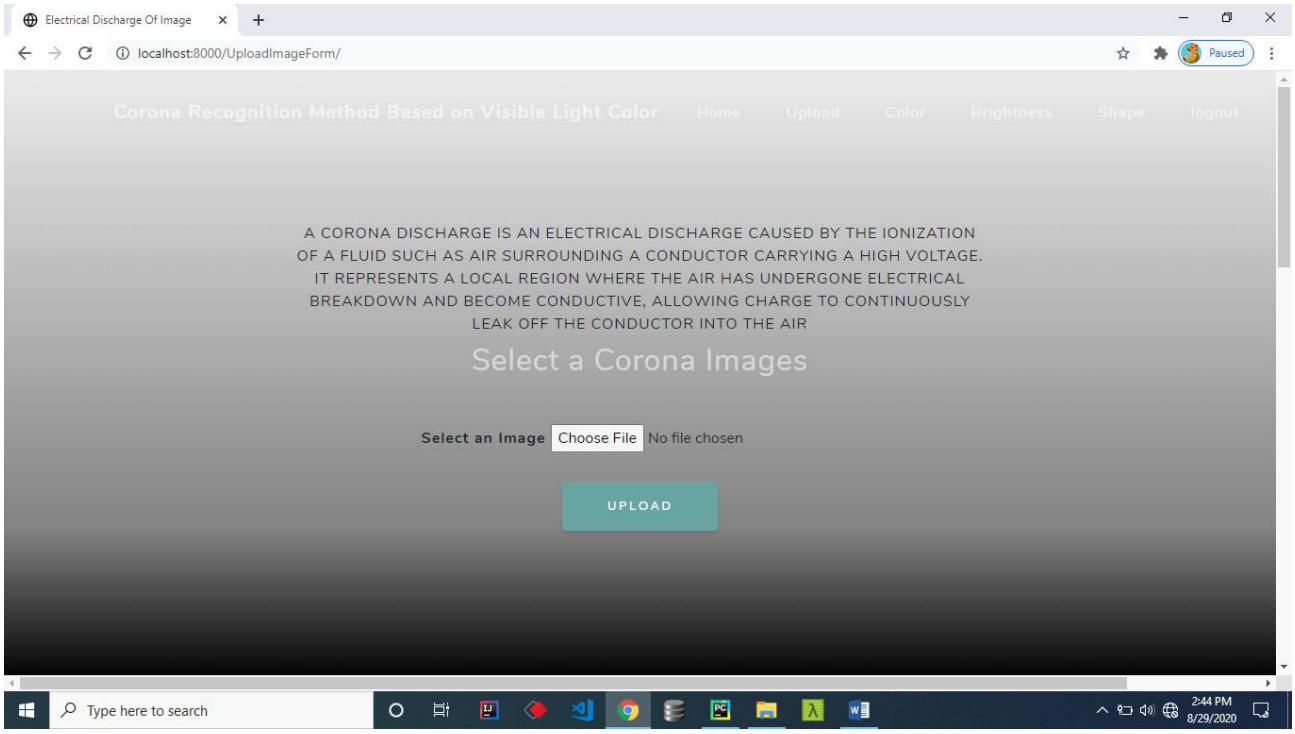
3 User Login page



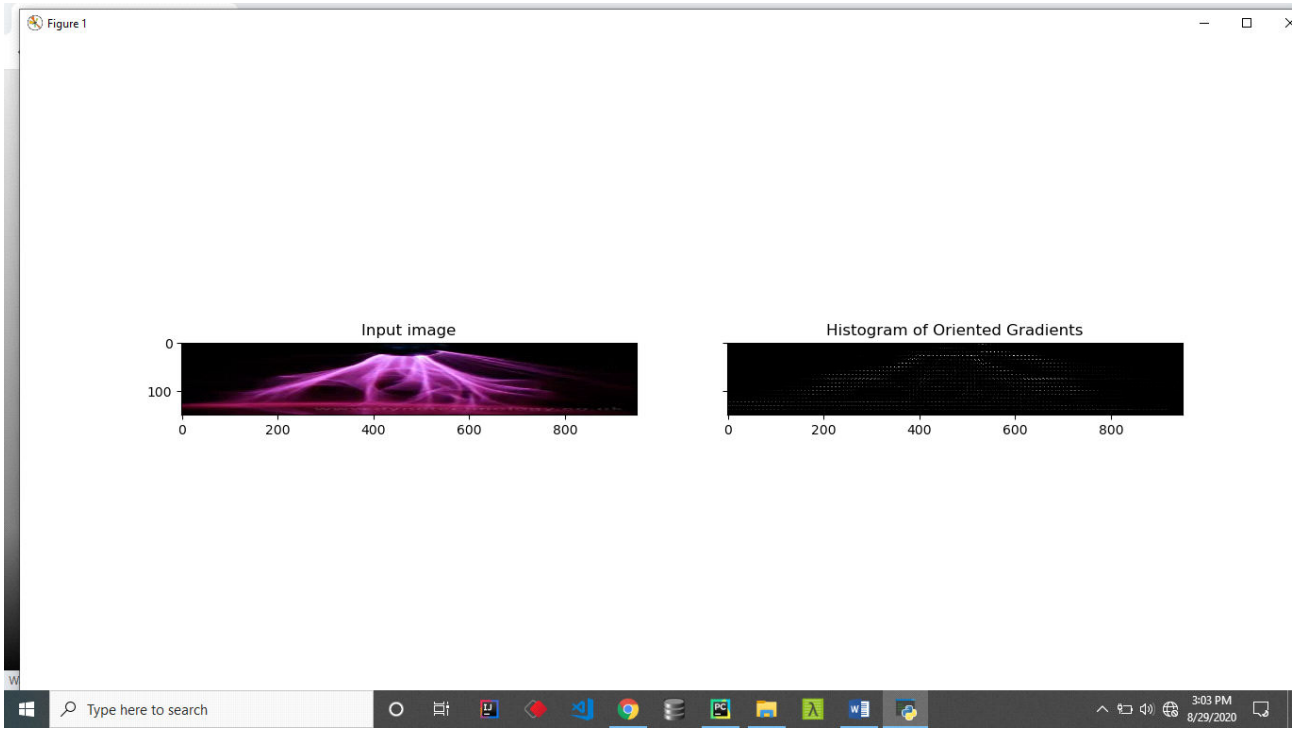
4 User Home Page:



