Preparation of Papers for IEEE ACCESS

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ABSTRACT This paper proposes a new method of tampered image detection by combining the CNN with a backbone of ResNet50 with ELA. Our method is designed for digital forensics, which is a very important domain for the detection and assessment of image modifications in many other domains, such as cybersecurity, journalism, and criminal investigations This procedure comprises image pre-processing to ascertain altered areas by comparing variations in compression levels to find compression artifacts using ELA. It serves as the foundation for reliable feature extraction: the ResNet50 model, pre-trained on ImageNet, has its basic layers frozen to preserve learned weights. For customization with regard to binary classification, some custom layers are appended on top: global average pooling, batch normalization, dense layers with ReLU, and dropout regularization. The architecture here comes up with a generator-based approach so that large datasets can be handled with better memory consumption, enabling real-time data preprocessing during training of models.Our methodology is assured to optimize resource utilization and enhance generalization, which has been evidenced with extensive experiments. The obtained model offers high accuracy and robustness in detecting tampered images; thus, it presents a scalable solution for real-world forensic applications. This integration of ELA and CNN provides the backbone of fast and accurate analysis of digital evidence to help in better decision-making in sensitive situations.

INDEX TERMS Tampered Image Detection, Error Level Analysis (ELA), Convolutional Neural Network (CNN), ResNet50, Digital Forensics, Image Manipulation Detection, Cybersecurity, Journalism, Criminal Investigations, Feature Extraction, Binary Classification, Data Preprocessing, Dropout Regularization, Compression Artifacts, Real-time Analysis, Scalable Forensic Applications.

I. INTRODUCTION

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A. ABBREVIATIONS AND ACRONYMS

Define abbreviations and acronyms the first time they are used in the text, even after they have already been defined in the abstract. Abbreviations such as IEEE, SI, ac, and dc do not have to be defined. Abbreviations that incorporate periods should not have spaces: write ''C.N.R.S.,'' not ''C. N. R. S.'' Do not use abbreviations in the title unless they are unavoidable (for example, ''IEEE'' in the title of this article).

B. OTHER RECOMMENDATIONS

Use one space after periods and colons. Hyphenate complex modifiers: ''zero-field-cooled magnetization.'' Avoid dangling participles, such as, ''Using (1), the potential was calculated.'' [It is not clear who or what used (1).] Write instead, ''The potential was calculated by using (1),'' or ''Using (1), we calculated the potential.''

Use a zero before decimal points: ''0.25,'' not ''.25.'' Use

"cm^3," not "cc." Indicate sample dimensions as "0.1 cm × 0.2 cm," not "0.1 × 0.2 cm^2." The abbreviation for "seconds" is "s," not "sec." Use "Wb/m^2" or "webers per square meter," not "webers/m^2." When expressing a range of values, write "7 to 9" or "7–9," not "7∼9."

A parenthetical statement at the end of a sentence is punctuated outside of the closing parenthesis (like this). (A parenthetical sentence is punctuated within the parentheses.) In American English, periods and commas are within quotation marks, like "this period." Other punctuation is "outside"! Avoid contractions; for example, write "do not" instead of "don't." The serial comma is preferred: "A, B, and C" instead of "A, B and C."

If you wish, you may write in the first person singular or plural and use the active voice ("I observed that . . ." or "We observed that . . ." instead of "It was observed that . . ."). Remember to check spelling. If your native language is not English, please get a native English-speaking colleague to carefully proofread your paper.

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C. EQUATIONS

Number equations consecutively with equation numbers in parentheses flush with the right margin, as in (1). To make your equations more compact, you may use the solidus (/), the exp function, or appropriate exponents. Use parentheses to avoid ambiguities in denominators. Punctuate equations when they are part of a sentence, as in

$$E = mc^2. \tag{1}$$

The following 2 equations are used to test your LaTeX compiler's math output. Equation (2) is your LaTeX compiler' output. Equation (3) is an image of what (2) should look like. Please make sure that your equation (2) matches (3) in terms of symbols and characters' font style (Ex: italic/roman).

$$\frac{47i + 89jk \times 10rym \pm 2npz}{(6XYZ\pi Ku)Aoq \sum_{i=1}^{r} Q(t)} \int_{0}^{\infty} f(g)\mathrm{d}x \sqrt[3]{\frac{abcdelqh^2}{(svw)\cos^3\theta}}. \tag{2}$$

$$\frac{47i + 89jk \times 10rym \pm 2npz}{(6XYZ\pi Ku)Aoq \sum_{i=1}^{r} Q(t)} \int_{0}^{\infty} f(g)\mathrm{d}x \sqrt[3]{\frac{abcdelqh^2}{(svw)\cos^3\theta}}. \tag{3}$$

Be sure that the symbols in your equation have been defined before the equation appears or immediately following. Italicize symbols (T might refer to temperature, but T is the unit tesla). Refer to "(1)," not "Eq. (1)" or "equation (1)," except at the beginning of a sentence: "Equation (1) is . . . ."

