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A CORONA RECOGNITION METHOD BASED ON VISIBLE LIGHT COLOUR ANDMACHINE LEARNING

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Abstract
Visual images: can they detect gas electric discharge states? The article describes a novel approach that uses four machine learning algorithms to extract color, brightness, and shape information from visible digital camera photos to develop various detection models for distinct corona discharge states. All models are evaluated on fresh photos to determine their performance. SVM, KNN, SLP, and DT are four machine learning algorithms. Traditional discharge image study in the present system focused on qualitative factors like shape, light intensity, etc. However, few quantitative assessment studies exist. With computer technology, digital image processing methods have been widely used to study discharge characteristics like breakdown paths, discharge area, etc., especially in ultraviolet (UV), which can help solve complex problems using statistical methods or fractal theory. High-speed camera pictures (nanosecond time scale) may show certain features of a single discharge, but gas discharge remains random under the same macroscopic physical circumstances.
We use machine learning methods to extract color, brightness, and form from visual pictures to develop various detection models of distinct corona discharge states. In the second half, corona discharge experiments are introduced. In the third section, the three main colors [red, green, and blue (RGB)] gray level histogram (RGB-GLH) of visual pictures will be presented, along with the method of using machine-learning algorithms to assess visual image characteristics. In the fourth section, we compare our model's predictions.

Introduction

Industrial equipment uses electric discharge, which is ubiquitous in nature. Researchers have studied voltage, current, optical spectrum, ultrahigh-frequency electromagnetic waves, number of discharges, phase angles (for ac discharge), etc. to understand electrical discharge. Although the earliest studies were focused on the picture, such as the original definition of corona, such study has not considered the crucial optical features of discharge images. In reality, optical measurements are superior than electromagnetic measurements for discharge geometries. Traditional recognition techniques may be more reliable if the discharge image's optical features are used in diagnosis.

Traditional discharge image research focused on qualitative factors like shape, light intensity, etc. However, few quantitative assessment studies exist. With computer technology, digital image processing methods have been widely used to study discharge characteristics like breakdown paths, discharge area, etc., especially in ultraviolet (UV), which can help solve complex problems using statistical methods or fractal theory. High-speed camera pictures (nanosecond time scale) may show certain features of a single discharge, but gas discharge remains random under the same macroscopic physical circumstances. However, some industrial discharges are a collection of several micro discharges. Compared to high-speed camera studies, a statistical assessment of discharge pictures spanning a large number of stochastic events on a long time scale is still important. In discharge image research, optical radiation color information is seldom employed. In 2000, Russell and Jones suggested

uses chromatic characteristics to directly evaluate plasma state stability. The investigations then focused on optical-electrical detection methods, which can only be applied to a vast region for a general comprehension. Koppisetty et al. sought to correlate visual picture color with partial-vacuum breakdown in 2009. Serrano et al. monitored arc welding with color in 2016. Plasma nonthermal development has stalled. We researched the color difference between corona and surface discharge and applied for patents to determine discharge condition using color. A significant advance was made by Prasad and Reddy in 2017 when they extracted color information from discharge photos and transformed it to brightness metrics to evaluate discharge power. Due to the emergence of high-resolution digital cameras, color information is being used to analyze nonthermal plasma discharge spatial distribution.

AI/Machine Learning research has advanced recently. These methods are commonly utilized in high-voltage domains to solve high-dimensional nonlinear issues. SVM and neural networks have been used to identify insulator conditions, PRPD, ultrahigh frequency pattern recognition, and fusion plasmas.

In addition to SVM, we have used KNN, SLP, and DT for analysis. These methods are used for supervised regression problems. We won't go into specifics here, although several literatures describe machine learning techniques. We use machine learning methods to extract color, brightness, and form from visual pictures to develop various detection models of distinct corona discharge states. In the second half, corona discharge experiments are introduced. The third portion introduces the three major colors—red, green, and blue (RGB)—grey level histogram (RGB-GLH) of visual pictures and discusses how machine-learning algorithms analyze visual image characteristics. The fourth portion

We report and compare our model's predictions. Conclusions will be given.