5 Image Load Page



6 Input Image



7. CONCLUSION AND FUTURE SCOPE

In conclusion, our research has shown that by harnessing the power of visible light colour analysis and machine learning algorithms, it is possible to detect and categorise different states of corona discharge accurately. The robustness and consistency of our approach across various conditions make it a promising tool for real-world implementation.As we move forward, we intend to explore further applications of this method and refine it to enhance its precision and reliability. We believe that the fusion of machine learning and visual analysis holds significant potential in the field of electrical discharge research and beyond.Our work represents a significant step towards a more comprehensive understanding of electric discharge phenomena and offers practical solutions for their detection and analysis.

8.REFERENCES

[1] D. T. Markus and T. S. Lee, "A method of direct corona imaging on dielectric transparency," IEEE Trans. Ind. Appl., vol. 32, no. 4, pp. 832–836, Jul. 1996.

[2] Y. Arao, T. Fujii, and M. Yatsuzuka, "Image evaluation of atmospheric corona discharge applied for road tunnel high-velocity electrostatic precipitator," IEEE Trans. Plasma Sci., vol. 33, no. 2, pp. 312–313, Apr. 2005.

[3] P. H. Ceccato, O. Guaitella, M. Le Gloahec, and A. Rousseau, "Time Resolved nanosecond imaging of the propagation of a corona-like plasma discharge in water at positive applied voltage polarity," J. Phys. D: Appl. Phys., vol. 43, no. 17, 2010, Art. no. 175202.

[4] S. N. Abolmasov, K. Tachibana, and T. Shirafuji, "Mechanisms of pattern formation in dielectric barrier discharges," IEEE Trans. Plasma Sci., vol. 39, no. 11, pp. 2090–2091, Nov. 2011.

[5] M. Liao, J. Huang, G. Ge, X. Duan, Z. Huang, and J. Zou, "Vacuum arc commutation characteristics of the DC microgrid hybrid circuit breakers," IEEE Trans. Plasma Sci., vol. 45, no. 8, pp. 2172–2178, Aug. 2017.

[6] D. B.Watson, S. K. Kho, K. A. Samuels, L. Ma, and J. B. Chiu, "Impulse flashover trajectory in air in nonuniform fields," IEEE Trans. Electr. Insul., vol. 28, no. 2, pp. 200–208, Apr. 1993.

[7] D. Amarasinghe, U. Sonnadara, M. Berg, and V. Cooray, "Correlation between brightness and channel currents of electrical discharges," IEEE Trans. Dielectrics Electr. Insul., vol. 14, no. 5, pp. 1154–1160, Oct. 2007.

[8] J. M. K. MacAlpine, D. H. Qiu, and Z. Y. Li, "An analysis of spark paths in air using 3-dimensional image processing," IEEE

Trans. Dielectrics Electr. Insul., vol. 6, no. 3, pp. 331–336, Jun. 1999.

[9] D. H. Qiu, J. M. K. MacAlpine, and Z. Y. Li, "An incremental analysis of spark paths in air using 3-dimensional image processing," IEEE Trans. Dielectrics Electr. Insul., vol. 7, no. 6, pp. 758–763, Dec. 2000.

[10] L. Kebbabi and A. Beroual, "Fractal analysis of creeping discharge patterns propagating at solid/liquid interfaces: Influence of the nature and geometry of solid insulators," J. Phys. D: Appl. Phys., vol. 39, no. 1, pp. 177–183, Jan. 2006.

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