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Please use "soft" (e.g., `\eqref{Eq}`) cross references instead of "hard" references (e.g., `(1)`). That will make it possible to combine sections, add equations, or change the order of figures or citations without having to go through the file line by line.

Please don't use the `{eqnarray}` equation environment. Use `{align}` or `{IEEEeqnarray}` instead. The `{eqnarray}` environment leaves unsightly spaces around relation symbols.

Please note that the `{subequations}` environment in LATEX will increment the main equation counter even when there are no equation numbers displayed. If you forget that, you might write an article in which the equation numbers skip from (17) to (20), causing the copy editors to wonder if you've discovered a new method of counting.

BibTEX does not work by magic. It doesn't get the bibliographic data from thin air but from .bib files. If you use BibTEX to produce a bibliography you must send the .bib files.

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Use either SI (MKS) or CGS as primary units. (SI units are strongly encouraged.) English units may be used as secondary units (in parentheses). This applies to papers in data storage. For example, write "15 Gb/cm^2 (100 Gb/in^2)." An exception is when English units are used as identifiers in trade, such as "3$^{1/2}$-in disk drive." Avoid combining SI and CGS units, such as current in amperes and magnetic field in oersteds. This often leads to confusion because equations do not balance dimensionally. If you must use mixed units, clearly state the units for each quantity in an equation.

The SI unit for magnetic field strength H is A/m. However, if you wish to use units of T, either refer to magnetic flux density B or magnetic field strength symbolized as $\mu_0 H$. Use the center dot to separate compound units, e.g., "A·m^2."

A. EXAMPLE TABLE

III. SOME COMMON MISTAKES

The word "data" is plural, not singular. The subscript for the permeability of vacuum μ_0 is zero, not a lowercase letter "o." The term for residual magnetization is "remanence"; the adjective is "remanent"; do not write "remnance" or "remnant." Use the word "micrometer" instead of "micron." A graph within a graph is an "inset," not an "insert." The word "alternatively" is preferred to the word "alternately" (unless you really mean something that alternates). Use the word "whereas" instead of "while" (unless you are referring to
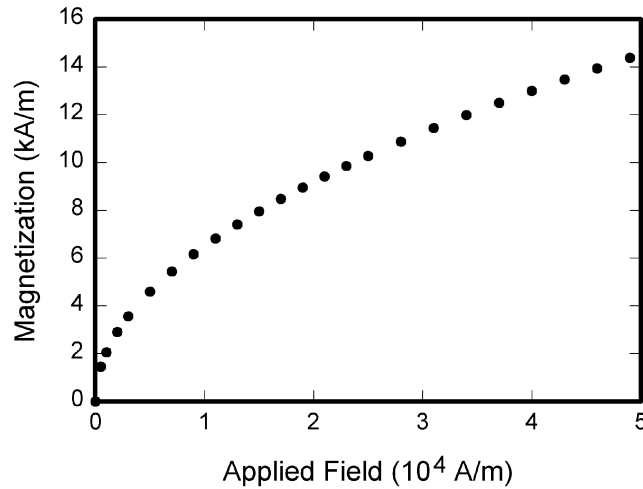
FIGURE 1. Magnetization as a function of applied field. It is good practice to explain the significance of the figure in the caption.

Literature	Dataset	Method	Result
Author et al. (2024) [1]	CICDDoS2019	CNNs	97.7%

TABLE 1. Literature Survey

simultaneous events). Do not use the word "essentially" to mean "approximately" or "effectively." Do not use the word "issue" as a euphemism for "problem." When compositions are not specified, separate chemical symbols by en-dashes; for example, "NiMn" indicates the intermetallic compound $Ni_{0.5}Mn_{0.5}$ whereas "Ni–Mn" indicates an alloy of some composition Ni_xMn_{1-x}.