The dc microgrid has been a research hotspot for distributed generating. Urgently needed: microgrid protection dc circuit breaker. The novel dc hybrid circuit breaker (HCB) with parallel vacuum circuit breakers (VCBs) and insulated gate bipolar transistors (IGBTs) has garnered interest. The dc HCB is a global research hub. For 400 V distribution networks, Genji et al. suggest the HCB initially. HCB is constructed using parallel switch and gate turn-off thyristor. Polman et al. presented an IGBT-based bidirectional 600 V/6 kA hybrid dc switch. Design and implementation of dc HCB are studied. MATLAB simulates hybrid breaker commutating circuits. AC power supplies employ the dc HCB as an automated transfer switch. ABB creates a high-voltage hybrid dc circuit breaker with parallel mechanical switches and semiconductor device IGBTs. Digital Object Identifier interrupts in under 5 ms. The 10-kV dc HCB has an integrated gate-commutated thyristor and has a breaking current of 3.6 kA. Alstom uses thyristors, fast VCBs, and other equipment to create a 120-kV dc HCB. Maximum interrupting current is 5.2 kA. Jingqiang et al. study the superconducting fault current limiter connected to the conventional HCB in series to restrict main circuit current in the high-voltage dc transmission field. Khan et al. simulated and tested superconductor shielding of dc HCB. The cost and dependability of high-voltage dc HCB will restrict its use in HVDC transmission.

Literature Survey

1) D. H. Qiu, J. M. K. MacAlpine, and Z. Y. Li, "An Incremental Analysis Of Spark Paths In Air Using 3-Dimensional Image Processing"

2) B. Pongrác, H. H. Kim, M. Janda, V. Martišovitš, and Z. Machal, "Fast Imaging Of Intermittent Electrospraying Of Water With Positive Corona Discharge"

3) X. Li et al, "Statistical evaluation of AC corona images in long-time scale and characterization of short-gap leader"

4) Jesus Mirapeix Serrano, Ruben Ruiz Lombera , Jose J. Valdiande , Jose Miguel Lopez-Higuera, " Colorimetric analysis for on-line arc-welding diagnostics by means of plasma optical spectroscopy"

5) D. S. Prasad and B. S. Reddy, "Digital Image Processing Techniques For Estimating Power Released From The Corona Discharges"

Data Flow Diagram

The DFD is also called as bubble chart. It is a simple graphical formalism thatcan be used to represent a system in terms of input data to the system, various processing carried out on this data, and the output data is generated by this system. Thedata flow diagram (DFD) is one of the most important modelling tools. It is used to model the system components. These components are the system process, the data usedby the process, an external entity that interacts with the system and the information flows in the system.

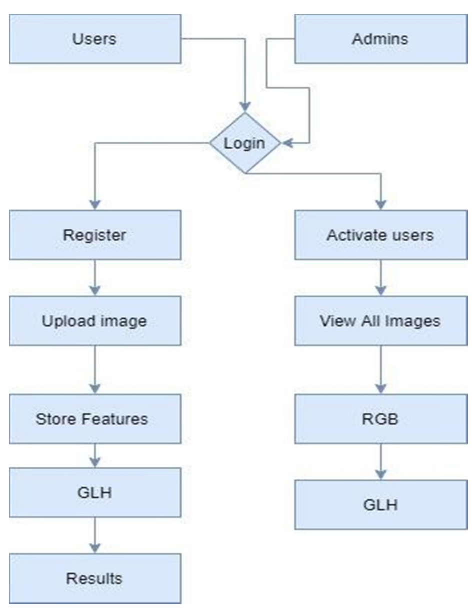

Fig 2.1 Data Flow Diagram

DFD shows how the information moves through the system and how it is modified by a series of transformations. It is a graphical technique that depicts information flow and the transformations that are applied as data moves from input to output. DFD may be used to represent a system at any level of abstraction. DFD may be partitioned into levels that represent increasing information flow and functional detail.

