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Innovation and Technology Support Office

RESPONSE TO FINDINGS in FORMALITY EXAMINATION REPORT

January 17, 2022

THE DIRECTOR OF PATENTS

Intellectual Property Office of the Philippines
Intellectual Property Center, World Finance Plaza
28 Upper McKinley Rd., McKinley Hill Town Center
Fort Bonifacio, Taguig City, 1634 Philippines

Dear **Sir/Madam**:

I am Jannie Fleur V. Oraño, a Patent Drafter of Innovation and Technology Support Office (ITSO) of Southern Leyte State University.

Sending herewith a **Response to Findings** in the **Formality Examination Report** for *Utility Model Patent Application* with the following information:

APPLICATION TYPE/No:	UTILITY MODEL 2-2020-050880
APPLICANT:	SOUTHERN LEYTE STATE UNIVERSITY
TITLE:	A DETECTION SYSTEM FOR PRESENCE OF FORMALIN IN FISH
DIVISION:	PATENTS/UTILITY MODELS
FILING DATE:	30 JUNE 2020
EXAMINER:	MARIANE R. GADAINGAN

Response to Findings:

1. Unity of Utility Model (Sec. 38, IP Code, as amended)

1.1. N/A.

1.2. Claims have been amended to direct only to an image-based detection system.

1.3. Claims have been amended to direct only to an image-based detection system.

2. Full Support and Enablement/Clarity:

2.1. N/A:

- 45 2.1.1. Claims have been amended to include the structural cooperative relationship of the elements.
- 2.1.2. Claims have been amended omitting the modal phrases “can be” and “could be”.
- 50 2.1.3. Claims have been amended omitting the alternative expression “or” to provide clear understanding as to which statement is essential in achieving the desired result.

3. Formality Defects

55 3.1. N/A

3.1.1. All amendments made in the claims were already reflected in the Detailed Description.

3.1.2. The Technical Description has been amended changing the word “invention” to “innovation”.

60 3.2. The abstract is amended to contain the phrase “Abstract of the Disclosure” as the heading of the page.

3.3. N/A

65 3.3.1. Drawings are revised conforming the standards of the IRR such as the name of the applicant and his signature, or the name and signature of his duly authorized representative should be placed at the lower right hand corner of each sheet of the drawings.

4. Compliance to Requirements:

75 Attached herewith are the amended Abstract, Claims, Specification and Drawings correcting the defects and in compliance with the findings as stated in said Formality Examination Report, along with a mark-up sheet of the application originally submitted.

The applicant has elected Group 1 of the mentioned utility model groups in item 1.2.

80 Anticipating your positive action on this matter.

Respectfully yours,

85 
JANNIE FLEUR V. ORAÑO

Innovation and Technology Support Office
Southern Leyte State University
90 Sogod, Southern Leyte, PH

Fish Eye Image-Based Formalin Detection System

Abstract of the Disclosure

95 The invention discloses a fish eye image-based formalin detection method based on a convolutional neural network. The CNN includes the following steps: configuring fish eye images input shape into desired dimension, applying image preprocessing technique, obtaining required features or parameters by training the network using sets of convolutional (Conv2D) – pooling (MaxPooling2D)
100 layers, representing extracted features into a one-dimensional array, and predicting the class of these features according to type using the final classifier that receives image information from the CNN.

The method can accurately detect the presence of formalin content in fish samples and is mainly used to help the community in choosing fresh fishes
105 without formalin making it safe for consumption. The method also provides a data collection scheme for conducting analysis as to which places around the country and around the world the presence of formalin on fishes is evident for continuous detection and monitoring.

110 **Claims:**

1. A computer-implemented system for detecting formalin in fish eye image, comprising of:

- (a) a camera that captures and loads fish eye digital images;
- 115 (b) a deep learning module that produces trained model base from the patterns extracted from received fish eye digital images.
- (c) a classification module that embeds the trained model into the process of automatically classifying fish eye digital images to desired classes; and
- 120 (d) a database that stores the geo points, time, date and status of the classified images.

2. The computer-implemented system according to claim 1 wherein said deep learning module in (b) comprising the following steps:

- (a) configuring fish eye images input shape into desired dimension;
- 125 (b) applying image preprocessing technique;
- (c) obtaining required features from fish eye images by training the network using sets of convolutional (Conv2D) – pooling (MaxPooling2D) layers;;
- (d) representing extracted features into a one-dimensional array;
- 130 (e) learning patterns of the extracted image feature through dense layers; and
- (f) generating the trained model.

3. The computer-implemented system according to claim 1 wherein said classification module in (c) comprising the following steps:

- 135 (a) configuring fish eye images input shape into desired dimension;
- (b) applying image preprocessing technique;

- (c) obtaining required features from fish eye images by training the network using sets of convolutional (Conv2D) – pooling (MaxPooling2D) layers;,,
- 140 (d) representing extracted features into a one-dimensional array;
- (e) learning patterns of the extracted image feature through dense layers;
- (f) embedding the trained model; and
- 145 (g) predicting the class of these features according to type using the final classifier that receives fish eye image information from the CNN.

Fish Eye Image-Based Formalin Detection System

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SPECIFICATIONS

Technical Field

The systems, methods, application programming interfaces (API), graphical user interfaces (GUI), data pack etc, and computer readable media described herein relate generally to food security and more particularly to detect formalin-laced fishes through fish eye digital images based on a deep convolutional neural network.

Background of the Innovation

Fish is considered a vital source of food for people with excellent nutritional value, providing high quality protein and a wide variety of vitamins and minerals that provides a range of benefits. White-fleshed fish, in particular, is lesser in fat than any other source of animal protein, an oily fish are high in omega-3 fatty acids which is known to be the “good” fats that help sustain cardiac health by playing a role in the regulation of blood clotting.

In 2016, the world total marine catch was 79.3 million tons. Though, fish consumption per country differs tremendously depending on its supplies, demands and traditions. Most of the developing countries have high consumption of fishes due to because it is often the only affordable and relatively easily available source of animal protein. In the case of Bangladesh, Cambodia and Ghana, around 50 per cent of animal protein is supplied by fish. In the Philippines, fish consumption per capita reached 34.1 kg in 2013. In the same year, fish consumption per capita in China amounted to 32.4 kg, 27.6 kg in Indonesia, 31.2 kg in Taiwan and 33.6 kg in Vietnam.

Fish is truly one of the highly consumable food items in the market. However, its quality gets deteriorated quickly. Hence, maintenance and preservation of the freshness and quality of fish remains one of the challenging tasks for fish vendors, retailers, transporters, producers, traders and fish products processor globally. Insufficiency in handling, storing, and transporting infrastructure after harvesting massive amount of fishes often resulted to

addition of chemicals like formalin and sodium benzoate in fresh fish to enhance its self-life significantly compared to existing short term preservation methods such as icing and refrigeration. Without denying the fact, the fresher and higher quality of fish fetches higher prices.

185 Recently, several media vents have reported on formalin preserved fish across Asia. In August 2018, the health department and fisheries bureau of the Philippines was alarmed by the imported galunggong or round scad from China that were allegedly tainted with the toxic chemical formalin. The Goa Congress, last June 2019, also alleged that formalin-laced fish continued to be sold in the
190 coastal state's fish markets, accusing the BJP-led coalition government of not doing enough to rein in the use of the carcinogenic cadaver-preservative in fish sold in the state's markets. An incident also was reported last Jun 26, 2018 wherein 9,600 kg of fish preserved with formalin were seized by the Kerala Food Safety Department from an inter-state consignment, at Aryankavu in
195 Kollam district. It was followed by another report last July 21, 2018 which stated that the Food Safety Department authorities in Kerala seized a whopping 6000 kg of fish laced with the toxic chemical formalin that was set to be distributed in a market in Kannur [9]. The study of Goon et. Al and Uddin et. El have proved and emphasized that formalin practice has been going on unabated in fish
200 markets of Bangladesh due to some dishonest trader's ill intentions. A study also cited some worldwide scenario of formalin-laced fish marketing in Indonesia, Tanzania, Malaysia Sri Lanka, China, Ghana and other countries.

 This prevalent use of formalin on fish preservation is causing a threat to
205 public health. Formalin is a solution made up of 37% formaldehyde by weight. It is one of the most popular and commonly used preservatives for long time preservation of dead animal body in museum, laboratories etc. If used in sufficiently low quantities, it does have legitimate commercial uses like preventing bacterial growth in fish farms. However, applying formalin in fish to
210 increase the shelf life is very harmful to human health. It is considered to be toxic, cancer causing due to its carcinogenic content. Consumption of fish adulterated with formalin can cause health conditions such as abdominal

discomfort, vomiting, and renal injury and worst is the uncontrolled cell growth or cancer in any part of the body like stomach, lung and respiratory system.

215 Determining or quantifying formalin content on fishes can facilitate protection aiming for national security and prevent catastrophic consequences on public health. Currently, food regulatory authority has advised consumers, traders and lab technicians to use the preliminary test kits, developed by Central Institute of Fisheries Technology to detect formalin in foods. Using this
220 kit, all one required to do is to take a paper strip and scrape it on the surface of fish, followed by putting a drop of the solution on the strip and waiting for two minutes to observe any colour change. If the paper turns dark blue, then it means that the fish is contaminated and hazardous for consumption. This process requires a significant amount of money and time that it becomes
225 necessary to develop an automatic detection of formalin on fishes based on machine vision.

 Embracing the advancement of artificial intelligence, Deep Learning approach was applied in detecting formalin-laced fishes. Here, Deep Learning technology is an artificial intelligence (AI) technology that enables a computer
230 to think and learn like a human being, and enables a machine to learn and solve complex nonlinear problems based on artificial neural network theory. Deep learning is a technology that allows a human brain to learn patterns in a lot of data and then learn the machine to imitate the information processing method of distinguishing objects so that the computer can distinguish objects.