Be aware of the different meanings of the homophones "affect" (usually a verb) and "effect" (usually a noun), "complement" and "compliment," "discreet" and "discrete," "principal" (e.g., "principal investigator") and "principle" (e.g., "principle of measurement"). Do not confuse "imply" and "infer."

Prefixes such as "non," "sub," "micro," "multi," and "ultra" are not independent words; they should be joined to the words they modify, usually without a hyphen. There is no period after the "et" in the Latin abbreviation "*et al.*" (it is also italicized). The abbreviation "i.e.," means "that is," and the abbreviation "e.g.," means "for example" (these abbreviations are not italicized).

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IV. PROPOSED METHOD

In this paper, we demonstrate that combining ELA with CNN model while freezing the base layers and adding custom layers to the base model which will provide a significant increase in the robustness of the final model and significantly improve performance of the classification task to detect images, which are tampered. We explore this idea in the context of digital forensics, where the goals are to analyze the images and detect suspicious activity in the field of crime, journalism etc. Since digital forensics helps uncover activities and patterns, determine the root causes of incidents, and establish a chain of evidence admissible in court, it becomes essential to identify, recover, analyze and present digital evidence from electronic devices and digital storage. Additionally, an ELA based model helps in identifying the difference in various layers of the images to help us uncover the underlying changes made to the image that is suspected to be tampered with. The model allows us to help various fields where criminal investigations, legal disputes and cybersecurity incidents occur and images need to be analyzed quicky to help user make quick informed decisions. The following sections outline the details of each step in the process.

A. INITIALIZATION

The initialization of the framework is preprocessing the images based on the number of images available in the dataset, it corresponds to the total number of images which are categorized in two classes specifically: 1) Authentic and 2) Tampered. The classes with their labels are split initially to ensure we have a sizeable amount of image to work with, we ensure that the classes are not biased and are equally balanced to provide a robust model and reduce overfitting. The classes are initialized with ones and zeros, zero if the image is authentic and one if the image has been tampered. For images to get preprocessed, we need to handle a chuck of images at a time, which will require us to take images in batches to preprocess and analyze further.

After reshaping the images according to our input shape which will reduce the size of the image so that our next

function would work effectively. Creating batches to handle memory overflow and preprocessing image before feeding them to the ELA function ensures that the system doesn't require a lot of resources and is more optimized to create a more robust model.

Further, we take each resized image and input it to our ELA function, this step is iterated over multiple images to get robust images with reduced quality to take forward for our ELA function.

B. ELA PROCESS WITH GENERATORS

For each image in our ELA function, we generate a buffer to save the original image to a temporary in-memory file with reduced quality, which helps us in reducing the overall memory utilization of the system. We load the compressed image from the buffer and calculate the difference between the original image and the one which was compressed to get the Pillow image object, this is a technique used in image forensics to detect tampering or inconsistencies in an image. We enhance the brightness of the image according to the extrema we get in the pillow image object.

This returns us the ELA image which is a new image that emphasizes regions with differing compression levels, useful for detecting tampering or manipulation. This image will highlight differences due to compression artifacts. To feed the image forward to the model for training, it requires the image to be converted to an array for numerical processing and is normalized making the data compatible with many machine learning models. We close the image further to free up resources and it is a good practice to avoid file locks or memory leaks, especially when processing multiple images in a loop. For the model to handle such large number of images at once would require a lot of resources, to tackle this issue we provide generators to the model.

These generators help in handle image preprocessing and feeding batches of data to the model during training. They are often used in deep learning workflows when the model requires to load images in batches and apply transformations or augmentation. Instead of loading all images into memory at once, generators load and process batches on-the-fly, reducing memory consumption. Generators often include on-the-fly preprocessing, which enhances the dataset and helps the model generalize better, increasing its robustness and generalizability for better performance. We also try to visualize the batch of images after the ELA function to ensure that the shape of the generator and preprocessed images are according to the requirements.