Activity Diagram

Activity diagrams are graphical representations of workflows of stepwise activities and actions with support for choice, iteration and concurrency. In the UnifiedModelling Language, activity diagrams can be used to describe the business and operational step-by-step workflows of components in a system. An activity diagram shows the overall flow of control.

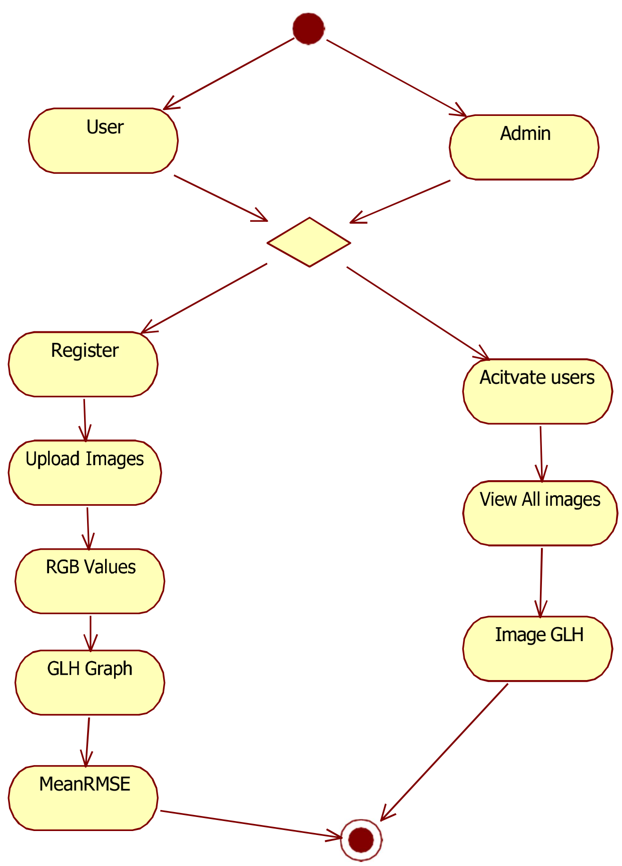

Fig 2.2 Activity Diagram

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UML Diagrams

UML stands for Unified Modeling Language. UML is a standardized general- purpose modeling language in the field of object-oriented software engineering. The standard is managed, and was created by, the Object Management Group. The goal is for UML to become a common language for creating models of object-oriented computer software. In its current form UML is comprised of two major components: aMeta-model and a notation. In the future, some form of method or process may also beadded to; or associated with, UML.

The Unified Modeling Language is a standard language for specifying, Visualization, Constructing and documenting the artifacts of software system, as well as for business modeling and other non-software systems. The UML represents a collection of best engineering practices that have proven successful in the modeling of large and complex systems. The UML is a very important part of developing objects- oriented software and the software development process. The UML uses mostly graphical notations to express the design of software projects.

GOALS

The Primary goals in the design of the UML are as follows:

1. Provide users a ready-to-use, expressive visual modeling Language so that they can develop and exchange meaningful models.
2. Provide extendibility and specialization mechanisms to extend the coreconcepts.
3. Be independent of particular programming languages and development process.
4. Provide a formal basis for understanding the modeling language.
5. Encourage the growth of OO tools market.
6. Support higher level development concepts such as collaborations, frameworks,patterns and components.
7. Integrate best practices.