235 Deep learning is passed through to combine the more abstract high-rise expression attribute classification of low-level feature formation or feature, to find number representation. Its significant advantage is to take out advanced features, constructs complicated high performance model. In view of these advantages, deep learning are well suited to this type of technology.

240 Convolutional neural networks, i.e. cnn, is one kind of deep learning algorithm that is very popular in working with images. It is advantageous in training that do not need any manual features when model rather algorithm can explore the feature that image is implied automatically.

245 This technological advancement will help the community in choosing fresh fishes without formalin making it safe for consumption. An analysis will also be conducted as to which places around the country and around the world the presence of formalin on fishes is evident for continuous detection and monitoring.

250 **SUMMARY**

The following presents a simplified summary of methods, systems, and computer readable media and so on for establishing classification data, classifying, and detection of Formalin or Formaldehyde through Fish Eye Images to facilitate providing a basic understanding of these items.

255 One object of the present innovation is to provide classifier for a convolutional neural network, a classification method using a classifier for a convolutional neural network, and a training method for a classifier for a convolutional neural network.

260 In one embodiment of the present innovation, a whole view on how the system works from inputting images, training, classifying and generating the analysis is represented.

265 In another embodiment of the present innovation, there is provided a classification method using a classifier of a convolutional neural network, wherein the classifier of the convolutional neural network includes a plurality of feature map layers, and the classification method includes the plurality of features performing forward propagation, and based on the output result And a step of classifying the classification target.

270 In another embodiment of the present innovation, there is provided a training method for a classifier of a convolutional neural network, wherein the classifier of the convolutional neural network includes a plurality of feature diagram layers, and the training method includes the plurality of feature diagrams. Partitioning at least one feature map of at least one feature map layer

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into a plurality of regions, and feeding a training sample having a known marker to the classifier of the convolutional neural network for forward propagation and output A step of obtaining a result, wherein when performing forward propagation, using each template of a plurality of convolution templates
280 respectively corresponding to the plurality of regions, obtaining a response value of a neuron in the corresponding region; and Back propagation is performed based on the difference between the output result and the known sign, and the convolution template is used. And correcting the parameters of the classifier of the convolutional neural network comprises a weight that, until
285 a predetermined condition is satisfied, including a step of repeating the above steps, providing a training method.

The embodiment of the present innovation further provides a computer program for performing the above method.

290

The embodiments of the present innovation further provide a computer program product in the form of at least a computer readable medium for recording a computer program for performing the above method.

295 These and other advantages of the innovation will become more apparent with reference to the following description of the innovation with reference to the drawings.

Through the following detailed description of the drawings, the above
300 objects, other objects, features and advantages of the embodiments of the present innovation will become clearer. The units in the drawings are merely illustrative of the principles of the present innovation. In the drawings, identical or similar technical features or units are indicated by identical or similar symbols.

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Brief Description of the Drawing

Figure 1 is a schematic conceptual framework design of Fish Eye Image-Based Formalin Detection System.

310 Figure 2 is an architectural design of the Convolutional Neural Network for training the Fish Eye Image-Based Formalin Detection System.

Figure 3 is a schematic diagram for testing the Fish Eye Image-Based Formalin Detection System.

Figure 4 is an architectural diagram for data access scheme applied in the
315 study.

Figure 5 is a main user interface of computer-based Fish Eye Image-Based Formalin Detection System

Figure 6 is a graphical user interface of the about section of computer-based Fish Eye Image-Based Formalin Detection System

320 Figure 7 is a graphical user interface of the training section of computer-based Fish Eye Image-Based Formalin Detection System

Figure 8 is a graphical user interface of the formalin detection section of computer-based Fish Eye Image-Based Formalin Detection System

Figure 9 is a main user interface of mobile-based Fish Eye Image-Based
325 Formalin Detection System.

Figure 10 is a graphical user interface of the formalin detection section of mobile-based Fish Eye Image-Based Formalin Detection System

DETAILED DESCRIPTION

In one embodiment of the present innovation, FIG. 1 represents the
330 conceptual framework of the system 100 which includes dataset 102 of fish eye images. The dataset is divided into three subgroups: the training set 104 which will be used to build the CNN model 106, the validation set 108 to validate the generated training model 110 as well as to tune the hyper parameters of the validation results 110. Using the images in the testing set 112, the performance
335 of the trained model 114 is evaluated by computing basic evaluation 116 metrics such as accuracy, precision, recall and specificity. The considered best model will be deployed into the mobile-based 118 and computer-based 120 applications for automated detection of formalin-laced fishes 122. Status of the capture images from mobile phones together with the location points, date and

340 time will be sent to a server 124 containing spatial database. These spatial data will then be used by a remote user 126 to generate GIS maps and analysis.

Convolutional Neural Network is substantially a kind of network structure of depth map, wherein input signal is passed through in network. In mapped layer by layer, constantly decomposed and represented, ultimately formed the
345 multilamellar expression with regard to the presence of formalin in fish eye, its main feature is exactly selection that need not be artificial again and the various features building unique characteristics in the eyes, but automatically learnt by machine, obtain the deep layer with regard to pulmonary carcinoma Represent.

200 is a block diagram of a deep learning module using image patterning
350 based on convolutional neural networks according to an embodiment of the present innovation. As shown in FIG. 2, the deep learning module using the convolutional neural network based image patterning according to the embodiment of the present innovation includes an image input unit 202 for inputting fish eye image. A learning unit based on
355 a convolutional neural network (CNN) that learns an input image received from the image input unit and a pattern image received from the patterning module. The network is composed of a linear stack of 4 sets of convolutional (Conv2D) – pooling (MaxPooling2D) layers before the dense or fully connected layers at the bottom. The Conv2D layers 204, 208, 2012, 2016 have 32, 64, 64, and 128
360 output channels respectively, and a kernel size of 3x3. The activation function for each Conv2D layer is the Rectified Linear Unit (ReLU), followed by a MaxPooling2D layers 206, 210, 214, 220 which reduces the number of parameters in the model by sliding a 2x2 pooling filter across the previous layer and taking the max values in the filter. In between the convolutional and the
365 dense layers, there is a Flatten layer 222 that connects them and converts extracted features to a one-dimensional array.

Final classifier that receives image information from the CNN executing unit and classifies objects of the image information according to classes. This classifier includes series of dense layers responsible for learning extracted
370 features to each desired output. The first two dense layers 224, 226 both have 128 nodes, each activated by a ReLU function. The added Batchnormalization

is for normalizing the matrix and for learning suitable parameters in the network. Also, the Dropout method was introduced to help reduce overfitting by randomly disabling neurons during the learning phase for the model to learn multiple independent representations of the same data. The last dense layer 228 has 2 nodes (number of classes) activated by softmax activation function, which allows the output to be interpreted as probabilities. Thus the model will take the class option, which obtained the highest probability.

Fig. 2 illustrates the overall structure of the convolutional neural network used for training the system. As shown in the figure, input image data of fish eye is 256 X 256 pixel images. The network is composed of a linear stack of 4 sets of convolutional (Conv2D) – pooling (MaxPooling2D) layers before the dense or fully connected layers at the bottom. The Conv2D layers 204, 208, 2012, 2016 have 32, 64, 64, and 128 output channels respectively, and a kernel size of 3x3. The activation function for each Conv2D layer is the Rectified Linear Unit (ReLU), followed by a MaxPooling2D layers 206, 210, 214, 220 which reduces the number of parameters in the model by sliding a 2x2 pooling filter across the previous layer and taking the max values in the filter. In between the convolutional and the dense layers, there is a Flatten layer 222 that connects them and converts extracted features to a one-dimensional array. The first two dense layers 224, 226 both have 128 nodes, each activated by a ReLU function. The added Batchnormalization is for normalizing the matrix and for learning suitable parameters in the network. Also, the Dropout method was introduced to help reduce overfitting by randomly disabling neurons during the learning phase for the model to learn multiple independent representations of the same data. The last dense layer 228 has 2 nodes (number of classes) activated by softmax activation function, which allows the output to be interpreted as probabilities. Thus the model will take the class option, which obtained the highest probability.

Fig. 2, as a whole, demonstrates how a convolutional neural network finds patterns in the images and how it carries the information from one layer to another layer. The activations in the above layers preserve most of the existing details of input image. However, when the layers get more in-depth,

the feature maps show less information on image visual contents and more
405 information on image class.

The convolution layer contains learnable filters or kernels which are applied across the width and height of the input tensor and then performed element-wise products between the entries of the filters and the input at any image positions and summed to obtain the feature maps.

410 The output feature maps of convolution are passed through a rectified linear activation function, which returns the input directly if it is positive or 0 if it receives any negative input. This function allows the model to learn faster and to perform better.

The pooling layer will then perform a downsampling operation, which
415 progressively reduces the spatial size of the representation to decrease the number of subsequent learnable parameters as well as the computation in the network. In this study, max pooling with a filter of 2x2 and with a stride of 2 was applied, which outputs the maximum value in each patch extracted from the input feature maps.

420 The above operations will be repeated until all the convolution-pooling layers have been finished, in which the final feature maps will be transformed into a one-dimensional array of numbers and connected to the fully connected or dense layers. The flattened output is fed to a feed-forward neural network and backpropagation applied to every iteration of training. Over a series of
425 epochs, the model can distinguish between dominating and certain low-level features in images and classify them using softmax activation function wherein each value ranges between 0 and 1, and all values sum up to 1.