C. RESNET50 MODEL ARCHITECTURE WITH TRAINING EVOLUTION

In this study, we employ a Resnet50 model to classify the images into two categories (Authentic and Tampered), we use a transfer learning approach based on the ResNet50 architecture, pre-trained on ImageNet to solve our classification problem. This method capitalizes on the robust feature extraction capabilities of ResNet50, significantly reducing training time and computational resources while improving model accuracy. The model was customized to adapt the pre-trained base for the task by introducing additional trainable (Custom) layers specifically designed for binary classification. Figure 2: shows the architecture of the base model we have used featuring Resnet50 in a five-stage design to represent the overall function of the layers

The base of our architecture is the ResNet50 model, known for its depth and efficient handling of the vanishing gradient problem through residual connections. The model was loaded without the top layers, removing the full-connected top layers helped us retained only the convolutional layers which are responsible for extracting hierarchical features from the input images. The input shape was fixed to match the requirement of the model while ensuring compatibility with pre-trained weights. The freezing of all layers in the base model during training aimed at preserving the learned weights and keeping the feature extraction capability unaltered by the new task-specific data. To this binary classification problem, we attached five different types of custom layers to the base pre-trained model in an attempt to make it adapt. First, there is a global average pooling layer that reduces the high-dimensional feature maps output by ResNet50 into a single vector for each feature map, reducing the number of trainable parameters and hence improving generalization. Unlike the traditional Flatten layer, this preserves spatial information and improves model performance when using ResNet-based architectures. Further, we added batch normalization to normalize the activations from the pooling layer, reducing internal covariate shift and accelerating convergence.

Once we are done with that, we added a series of two dense layers. The first layer consists of 512 neurons providing substantial capacity to capture complex patterns. The second contains 256 neurons for further refinement of feature extraction. Both are activated by the ReLU activation function, which introduces non-linearity in deep networks and provides output zero for negative inputs, creating sparsity in the activations that could further be helpful in efficient computations with a reduction in overfitting. While being computationally less expensive than sigmoid or tanh function. The custom layers then involved a dropout regularization technique which was employed after each dense layer to with a rate of 0.75 after the first dense layer to impose strong regularization and rate of 0.5 was applied after the second dense layer for moderate regularization. This helped in preventing overfitting of the model during training. After dropout regularization, there was a single neuron in the output layer with sigmoid activation to predict the probability of the positive class, which is suitable for binary classification tasks.

It achieves a very good trade-off among accuracy, training efficiency, and robustness, making it pretty effective in real-world applications. This model was trained for more than 100 epochs with a step size of about 145 while capturing essential evaluation metrics such as accuracy, the f1 score, and validation accuracy. This will make sure we minimize the gap between the training and validation accuracy of the

TABLE 2. Units for Magnetic Properties

Symbol	Quantity	Conversion from Gaussian and CGS EMU to SI [a]
Φ	magnetic flux	$1\,\text{Mx} \rightarrow 10^{-8}\,\text{Wb} = 10^{-8}\,\text{V·s}$
B	magnetic flux density, magnetic induction	$1\,\text{G} \rightarrow 10^{-4}\,\text{T} = 10^{-4}\,\text{Wb/m}^2$
H	magnetic field strength	$1\,\text{Oe} \rightarrow 10^3/(4\pi)\,\text{A/m}$
m	magnetic moment	$1\,\text{erg/G} = 1\,\text{emu}$ $\rightarrow 10^{-3}\,\text{A·m}^2 = 10^{-3}\,\text{J/T}$
M	magnetization	$1\,\text{erg/(G·cm}^3) = 1\,\text{emu/cm}^3$ $\rightarrow 10^3\,\text{A/m}$
$4\pi M$	magnetization	$1\,\text{G} \rightarrow 10^3/(4\pi)\,\text{A/m}$
σ	specific magnetization	$1\,\text{erg/(G·g)} = 1\,\text{emu/g} \rightarrow 1\,\text{A·m}^2/\text{kg}$
j	magnetic dipole moment	$1\,\text{erg/G} = 1\,\text{emu}$ $\rightarrow 4\pi \times 10^{-10}\,\text{Wb·m}$
J	magnetic polarization	$1\,\text{erg/(G·cm}^3) = 1\,\text{emu/cm}^3$ $\rightarrow 4\pi \times 10^{-4}\,\text{T}$
χ, κ	susceptibility	$1 \rightarrow 4\pi$
χ_ρ	mass susceptibility	$1\,\text{cm}^3/\text{g} \rightarrow 4\pi \times 10^{-3}\,\text{m}^3/\text{kg}$
μ	permeability	$1 \rightarrow 4\pi \times 10^{-7}\,\text{H/m}$ $= 4\pi \times 10^{-7}\,\text{Wb/(A·m)}$
μ_r	relative permeability	$\mu \rightarrow \mu_r$
w, W	energy density	$1\,\text{erg/cm}^3 \rightarrow 10^{-1}\,\text{J/m}^3$
N, D	demagnetizing factor	$1 \rightarrow 1/(4\pi)$

Vertical lines are optional in tables. Statements that serve as captions for the entire table do not need footnote letters.
[a]Gaussian units are the same as cg emu for magnetostatics; Mx = maxwell, G = gauss, Oe = oersted; Wb = weber, V = volt, s = second, T = tesla, m = meter, A = ampere, J = joule, kg = kilogram, H = henry.

model, which will be robust and very effective in real-world applications.