Hardware Requirements

For developing the application the following are the Hardware Requirements:

- Processor: Intel i3
- RAM: 4 GB
- Space on Hard Disk: minimum 1 TB

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Result and it's Discussion

User Register page

Fig 5.1 Home Page

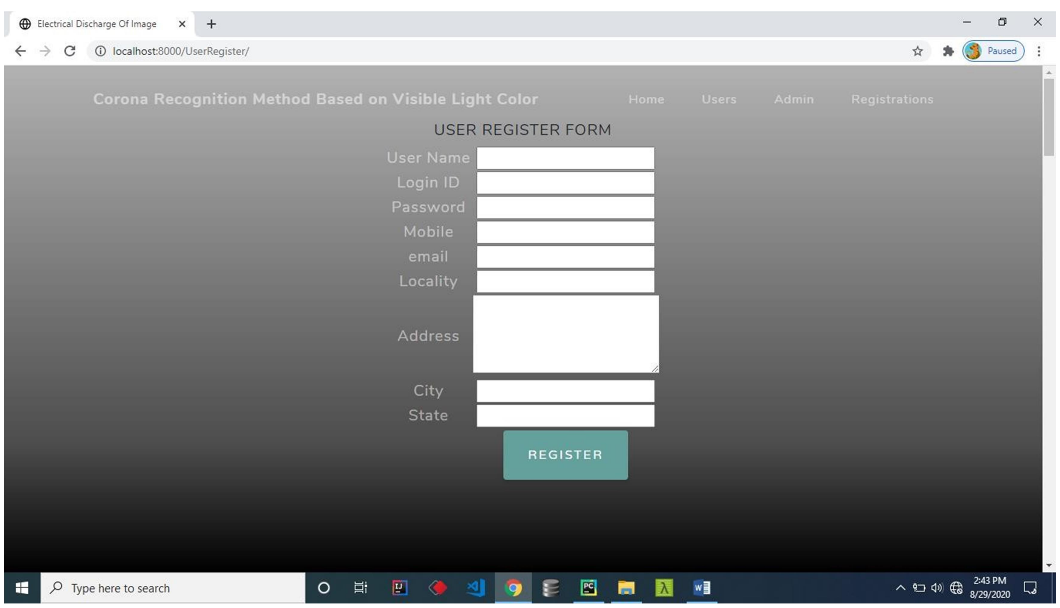