As another embodiment of the present innovation, an image learning method using image patterning based on a convolutional neural network uses
430 a deep learning system wherein the CNN learning unit learns an input image received from the image input unit. Figure 3, an example system 300 for imaging, processing and detecting formalin on fishes. The system 300 includes a fish eye image sample 302, an imager or camera 304, a computer system 306, and a database 308 for the trained model and a cloud database for
435 geospatial information where the sample images were taken. It is to be

appreciated that this is but one example arrangement of components for a computer implemented system for grading cacao bean. The System 300 receives digital images from an external camera 304 connected to the computer through bluetooth, wifi, wire, etc, and thus the system would include formalin
440 detection on fish eye images 306 and the databases 308 and a separate cloud database 310.

The fish sample 302 must be placed in an area in a manner that facilitates acquiring digital images from which features can be extracted.

The imager 304 may be a DSLR, compact camera, phone camera or
445 any type of camera with resolution of atleast 12 mega pixel. The image input unit is a device that is connected to this imager 304 and receives a direct input image, receives the input image from the wireless network or the Internet network, receives the image directly through the camera, or receive images through a mobile device or a PC via a wireless network or an Internet network.

450 The images received from the image input unit are analyzed by the fish eye image-based formalin detection system 306. Images are analyzed by taking or embedding the trained model 308 which include the Convolutional Neural Network algorithm. The input information obtained through the image input unit and the patterning module in the deep learning system and the image
455 learning method using the deep learning system according to the embodiment of the present innovation are inputs to the CNN structure correspond to an output unit for outputting the pattern image and the weight information to obtain the output information.

The geo points of the location, data and time where and when the fish
460 eye photos were taken and its corresponding classification are stored in a cloud database for future and relative studies. These data will be utilized to generate maps, analysis and easy-to-understand visualizations that can open up avenues to improve decision-making, policy making, enhance research and in solving day-to-day spatial problems by data analysis through computation and
465 geo-visualization.

Figure 4 shows how information in the cloud server is being utilized by the remote users. System 400 composed of the cloud server 402 which

contains the geoints (latitude and longitude), the date and the time of the samples taken and its corresponding classification. A backup server 404 is also
470 put in place to store copied data from the cloud server to provide access during online transaction. Remote User 406 access these data from any of these servers (cloud server if online and backup server for offline) to generate maps and analysis on the presence of formalin-laced fishes around the nationwide or even worldwide. Remote user may be a researcher, data analyst, or any
475 personnel who needs this data for food security and related studies.

The embodiment of the present innovation further provides a computer program for performing the above methods.

Figure 5 illustrates an example main user interface of the Fish Eye
480 Image-based Formalin Detection System. In the particular embodiments, a main user interface 500 is visible to the user of the system, both the expert and the guest users. The main user interface includes the title of the system 502, a logo 504 and a closing button 512. The main user interface also comprises of three (3) links namely the train model 506, formalin detection 508 and about
485 510. The train model button 506 will open a sub window for the user to add new training sets in retraining the model. The formalin detection button 508, on the other hand, will enable the user to detect formalin-laced fishes automatically. Lastly, the About link 510 will launch a sub window containing the brief description of the technology.

490 Figure 6 illustrates the about section 600. The illustrated embodiment contains a header 602, a logo 604, a developer section 606 describing the authors and programmers of the system and the description section 608 for a brief information and instruction about the system.

Figure 7 illustrates an example of the train model section. By way of
495 example, in the illustrated embodiment, the main portion of the training section is a set of labels 704, 706, 708, 712, 714, 716, 718 which serves as guide on what information are asked from the user. The section also consist of set of input fields 720, 722, 724, 728, 730 and 732 accepting critical inputs necessary for training the system namely the number of epoch, batch size, seed start,

500 learning rate, image dimension and number of images for training. In one embodiment, the user needs to load the directory of the new images samples by clicking Load Image File Directory button 736. When the user triggers the Load Image File Directory button 736, a folder dialog is prompted in order to locate the training dataset of the acquired images for training phase and the file
505 path is displayed into the text field 734. The user starts or cancels the training using the start training button 738 or cancel training button 742 respectively. After the start training button is triggered, the training process begins following the patterning module used in a deep learning system using convolutional neural network-based image patterning according to an
510 embodiment of the present innovation 300. The current progress or the status of the training is being monitored through a multiline textfield 740. This is for keeping track the on-going training and evaluating the best model achieved of the CNN.

Figure 8 illustrates an example of the formalin detection section 800. In
515 the illustrated embodiment, the user captures and loads an image into a picture box 804 using the Load Image button 806. Once the image is loaded, its file path will be displayed in label 812. This image is then resized to 256 x 256 and goes into series of filters of the Convolutional Neural Network extracting low level to high level features. The extracted features will then be the input of the
520 backpropagation algorithm (*the pattern classifying unit*) in classifying whether the inputted fish eye image is formalin positive or negative. A tabular form 816 displays the prediction outcomes of the model on every class and emphasized that the class which obtained the highest probability value, is the final classification of model on the uploaded or selected image displayed in an output
525 box 818.

Another embodiment of the present innovation provides not just a computer program for performing the above methods but also a mobile-based program for easy and comfortable way of accessing and using the application.

530 The mobile application is only capable of classifying the fish eye image. Training function is not available for it requires large memory size, faster CPU and necessary installations that only computer-based system can handle.

Figure 9 illustrates the main interface 900 of the mobile application. The main user interface, most likely the same with the computer-based application, includes the title of the system 902, a logo 904, a gallery button 906, camera button 908 and about button 910.

The gallery button 906 will open a sub window for the user to select saved images from the phone gallery. Once an image has been selected, it will be loaded to a picture box in a separate window (see Figure 10).

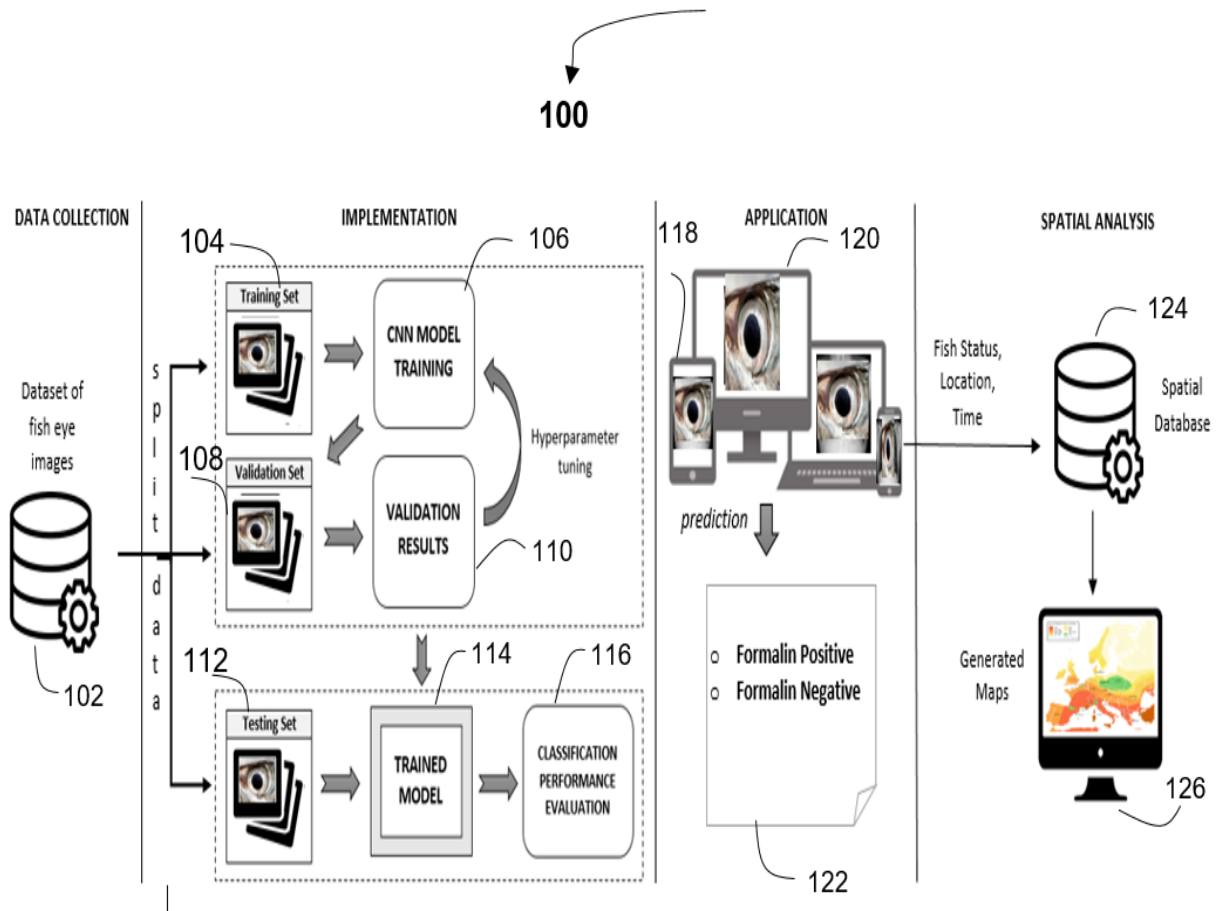
To capture fish eye samples to be classified, camera button 908 should be pressed activating the camera of the device. The captured image will then be loaded to a picture box in a separate window (see Figure 10).

The About button 910 is for detailed description about the application and its developer.

The classification of the loaded fish eye images is illustrated in Figure 10. Detection of formalin-laced fishes will automatically proceed following the steps of the embodiment 300 once the target image is loaded in the picture box 1004. The prediction outcomes of the model on every class is displayed in a table 1010 and the class which obtained the highest probability value and considered the final classification of model is displayed in the output box 1008. The Back button 1012 is added to go back to the main user interface of the application.

The embodiments and the accompanying drawings described in the present specification are merely illustrative of some of the technical ideas included in the present innovation. Accordingly, the embodiments disclosed herein are for the purpose of describing rather than limiting the technical spirit of the present innovation, and it is apparent that the scope of the technical idea of the present innovation is not limited by these embodiments. It will be understood by those of ordinary skill in the art that various changes in form and details may be made therein without departing from the spirit and scope of the innovation as defined by the appended claims.