D. TYPES OF GRAPHICS

The following list outlines the different types of graphics published in IEEE journals. They are categorized based on their construction, and use of color/shades of gray:

1) Color/Grayscale figures

Figures that are meant to appear in color, or shades of black/gray. Such figures may include photographs, illustrations, multicolor graphs, and flowcharts. For multicolor graphs, please avoid any gray backgrounds or shading, as well as screenshots, instead export the graph from the program used to collect the data.

2) Line Art figures

Figures that are composed of only black lines and shapes. These figures should have no shades or half-tones of gray, only black and white.

3) Author photos

Author photographs should be included with the author biographies located at the end of the article underneath References.

4) Tables

Data charts which are typically black and white, but sometimes include color.

E. MULTIPART FIGURES

Figures compiled of more than one sub-figure presented side-by-side, or stacked. If a multipart figure is made up of multiple figure types (one part is lineart, and another is grayscale or color) the figure should meet the stricter guidelines.

F. FILE FORMATS FOR GRAPHICS

Format and save your graphics using a suitable graphics processing program that will allow you to create the images as PostScript (.PS), Encapsulated PostScript (.EPS), Tagged Image File Format (.TIFF), Portable Document Format (.PDF), Portable Network Graphics (.PNG), or Metapost (.MPS), sizes them, and adjusts the resolution settings. When submitting your final paper, your graphics should all be submitted individually in one of these formats along with the manuscript.

G. SIZING OF GRAPHICS

Most charts, graphs, and tables are one column wide (3.5 inches/88 millimeters/21 picas) or page wide (7.16 inches/181 millimeters/43 picas). The maximum depth a graphic can be is 8.5 inches (216 millimeters/54 picas). When choosing the depth of a graphic, please allow space for a caption. Figures can be sized between column and page widths if the author chooses, however it is recommended that figures are not sized less than column width unless when necessary.

There is currently one publication with column measurements that do not coincide with those listed above. Proceedings of the IEEE has a column measurement of 3.25 inches (82.5 millimeters/19.5 picas).

The final printed size of author photographs is exactly 1 inch wide by 1.25 inches tall (25.4 millimeters × 31.75 millimeters/6 picas × 7.5 picas). Author photos printed in editorials measure 1.59 inches wide by 2 inches tall (40 millimeters × 50 millimeters/9.5 picas × 12 picas).

H. RESOLUTION

The proper resolution of your figures will depend on the type of figure it is as defined in the "Types of Figures" section. Author photographs, color, and grayscale figures should be at least 300dpi. Line art, including tables should be a minimum of 600dpi.

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In order to preserve the figures' integrity across multiple computer platforms, we accept files in the following formats: .EPS/.PDF/.PS. All fonts must be embedded or text converted to outlines in order to achieve the best-quality results.

J. COLOR SPACE

The term color space refers to the entire sum of colors that can be represented within the said medium. For our purposes, the three main color spaces are Grayscale, RGB (red/green/blue) and CMYK (cyan/magenta/yellow/black). RGB is generally used with on-screen graphics, whereas CMYK is used for printing purposes.
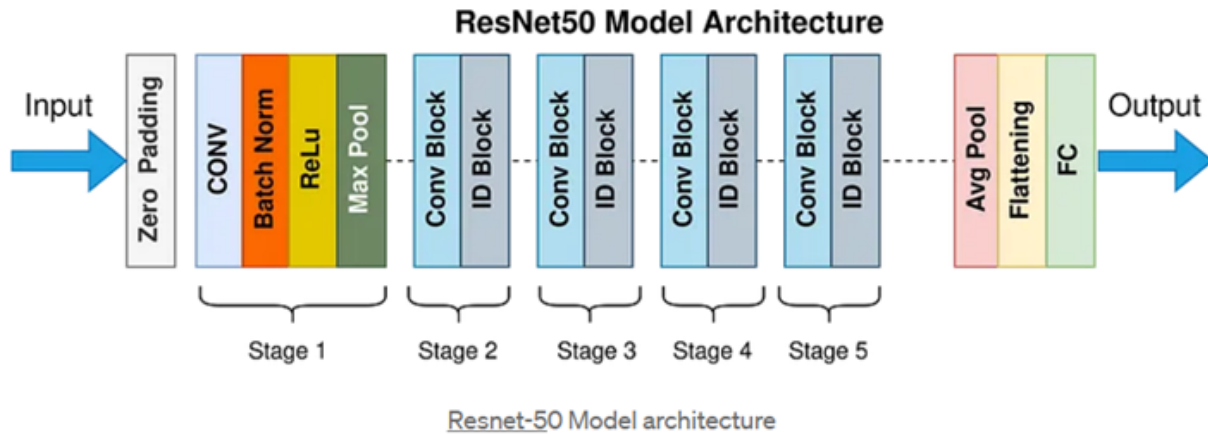
ResNet50 Model Architecture