Fig 5.2 User Register page

User Login page

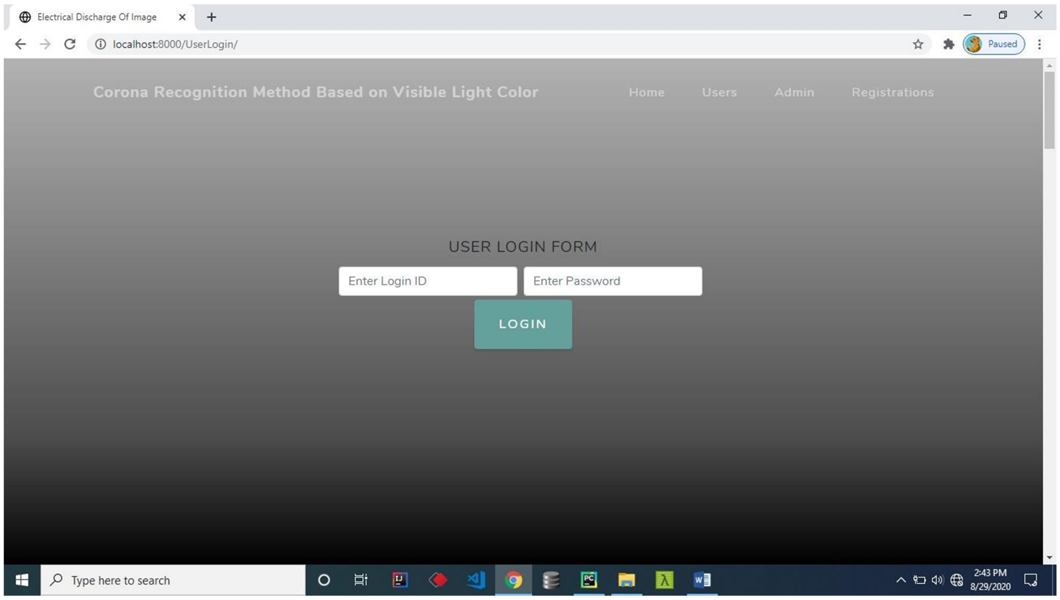

Fig 5.3 User Login Page

User Home Page

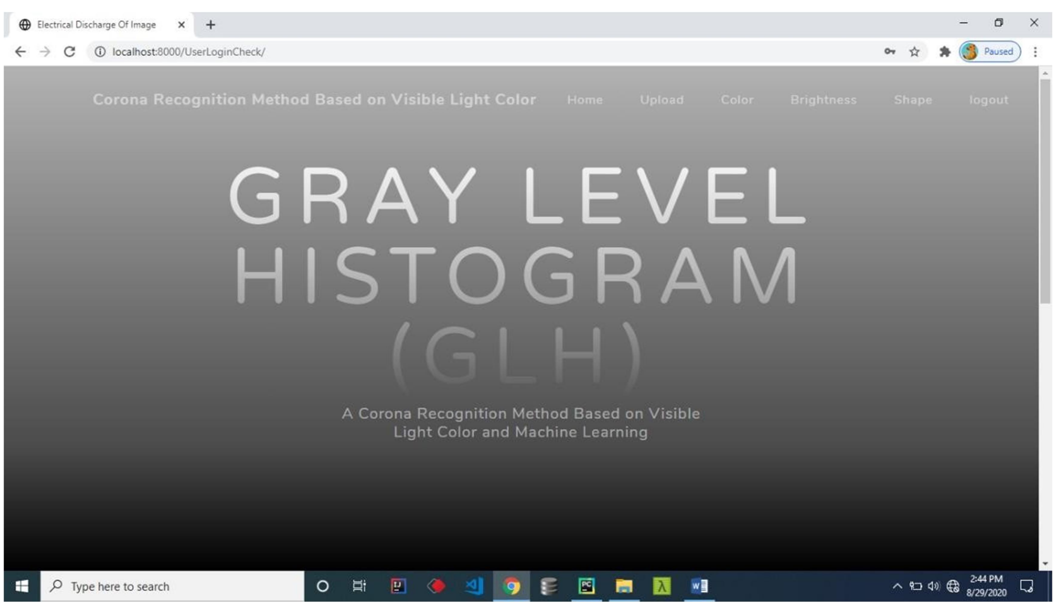

Fig 5.4 User Home Page

Image Upload page

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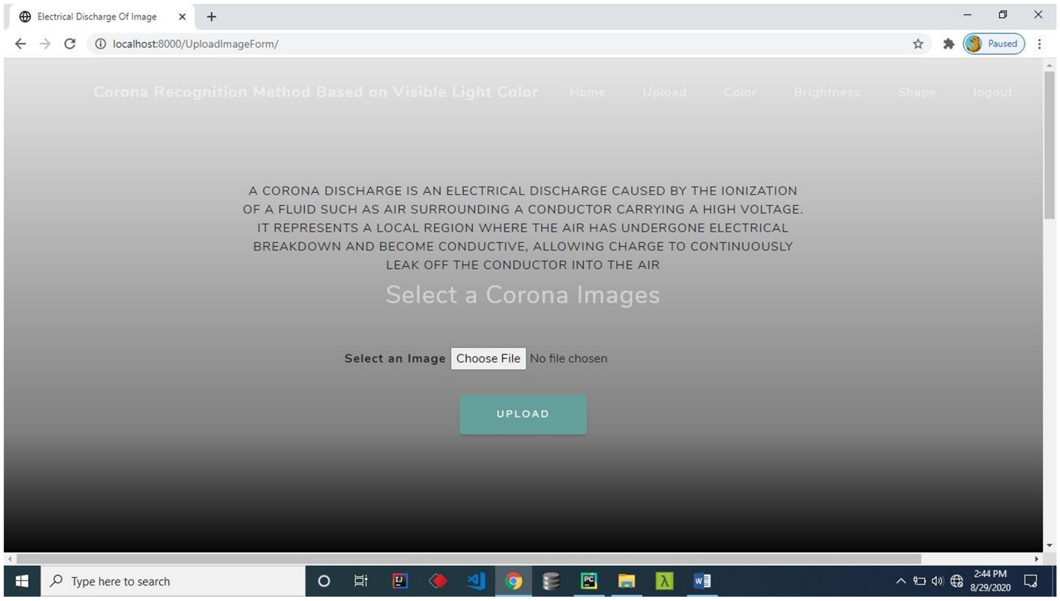