FIGURE 1



565


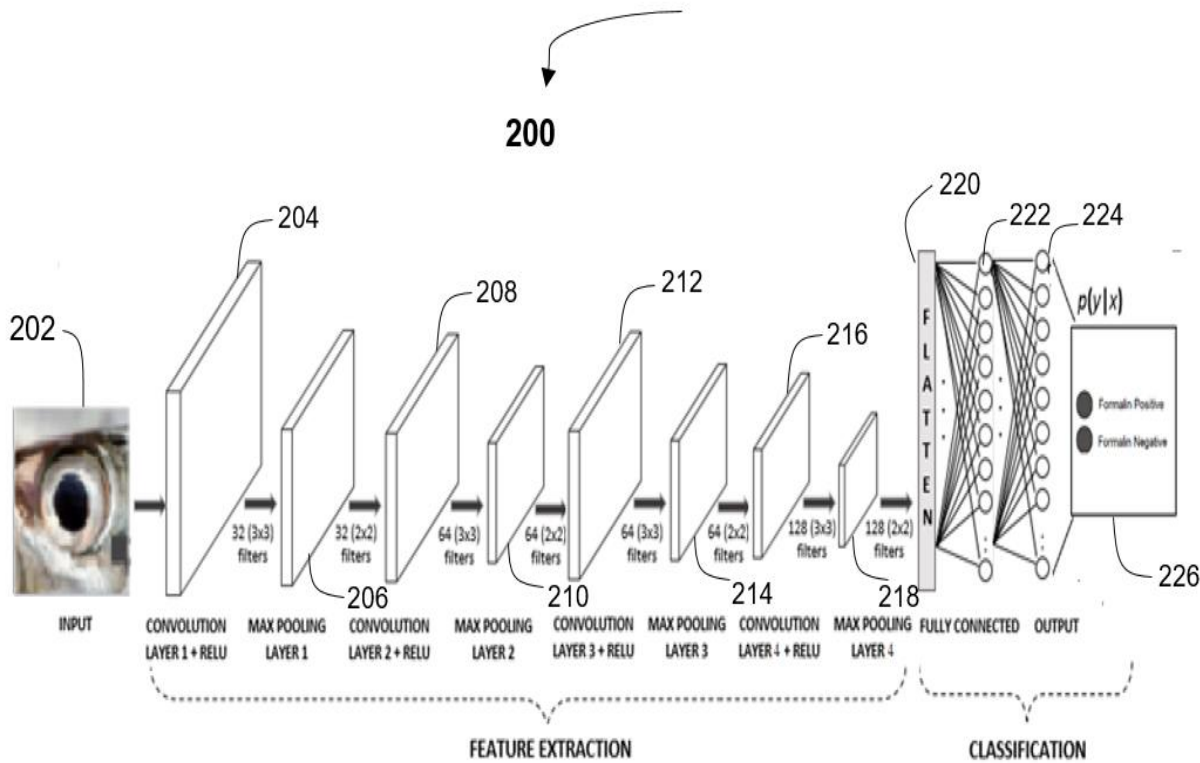

JANNIE FLEUR V. ORAÑO
 Maker

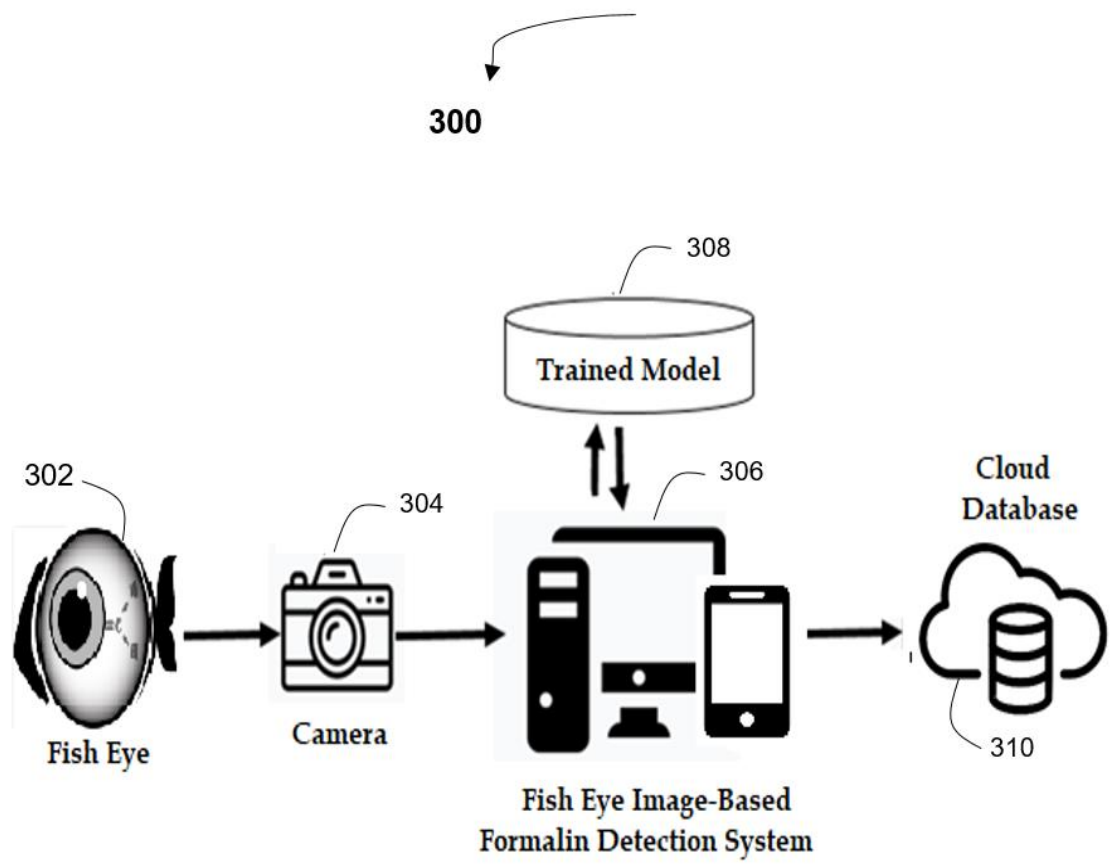
FIGURE 2

570




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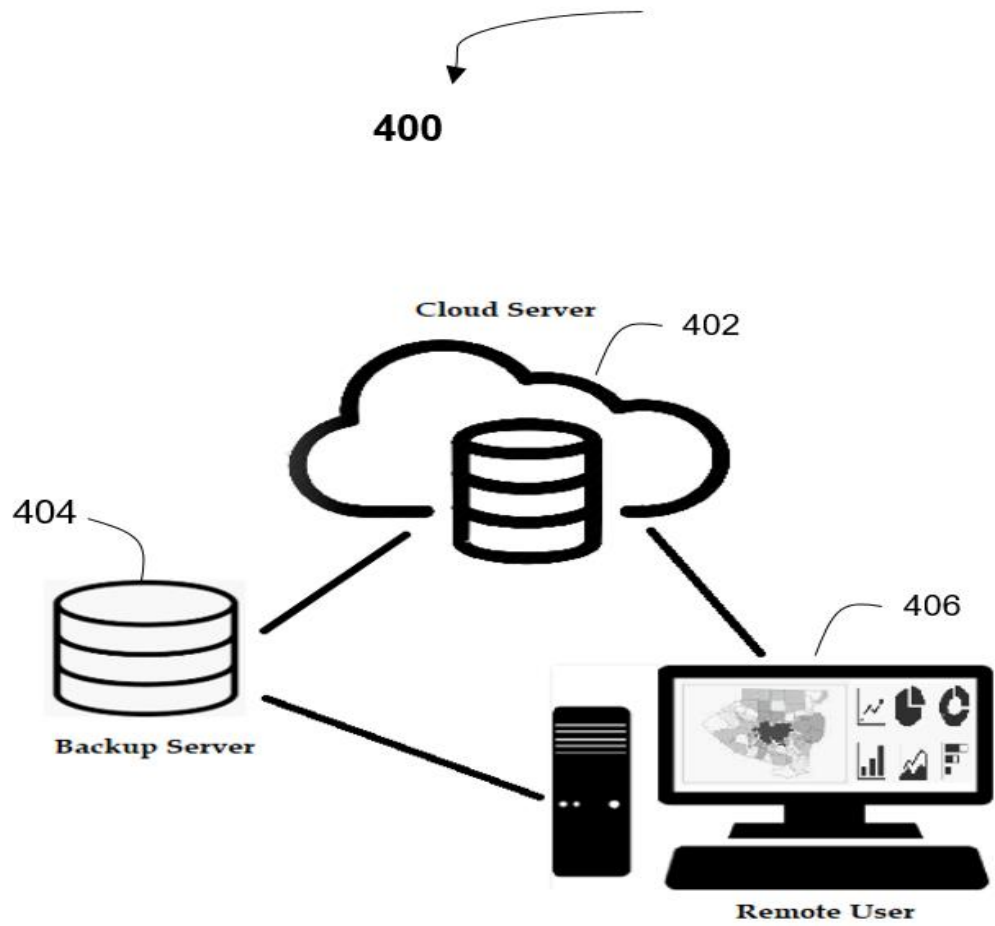
FIGURE 3