Resnet-50 Model architecture

FIGURE 2. Architecture of the base model

All color figures should be generated in RGB or CMYK color space. Grayscale images should be submitted in Grayscale color space. Line art may be provided in grayscale OR bitmap colorspace. Note that "bitmap colorspace" and "bitmap file format" are not the same thing. When bitmap color space is selected, .TIF/.TIFF/.PNG are the recommended file formats.

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When preparing your graphics IEEE suggests that you use of one of the following Open Type fonts: Times New Roman, Helvetica, Arial, Cambria, and Symbol. If you are supplying EPS, PS, or PDF files all fonts must be embedded. Some fonts may only be native to your operating system; without the fonts embedded, parts of the graphic may be distorted or missing.

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L. USING LABELS WITHIN FIGURES
1) Figure Axis labels
Figure axis labels are often a source of confusion. Use words rather than symbols. As an example, write the quantity "Magnetization," or "Magnetization M," not just "M." Put units in parentheses. Do not label axes only with units. As in Fig. 1, for example, write "Magnetization (A/m)" or "Magnetization $(A \cdot m^{-1})$," not just "A/m." Do not label axes with a ratio of quantities and units. For example, write "Temperature (K)," not "Temperature/K."

Multipliers can be especially confusing. Write "Magnetization (kA/m)" or "Magnetization (10^3 A/m)." Do not write "Magnetization (A/m) $\times$ 1000" because the reader would not know whether the top axis label in Fig. 1 meant 16000 A/m

or 0.016 A/m. Figure labels should be legible, approximately 8 to 10 point type.

2) Subfigure Labels in Multipart Figures and Tables
Multipart figures should be combined and labeled before final submission. Labels should appear centered below each subfigure in 8 point Times New Roman font in the format of (a) (b) (c).

M. FILE NAMING
Figures (line artwork or photographs) should be named starting with the first 5 letters of the author's last name. The next characters in the filename should be the number that represents the sequential location of this image in your article. For example, in author "Anderson's" paper, the first three figures would be named ander1.tif, ander2.tif, and ander3.ps.

Tables should contain only the body of the table (not the caption) and should be named similarly to figures, except that '.t' is inserted in-between the author's name and the table number. For example, author Anderson's first three tables would be named ander.t1.tif, ander.t2.ps, ander.t3.eps.

Author photographs should be named using the first five characters of the pictured author's last name. For example, four author photographs for a paper may be named: oppen.ps, moshc.tif, chen.eps, and duran.pdf.

If two authors or more have the same last name, their first initial(s) can be substituted for the fifth, fourth, third. . . letters of their surname until the degree where there is differentiation. For example, two authors Michael and Monica Oppenheimer's photos would be named oppmi.tif, and oppmo.eps.

N. REFERENCING A FIGURE OR TABLE WITHIN YOUR PAPER
When referencing your figures and tables within your paper, use the abbreviation "Fig." even at the beginning of a sen-

tence. Figures should be numbered with Arabic Numerals. Do not abbreviate "Table." Tables should be numbered with Roman Numerals.

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Because IEEE will do the final formatting of your paper, you do not need to position figures and tables at the top and bottom of each column. In fact, all figures, figure captions, and tables can be placed at the end of your paper. In addition to, or even in lieu of submitting figures within your final manuscript, figures should be submitted individually, separate from the manuscript in one of the file formats listed above in Section IV-F. Place figure captions below the figures; place table titles above the tables. Please do not include captions as part of the figures, or put them in "text boxes" linked to the figures. Also, do not place borders around the outside of your figures.