Input Image

Fig 5.5 Image Upload page

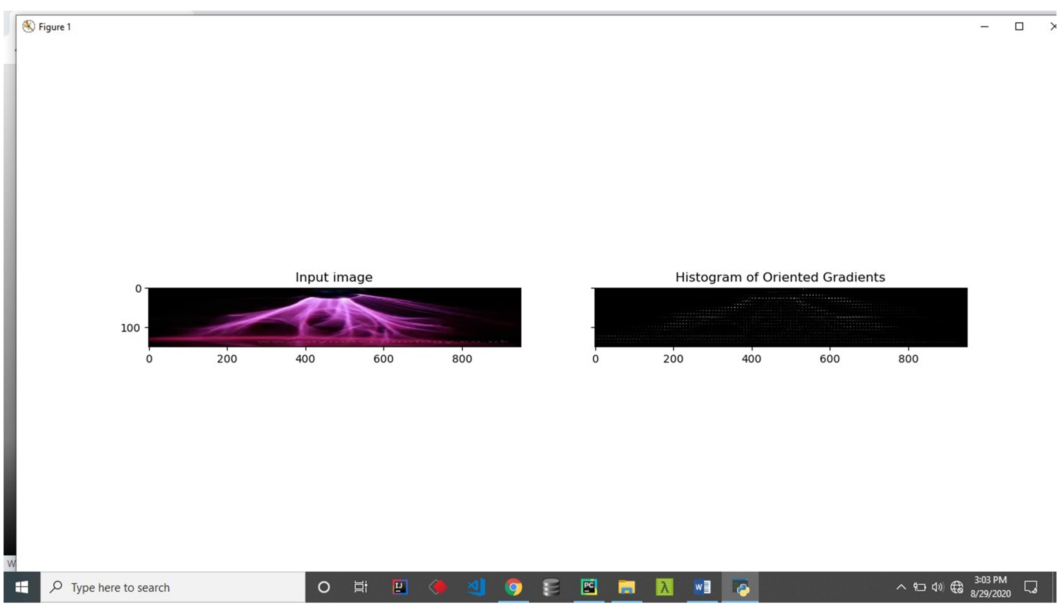

Fig 5.6 Input Image

Conclusion

The prediction shows that the colour features perform the best among all the three characteristics information and the KNN algorithm performs the best among all four algorithms. The model shows consistently good performance with different cameras and camera settings as well. Discharge produces radiation of UV, visible, andnear infrared wavelengths. Past studies focused mostly on the UV spectrum, yet the measurement of the light spectrum demonstrates that radiation intensity of the visible spectrum can be high as well. Objects that can produce radiation of visible spectrum isaffected by radiation across all spectra. Because of this, even though our RGB-GLH method uses information only from the visible spectrum, it is still able to encompass discharge status-related information across spectra, thus enabling us to build a more successful model. The RGB colour information characteristics method can also be applied to other discharge types other than corona.

Future Work

Corona discharge only forms when the electric field (potential gradient) at the surface of the conductor exceeds a critical value, the dielectric strength or disruptive potential gradient of the fluid. In air at atmospheric pressure, it is roughly 30 kilovolts per centimetre, but this decreases with pressure, so corona is more of a problem at highaltitudes. A corona discharge is an electrical discharge possible because of the ionization of air surrounding a conductor that is electrically charged. The corona treatment is frequently used for polypropylene, PVC, PET, polyethylene, metallized surfaces, paper, and paperboard stock. Electric cables, automotive components, 3D parts, medical devices, pipes & tubes, board & foam, domestic appliances, extruded profiles are some components that are processed with corona.

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