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Maker

FIGURE 4

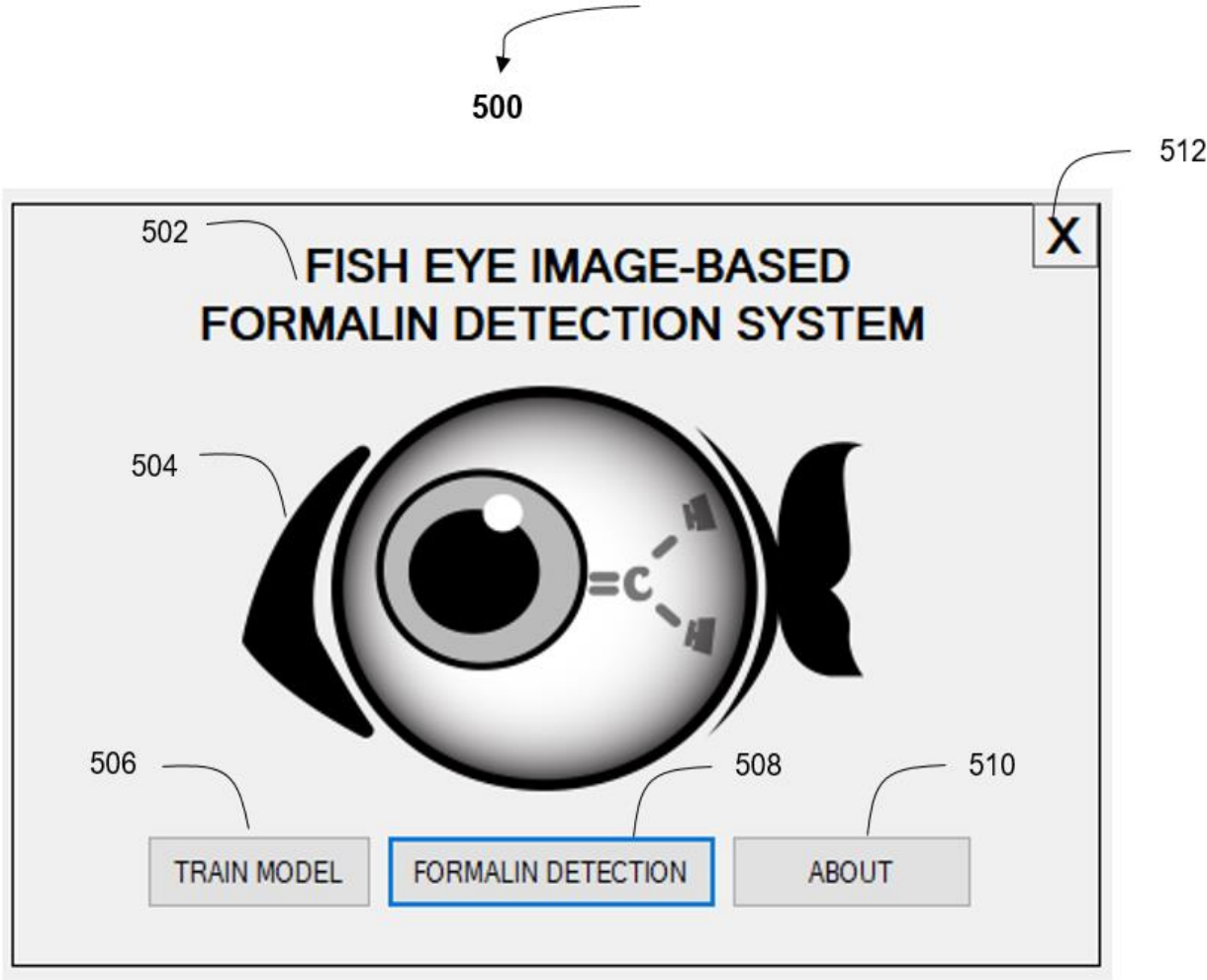
580




JANNIE FLEUR V. ORAÑO
Maker

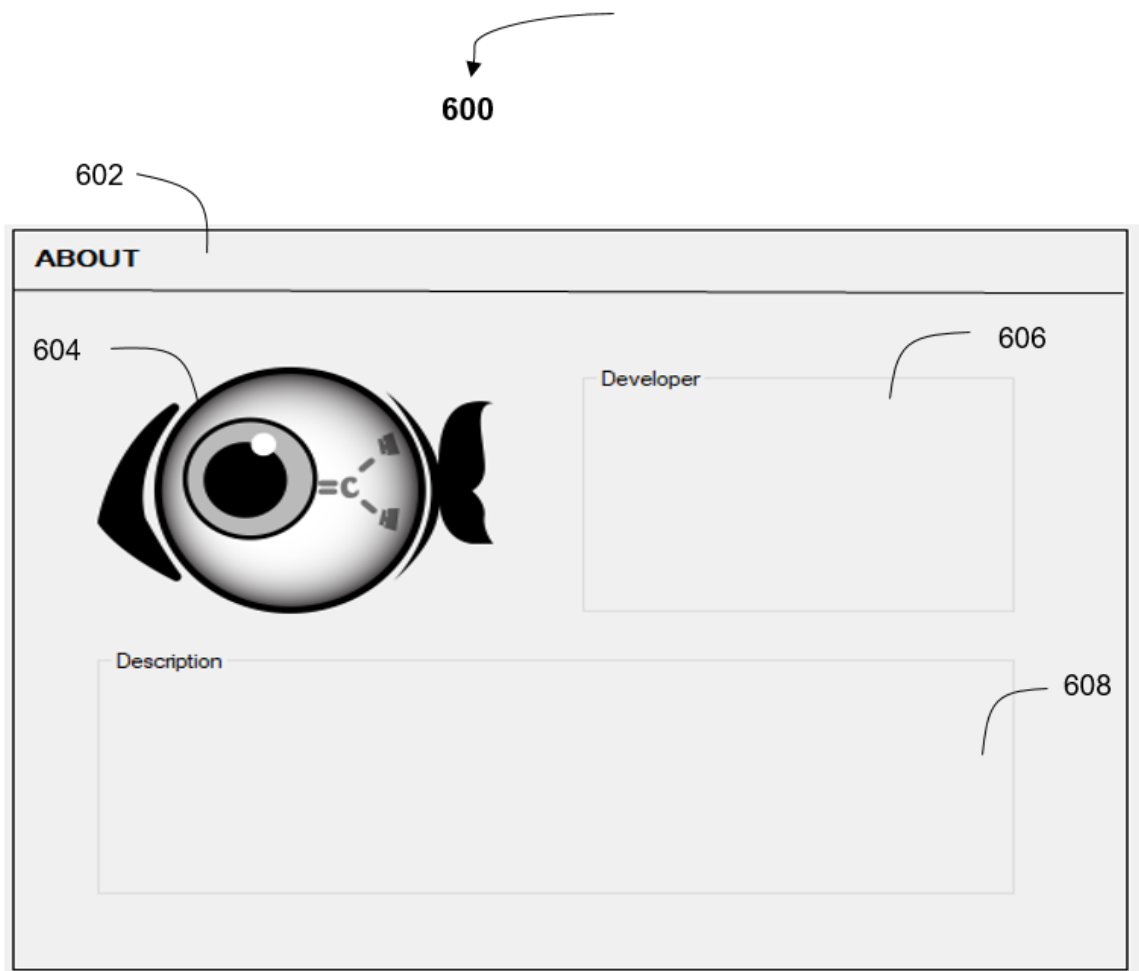
FIGURE 5

585




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Maker

FIGURE 6



590


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Maker

FIGURE 7

700

702

704

No. of Epochs:

720

706

Batch Size:

722

708

Random Seed Start:

724

710

Directory:

712

714

Initial Learning Rate:

728

716

Image Dimension:

730

718

Number of Trained Images:

732

734

Load Image File Directory

736

738

START TRAINING

742

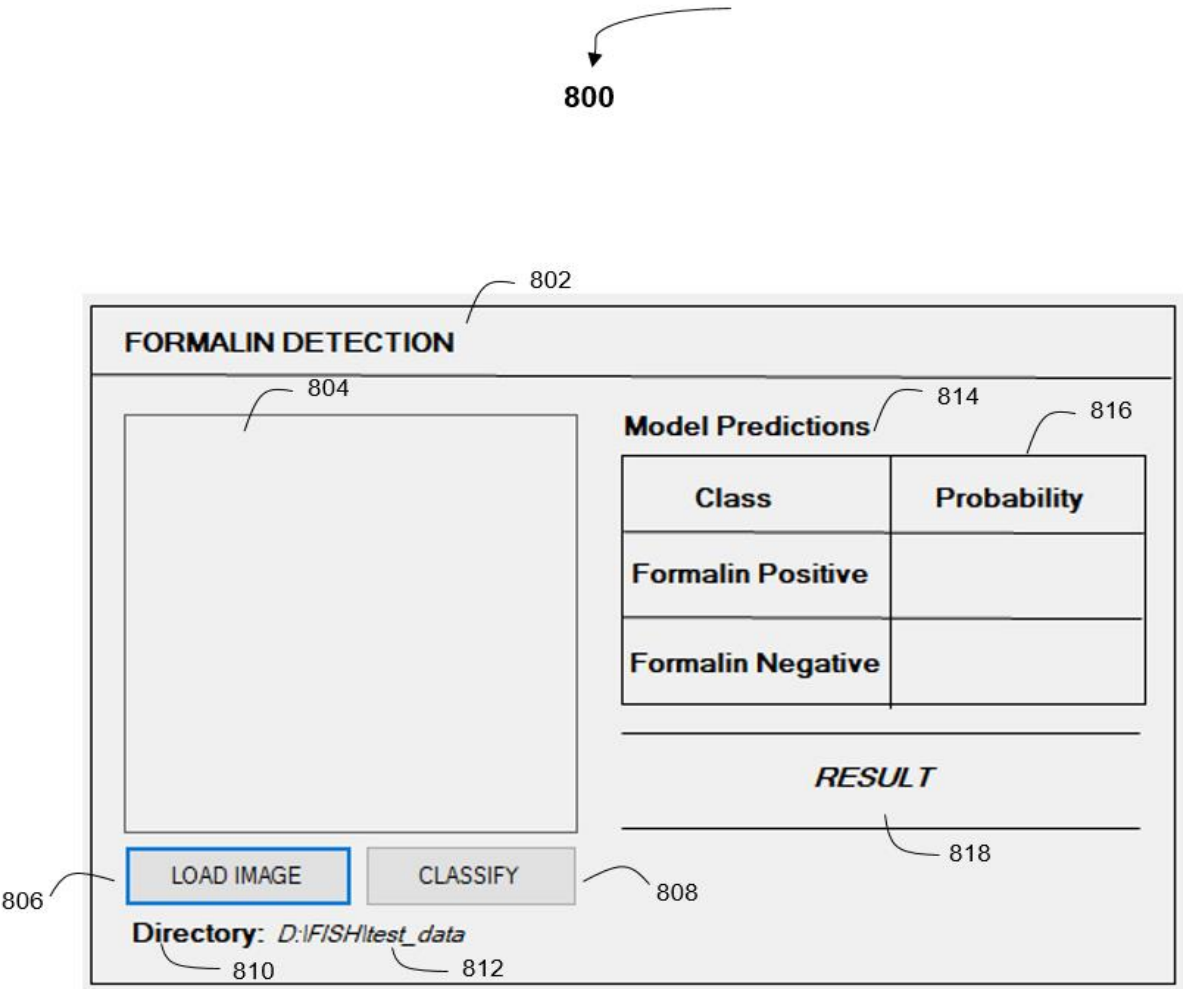
CANCEL TRAINING

740


JANNIE FLEUR V. ORAÑO
Maker

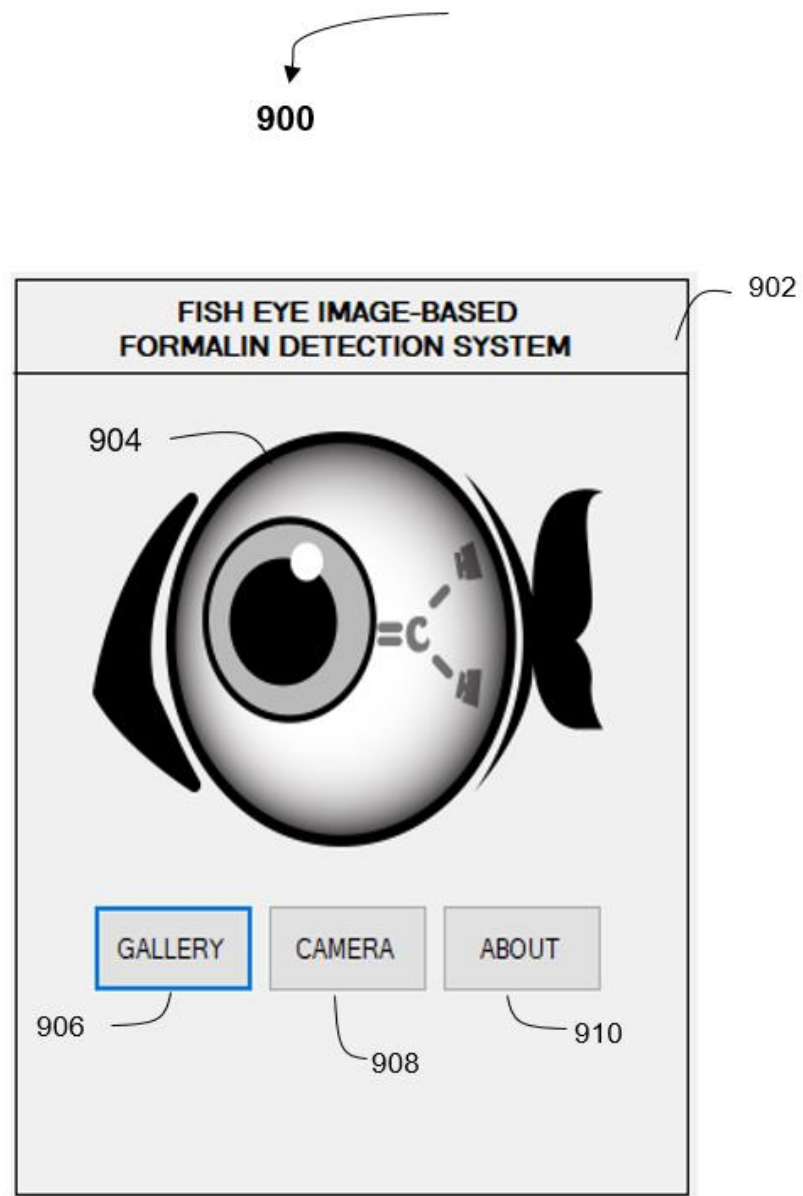
FIGURE 8

600




JANNIE FLEUR V. ORAÑO
Maker

FIGURE 9

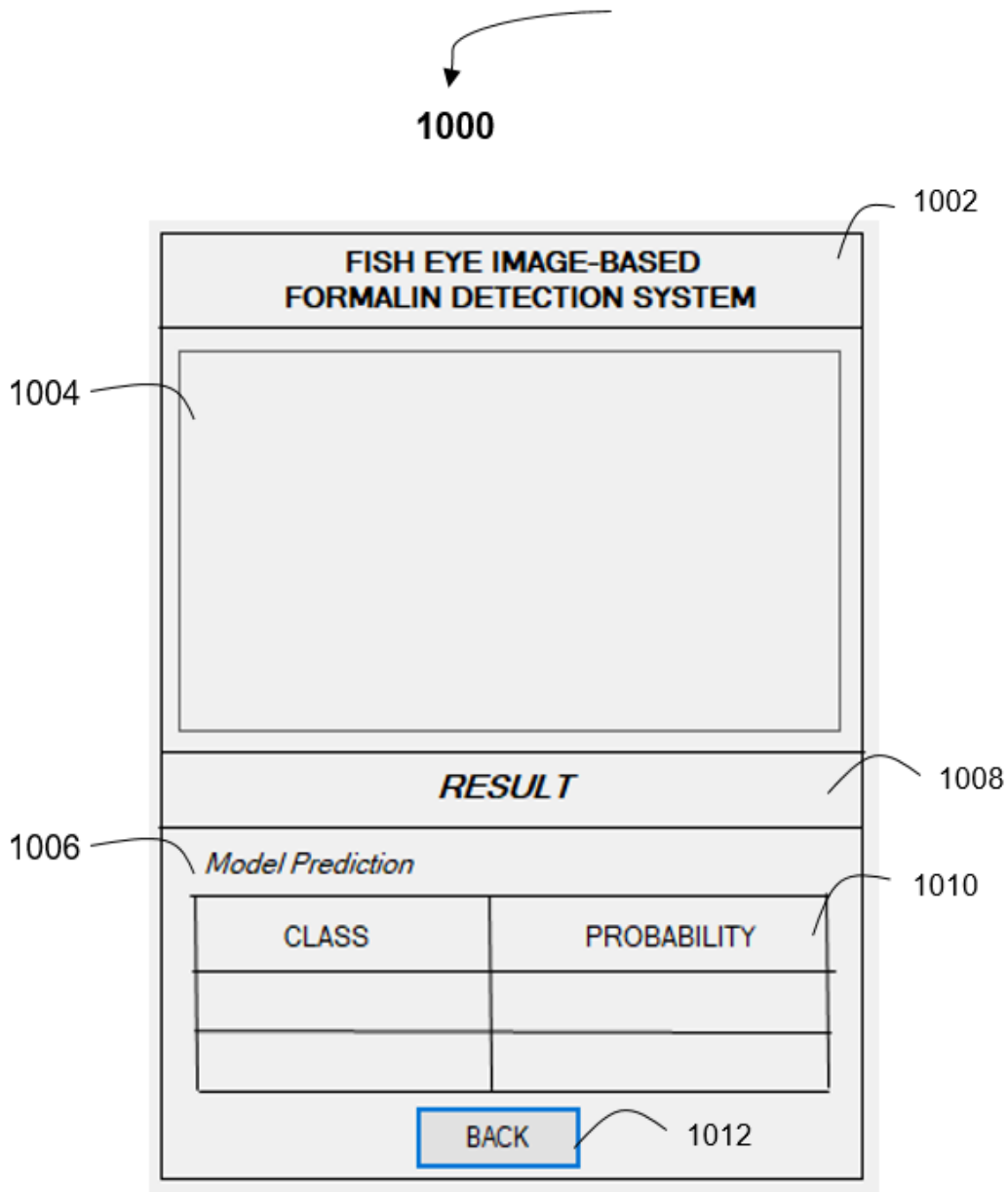


605


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FIGURE 10

610




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Fish Eye Image-Based Formalin Detection System

615 **Abstract of the Disclosure**

The invention discloses a fish eye image-based formalin detection method based on a convolutional neural network. The CNN includes the following steps: configuring fish eye images input shape into desired dimension, applying image
620 preprocessing technique, obtaining required features or parameters by training the network using sets of convolutional (Conv2D) – pooling (MaxPooling2D) layers, representing extracted features into a one-dimensional array, and predicting the class of these features according to type using the final classifier that receives image information from the CNN.

625 The method can accurately detect the presence of formalin content in fish samples and is mainly used to help the community in choosing fresh fishes without formalin making it safe for consumption. The method also provides a data collection scheme for conducting analysis as to which places around the country and around the world the presence of formalin on fishes is evident for
630 continuous detection and monitoring.

CLAIMS:

1. A computer-implemented system for detecting formalin in fish eye image-
~~based formalin detection system,~~ comprising of:

635

_____ (a) a camera ~~or imager for capturing and loading~~that
captures and loads fish eye digital images;

640

(b) ~~a trainable fish eye~~deep learning module that produces trained
model base from the patterns extracted from received fish eye digital
images.