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Although a conclusion may review the main points of the paper, do not replicate the abstract as the conclusion. A conclusion might elaborate on the importance of the work or suggest applications and extensions.

If you have multiple appendices, use the \appendices command below. If you have only one appendix, use \appendix[Appendix Title]

APPENDIX A
FOOTNOTES
Number footnotes separately in superscript numbers.[1] Place the actual footnote at the bottom of the column in which it is cited; do not put footnotes in the reference list (endnotes). Use letters for table footnotes (see Table 2).

APPENDIX B
SUBMITTING YOUR PAPER FOR REVIEW
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When your article is accepted, you can submit the final files, including figures, tables, and photos, per the journal's guidelines through the submission system used to submit the articlle. You may use *Zip* for large files, or compress files using *Compress, Pkzip, Stuffit,* or *Gzip.*

[1]It is recommended that footnotes be avoided (except for the unnumbered footnote with the receipt date on the first page). Instead, try to integrate the footnote information into the text.

In addition, designate one author as the "corresponding author." This is the author to whom proofs of the paper will be sent. Proofs are sent to the corresponding author only.

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APPENDIX C
IEEE PUBLISHING POLICY
The general IEEE policy requires that authors should only submit original work that has neither appeared elsewhere for publication, nor is under review for another refereed publication. The submitting author must disclose all prior publication(s) and current submissions when submitting a manuscript. Do not publish "preliminary" data or results. To avoid any delays in publication, please be sure to follow these instructions. Final submissions should include source files of your accepted manuscript, high quality graphic files, and a formatted pdf file. If you have any questions regarding the final submission process, please contact the administrative contact for the journal. author is responsible for obtaining

agreement of all coauthors and any consent required from employers or sponsors before submitting an article.

The IEEE Access Editorial Office does not publish conference records or proceedings, but can publish articles related to conferences that have undergone rigorous peer review. Minimally, two reviews are required for every article submitted for peer review.

APPENDIX D
PUBLICATION PRINCIPLES

Authors should consider the following points:

1) Technical papers submitted for publication must advance the state of knowledge and must cite relevant prior work.
2) The length of a submitted paper should be commensurate with the importance, or appropriate to the complexity, of the work. For example, an obvious extension of previously published work might not be appropriate for publication or might be adequately treated in just a few pages.
3) Authors must convince both peer reviewers and the editors of the scientific and technical merit of a paper; the standards of proof are higher when extraordinary or unexpected results are reported.
4) Because replication is required for scientific progress, papers submitted for publication must provide sufficient information to allow readers to perform similar experiments or calculations and use the reported results. Although not everything need be disclosed, a paper must contain new, useable, and fully described information. For example, a specimen's chemical composition need not be reported if the main purpose of a paper is to introduce a new measurement technique. Authors should expect to be challenged by reviewers if the results are not supported by adequate data and critical details.
5) Papers that describe ongoing work or announce the latest technical achievement, which are suitable for presentation at a professional conference, may not be appropriate for publication.

APPENDIX E
REFERENCE EXAMPLES

- *Basic format for books:*
  J. K. Author, "Title of chapter in the book," in *Title of His Published Book, x*th ed. City of Publisher, (only U.S. State), Country: Abbrev. of Publisher, year, ch. *x*, sec. *x*, pp. *xxx–xxx*.
  See [1], [1].
- *Basic format for periodicals:*
  J. K. Author, "Name of paper," *Abbrev. Title of Periodical*, vol. *x, no. x*, pp. *xxx–xxx*, Abbrev. Month, year, DOI. 10.1109.*XXX*.123456.
  See [1]– [1].
- *Basic format for reports:*
  J. K. Author, "Title of report," Abbrev. Name of Co.,