~~image-based formalin detection system that receive a fish eye~~
~~images and that can be taught to relate the digital image information~~
~~to a specific classification;~~

645

(c) ~~a classification~~ algorithm module that embeds the trained model
into the process of automatically ~~classifying~~ ies the extracted features
~~of fish eye~~ digital images to desired classes; ~~d~~ and

(d) a database ~~for that storing~~ stores the geo points, time, date and
status of the ~~captured and~~ classified images.

650

2. The computer-implemented system according to ~~of~~ claim 1, wherein ~~the fish~~
~~eye image-based formalin detection system includes a computer component~~
~~for performing a deep learning approach that relates the digital fish eye image~~
~~to a presence of formalin classification.~~ said deep learning module in (b)
comprising the following steps:

655

_____ (a) configuring fish eye images input shape into desired dimension;

_____ (b) applying image preprocessing technique;

(c) obtaining required features from fish eye images by training the
network using sets of convolutional (Conv2D) – pooling
(MaxPooling2D) layers;.

660

_____ (d) representing extracted features into a one-dimensional array;

(e) learning patterns of the extracted image feature through dense
layers; and

(f) generating the trained model.

3. The computer-implemented system according to claim 1 wherein said classification module in (c) comprising the following steps: The system of claim 1, where the fish eye image-based formalin detection system includes a mobile-based component for performing classification whether inputted fish eye image is formalin positive or negative.

(a) configuring fish eye images input shape into desired dimension;

(b) applying image preprocessing technique;

(c) obtaining required features from fish eye images by training the network using sets of convolutional (Conv2D) – pooling (MaxPooling2D) layers;.

(d) representing extracted features into a one-dimensional array;

(e) learning patterns of the extracted image feature through dense layers;

(f) embedding the trained model; and

(g) predicting the class of these features according to type using the final classifier that receives fish eye image information from the CNN.

4. The System of claim 1, where the trainable fish eye image-based formalin detector includes a computer component for performing a Convolutional Neural Network (CNN) comprising the following steps:

(a) configuring fish eye images input shape into desired dimension

(b) applying image preprocessing technique

(c) obtaining required features or parameters from fish eye images by training the network using sets of convolutional (Conv2D) – pooling (MaxPooling2D) layers,

(d) representing extracted features into a one-dimensional array

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~~(e) predicting the class of these features according to type using the final classifier that receives fish eye image information from the GNN.~~

~~5. The System of claim 1, where the data are stored in a cloud server and a backup server.~~

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Fish Eye Image-Based Formalin Detection System

700

SPECIFICATIONS

Technical Field

705 The systems, methods, application programming interfaces (API), graphical user interfaces (GUI), data pack etc, and computer readable media described herein relate generally to food security and more particularly to detect formalin-laced fishes through fish eye digital images based on a deep convolutional neural network.

Background of the ~~Invention~~Innovation

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Fish is considered a vital source of food for people with excellent nutritional value, providing high quality protein and a wide variety of vitamins and minerals that provides a range of benefits. White-fleshed fish, in particular, is lesser in fat than any other source of animal protein, an oily fish are high in
715 omega-3 fatty acids which is known to be the “good” fats that help sustain cardiac health by playing a role in the regulation of blood clotting.

In 2016, the world total marine catch was 79.3 million tons. Though, fish consumption per country differs tremendously depending on its supplies, demands and traditions. Most of the developing countries have high
720 consumption of fishes due to because it is often the only affordable and relatively easily available source of animal protein. In the case of Bangladesh, Cambodia and Ghana, around 50 per cent of animal protein is supplied by fish. In the Philippines, fish consumption per capita reached 34.1 kg in 2013. In the same year, fish consumption per capita in China amounted to 32.4 kg, 27.6 kg
725 in Indonesia, 31.2 kg in Taiwan and 33.6 kg in Vietnam.

Fish is truly one of the highly consumable food items in the market. However, its quality gets deteriorated quickly. Hence, maintenance and preservation of the freshness and quality of fish remains one of the challenging tasks for fish vendors, retailers, transporters, producers, traders and fish
730 products processor globally. Insufficiency in handling, storing, and transporting

infrastructure after harvesting massive amount of fishes often resulted to addition of chemicals like formalin and sodium benzoate in fresh fish to enhance its self-life significantly compared to existing short term preservation methods such as icing and refrigeration. Without denying the fact, the fresher and higher
735 quality of fish fetches higher prices.

Recently, several media vents have reported on formalin preserved fish across Asia. In August 2018, the health department and fisheries bureau of the Philippines was alarmed by the imported galunggong or round scad from China that were allegedly tainted with the toxic chemical formalin. The Goa Congress,
740 last June 2019, also alleged that formalin-laced fish continued to be sold in the coastal state's fish markets, accusing the BJP-led coalition government of not doing enough to rein in the use of the carcinogenic cadaver-preservative in fish sold in the state's markets. An incident also was reported last Jun 26, 2018 wherein 9,600 kg of fish preserved with formalin were seized by the Kerala
745 Food Safety Department from an inter-state consignment, at Aryankavu in Kollam district. It was followed by another report last July 21, 2018 which stated that the Food Safety Department authorities in Kerala seized a whopping 6000 kg of fish laced with the toxic chemical formalin that was set to be distributed in a market in Kannur [9]. The study of Goon et. Al and Uddin et. El have proved
750 and emphasized that formalin practice has been going on unabated in fish markets of Bangladesh due to some dishonest trader's ill intentions. A study also cited some worldwide scenario of formalin-laced fish marketing in Indonesia, Tanzania, Malaysia Sri Lanka, China, Ghana and other countries.

755 This prevalent use of formalin on fish preservation is causing a threat to public health. Formalin is a solution made up of 37% formaldehyde by weight. It is one of the most popular and commonly used preservatives for long time preservation of dead animal body in museum, laboratories etc. If used in sufficiently low quantities, it does have legitimate commercial uses like
760 preventing bacterial growth in fish farms. However, applying formalin in fish to increase the shelf life is very harmful to human health. It is considered to be toxic, cancer causing due to its carcinogenic content. Consumption of fish adulterated with formalin can cause health conditions such as abdominal

discomfort, vomiting, and renal injury and worst is the uncontrolled cell growth
765 or cancer in any part of the body like stomach, lung and respiratory system.

Determining or quantifying formalin content on fishes can facilitate
protection aiming for national security and prevent catastrophic consequences
on public health. Currently, food regulatory authority has advised consumers,
traders and lab technicians to use the preliminary test kits, developed by
770 Central Institute of Fisheries Technology to detect formalin in foods. Using this
kit, all one required to do is to take a paper strip and scrape it on the surface of
fish, followed by putting a drop of the solution on the strip and waiting for two
minutes to observe any colour change. If the paper turns dark blue, then it
means that the fish is contaminated and hazardous for consumption. This
775 process requires a significant amount of money and time that it becomes
necessary to develop an automatic detection of formalin on fishes based on
machine vision.

Embracing the advancement of artificial intelligence, Deep Learning
approach was applied in detecting formalin-laced fishes. Here, Deep Learning
780 technology is an artificial intelligence (AI) technology that enables a computer
to think and learn like a human being, and enables a machine to learn and solve
complex nonlinear problems based on artificial neural network theory. Deep
learning is a technology that allows a human brain to learn patterns in a lot of
data and then learn the machine to imitate the information processing method
785 of distinguishing objects so that the computer can distinguish objects.

Deep learning is passed through to combine the more abstract high-rise
expression attribute classification of low-level feature formation or feature, to
find number representation. Its significant advantage is to take out advanced
features, constructs complicated high performance model. In view of these
790 advantages, deep learning are well suited to this type of technology.

Convolutional neural networks, i.e. cnn, is one kind of deep learning
algorithm that is very popular in working with images. It is advantageous in
training that do not need any manual features when model rather algorithm can
explore the feature that image is implied automatically.

795 This technological advancement will help the community in choosing fresh fishes without formalin making it safe for consumption. An analysis will also be conducted as to which places around the country and around the world the presence of formalin on fishes is evident for continuous detection and monitoring.

800

SUMMARY

 The following presents a simplified summary of methods, systems, and computer readable media and so on for establishing classification data, classifying, and detection of Formalin or Formaldehyde through Fish Eye
805 Images to facilitate providing a basic understanding of these items.

| One object of the present inventioninnovation is to provide classifier for a convolutional neural network, a classification method using a classifier for a convolutional neural network, and a training method for a classifier for a convolutional neural network.

810

| In one embodiment of the present inventioninnovation, a whole view on how the system works from inputting images, training, classifying and generating the analysis is represented.

|815 In another embodiment of the present inventioninnovation, there is provided a classification method using a classifier of a convolutional neural network, wherein the classifier of the convolutional neural network includes a plurality of feature map layers, and the classification method includes the plurality of features performing forward propagation, and based on the output
820 result And a step of classifying the classification target.

| In another embodiment of the present inventioninnovation, there is provided a training method for a classifier of a convolutional neural network, wherein the classifier of the convolutional neural network includes a plurality of
825 feature diagram layers, and the training method includes the plurality of feature diagrams. Partitioning at least one feature map of at least one feature map layer

into a plurality of regions, and feeding a training sample having a known marker to the classifier of the convolutional neural network for forward propagation and output A step of obtaining a result, wherein when performing forward
830 propagation, using each template of a plurality of convolution templates respectively corresponding to the plurality of regions, obtaining a response value of a neuron in the corresponding region; and Back propagation is performed based on the difference between the output result and the known sign, and the convolution template is used. And correcting the parameters of
835 the classifier of the convolutional neural network comprises a weight that, until a predetermined condition is satisfied, including a step of repeating the above steps, providing a training method.

| The embodiment of the present inventioninnovation further provides a
840 computer program for performing the above method.

| The embodiments of the present inventioninnovation further provide a
computer program product in the form of at least a computer readable medium
for recording a computer program for performing the above method.