City of Co., Abbrev. State, Country, Rep. *xxx*, year.
See [1].
- *Basic format for handbooks:*
  Name of Manual/Handbook, x ed., Abbrev. Name of Co., City of Co., Abbrev. State, Country, year, pp. *xxx–xxx*.
  See [1].
- *Basic format for books (when available online):*
  J. K. Author, "Title of chapter in the book," in *Title of Published Book*, *x*th ed. City of Publisher, State, Country: Abbrev. of Publisher, year, ch. *x*, sec. *x*, pp. *xxx–xxx*. [Online]. Available: http://www.web.com
  See [1]– [1].
- *Basic format for journals (when available online):*
  J. K. Author, "Name of paper," *Abbrev. Title of Periodical*, vol. *x*, no. *x*, pp. *xxx–xxx*, Abbrev. Month, year. Accessed on: Month, Day, year, DOI: 10.1109.*XXX*.123456, [Online].
  See [1]– [1].
- *Basic format for papers presented at conferences (when available online):*
  J.K. Author. (year, month). Title. presented at abbrev. conference title. [Type of Medium]. Available: site/path/file
  See [1].
- *Basic format for reports and handbooks (when available online):*
  J. K. Author. "Title of report," Company. City, State, Country. Rep. no., (optional: vol./issue), Date. [Online] Available: site/path/file
  See [1].
- *Basic format for computer programs and electronic documents (when available online):*
  Legislative body. Number of Congress, Session. (year, month day). *Number of bill or resolution*, *Title*. [Type of medium]. Available: site/path/file
  See [1].
- *Basic format for patents (when available online):*
  Name of the invention, by inventor's name. (year, month day). Patent Number [Type of medium]. Available: site/path/file
  See [1].
- *Basic format for conference proceedings (published):*
  J. K. Author, "Title of paper," in *Abbreviated Name of Conf.*, City of Conf., Abbrev. State (if given), Country, year, pp. *xxxxxx*.
  See [1].
- *Example for papers presented at conferences (unpublished):*
  See [1].
- *Basic format for patents*:
  J. K. Author, "Title of patent," U.S. Patent *x xxx xxx*, Abbrev. Month, day, year.
  See [1].
- *Basic format for theses (M.S.) and dissertations (Ph.D.):*

  1) J. K. Author, "Title of thesis," M.S. thesis, Abbrev.

Dept., Abbrev. Univ., City of Univ., Abbrev. State, year.

2) J. K. Author, "Title of dissertation," Ph.D. dissertation, Abbrev. Dept., Abbrev. Univ., City of Univ., Abbrev. State, year.

See [1], [1].

- *Basic format for the most common types of unpublished references:*

  1) J. K. Author, private communication, Abbrev. Month, year.

  2) J. K. Author, "Title of paper," unpublished.

  3) J. K. Author, "Title of paper," to be published.

  See [**?**]– [1].

- *Basic formats for standards:*

  1) *Title of Standard*, Standard number, date.

  2) *Title of Standard*, Standard number, Corporate author, location, date.

  See [1].

- *Article number in reference examples:*
  See [1].

- *Example when using et al.:*
  See [1].

ACKNOWLEDGMENT

The preferred spelling of the word "acknowledgment" in American English is without an "e" after the "g." Use the singular heading even if you have many acknowledgments. Avoid expressions such as "One of us (S.B.A.) would like to thank . . . ." Instead, write "F. A. Author thanks . . . ." In most cases, sponsor and financial support acknowledgments are placed in the unnumbered footnote on the first page, not here.

REFERENCES

[1] A. Chandio, G. Gui, T. Kumar, I. Ullah, R. Ranjbarzadeh, A. M. Roy, A. Hussain, and Y. Shen, "Precise single-stage detector," 2022.
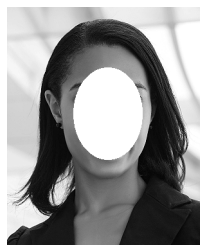
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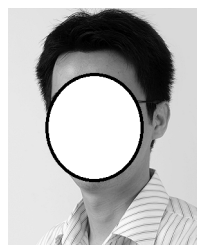
SECOND B. AUTHOR (M'76–SM'81–F'87) and all authors may include biographies. Biographies are often not included in conference-related papers. This author became a Member (M) of IEEE in 1976, a Senior Member (SM) in 1981, and a Fellow (F) in 1987. The first paragraph may contain a place and/or date of birth (list place, then date). Next, the author's educational background is listed. The degrees should be listed with type of degree in what field, which institution, city, state, and country, and year the degree was earned. The author's major field of study should be lower-cased.

The second paragraph uses the pronoun of the person (he or she) and not the author's last name. It lists military and work experience, including summer and fellowship jobs. Job titles are capitalized. The current job must have a location; previous positions may be listed without one. Information concerning previous publications may be included. Try not to list more than three books or published articles. The format for listing publishers of a book within the biography is: title of book (publisher name, year) similar to a reference. Current and previous research interests end the paragraph.

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