845

| These and other advantages of the inventioninnovation will become
more apparent with reference to the following description of the
| inventioninnovation with reference to the drawings.

850 Through the following detailed description of the drawings, the above objects, other objects, features and advantages of the embodiments of the present inventioninnovation will become clearer. The units in the drawings are merely illustrative of the principles of the present inventioninnovation. In the drawings, identical or similar technical features or units are indicated by
855 identical or similar symbols.

Brief Description of the Drawing

Figure 1 is a schematic conceptual framework design of Fish Eye Image-
860 Based Formalin Detection System.

Figure 2 is an architectural design of the Convolutional Neural Network for training the Fish Eye Image-Based Formalin Detection System.

Figure 3 is a schematic diagram for testing the Fish Eye Image-Based Formalin Detection System.

865 Figure 4 is an architectural diagram for data access scheme applied in the study.

Figure 5 is a main user interface of computer-based Fish Eye Image-Based Formalin Detection System

870 Figure 6 is a graphical user interface of the about section of computer-based Fish Eye Image-Based Formalin Detection System

Figure 7 is a graphical user interface of the training section of computer-based Fish Eye Image-Based Formalin Detection System

Figure 8 is a graphical user interface of the formalin detection section of computer-based Fish Eye Image-Based Formalin Detection System

875 Figure 9 is a main user interface of mobile-based Fish Eye Image-Based Formalin Detection System.

Figure 10 is a graphical user interface of the formalin detection section of mobile-based Fish Eye Image-Based Formalin Detection System

880

DETAILED DESCRIPTION

885 In one embodiment of the present ~~invention~~innovation, FIG. 1 represents the conceptual framework of the system 100 which includes dataset 102 of fish eye images. The dataset is divided into three subgroups: the training set 104 which will be used to build the CNN model 106, the validation set 108 to validate the generated training model 110 as well as to tune the hyper parameters of

the validation results 110. Using the images in the testing set 112, the
 890 performance of the trained model 114 is evaluated by computing basic
 evaluation 116 metrics such as accuracy, precision, recall and specificity. The
 considered best model will be deployed into the mobile-based 118 and
 computer-based 120 applications for automated detection of formalin-laced
 fishes 122. Status of the capture images from mobile phones together with the
 895 location points, date and time will be sent to a server 124 containing spatial
 database. These spatial data will then be used by a remote user 126 to
 generate GIS maps and analysis.

Convolutional Neural ~~net~~Network is substantially a kind of network
 structure of depth map, wherein input signal is passed through in network. In
 900 mapped layer by layer, constantly decomposed and represented, ultimately
 formed the multilamellar expression with regard to the presence of formalin in
 fish eye, its main feature is exactly s~~S~~selection that need not be artificial again
 and the various features building unique characteristics in the eyes, but
 automatically learnt by machine, obtain the deep layer with regard to pulmonary
 905 carcinoma Represent.

200 is a block diagram of a deep learning ~~system~~system-module using image
 patterning based on convolutional neural networks according to an
 embodiment of the present ~~invention~~innovation. As shown in FIG. 2, the deep
 learning ~~system~~system-module using the convolutional neural network based image
 910 patterning according to the embodiment of the present ~~invention~~innovation
 includes an image input unit 202 for inputting fish eye image. A ~~CNN~~-learning
 unit based on a convolutional neural network (CNN) that learns an input image
 received from the image input unit and a pattern image received from the
 patterning module. The network is composed of a linear stack of 4 sets of
 915 convolutional (Conv2D) – pooling (MaxPooling2D) layers before the dense or
 fully connected layers at the bottom. The Conv2D layers 204, 208, 2012, 2016
 have 32, 64, 64, and 128 output channels respectively, and a kernel size of 3x3.
 The activation function for each Conv2D layer is the Rectified Linear Unit
 (ReLU), followed by a MaxPooling2D layers 206, 210, 214, 220 which reduces
 920 the number of parameters in the model by sliding a 2x2 pooling filter across the
 previous layer and taking the max values in the filter. In between the

convolutional and the dense layers, there is a Flatten layer 222 that connects them and converts extracted features to a one-dimensional array.

Final classifier that receives image information from the CNN executing unit and classifies objects of the image information according to classes. This classifier includes series of dense layers responsible for learning extracted features to each desired output. The first two dense layers 224, 226 both have 128 nodes, each activated by a ReLU function. The added Batchnormalization is for normalizing the matrix and for learning suitable parameters in the network. Also, the Dropout method was introduced to help reduce overfitting by randomly disabling neurons during the learning phase for the model to learn multiple independent representations of the same data. The last dense layer 228 has 2 nodes (number of classes) activated by softmax activation function, which allows the output to be interpreted as probabilities. Thus the model will take the class option, which obtained the highest probability.

Fig. 2 illustrates the overall structure of the convolutional neural network 200 used for training the system. As shown in the figure, input image data of fish eye is 256 X 256 pixel images. The network is composed of a linear stack of 4 sets of convolutional (Conv2D) – pooling (MaxPooling2D) layers before the dense or fully connected layers at the bottom. The Conv2D layers 204, 208, 2012, 2016 have 32, 64, 64, and 128 output channels respectively, and a kernel size of 3x3. The activation function for each Conv2D layer is the Rectified Linear Unit (ReLU), followed by a MaxPooling2D layers 206, 210, 214, 220 which reduces the number of parameters in the model by sliding a 2x2 pooling filter across the previous layer and taking the max values in the filter. In between the convolutional and the dense layers, there is a Flatten layer 222 that connects them and converts extracted features to a one-dimensional array. The first two dense layers 224, 226 both have 128 nodes, each activated by a ReLU function. The added Batchnormalization is for normalizing the matrix and for learning suitable parameters in the network. Also, the Dropout method was introduced to help reduce overfitting by randomly disabling neurons during the learning phase for the model to learn multiple independent representations of the same data. The last dense layer 228 has 2 nodes (number of classes) activated by softmax activation function, which allows the output to be

955 interpreted as probabilities. Thus the model will take the class option, which obtained the highest probability.

Fig. 2, as a whole, demonstrates how a convolutional neural network finds patterns in the images and how it carries the information from one layer to another layer. The activations in the above layers preserve most of the
960 existing details of input image. However, when the layers get more in-depth, the feature maps show less information on image visual contents and more information on image class.

The convolution layer contains learnable filters or kernels which are applied across the width and height of the input tensor and then performed
965 element-wise products between the entries of the filters and the input at any image positions and summed to obtain the feature maps.

The output feature maps of convolution are passed through a rectified linear activation function, which returns the input directly if it is positive or 0 if it receives any negative input. This function allows the model to learn faster and
970 to perform better.

The pooling layer will then perform a downsampling operation, which progressively reduces the spatial size of the representation to decrease the number of subsequent learnable parameters as well as the computation in the network. In this study, max pooling with a filter of 2x2 and with a stride of 2 was
975 applied, which outputs the maximum value in each patch extracted from the input feature maps.

The above operations will be repeated until all the convolution-pooling layers have been finished, in which the final feature maps will be transformed into a one-dimensional array of numbers and connected to the fully connected
980 or dense layers. The flattened output is fed to a feed-forward neural network and backpropagation applied to every iteration of training. Over a series of epochs, the model can distinguish between dominating and certain low-level features in images and classify them using softmax activation function wherein each value ranges between 0 and 1, and all values sum up to 1.

985 As another embodiment of the present ~~invention~~innovation, an image learning method using image patterning based on a convolutional neural network uses a deep learning system wherein the CNN learning unit learns an input image received from the image input unit. Figure 3, an example system 300 for imaging, processing and detecting formalin on
990 fishes. The system 300 includes a fish eye image sample 302, an imager or camera 304, a computer system 306, and a database 308 for the trained model and a cloud database for geospatial information where the sample images were taken. It is to be appreciated that this is but one example arrangement of components for a computer implemented system for grading cacao bean. The
995 System 300 ~~may~~receives digital images from an external camera 304 connected to the computer through bluetooth, wifi, wire, etc, and thus the system would include formalin detection on fish eye images 306 and the databases 308 and a separate cloud database 310.

The fish sample 302 must be placed in an area in a manner that
1000 facilitates acquiring digital images from which features can be extracted.

The imager 304 may be a DSLR, compact camera, phone camera or any type of camera with resolution of atleast 12 mega pixel. The image input unit is a device that is connected to this imager 304 and receives a direct input image, receives the input image from the wireless network or the Internet
1005 network, receives the image directly through the camera, or receive images through a mobile device or a PC via a wireless network or an Internet network.

The images received from the image input unit are analyzed by the fish eye image-based formalin detection system 306. Images are analyzed by taking or embedding the trained model 308 which include the Convolutional
1010 Neural Network algorithm. The input information obtained through the image input unit and the patterning module in the deep learning system and the image learning method using the deep learning system according to the embodiment
of the present ~~invention~~innovation are inputs ~~to-to the input unit of~~ the CNN structure correspond to an output unit for outputting the pattern image and the
1015 weight information to obtain the output information.

The geo points of the location, data and time where and when the fish eye photos were taken and its corresponding classification are stored in a cloud database for future and relative studies. These data will be utilized to generate maps, analysis and easy-to-understand visualizations that can open up avenues to improve decision-making, policy making, enhance research and in solving day-to-day spatial problems by data analysis through computation and geo-visualization.

Figure 4 shows how information in the cloud server is being utilized by the remote users. System 400 composed of the cloud server 402 which contains the geopoints (latitude and longitude), the date and the time of the samples taken and its corresponding classification. A backup server 404 is also put in place to store copied data from the cloud server to provide access during online transaction. Remote User 406 access these data from any of these servers (cloud server if online and backup server for offline) to generate maps and analysis on the presence of formalin-laced fishes around the nationwide or even worldwide. Remote user may be a researcher, data analyst, or any personnel who needs this data for food security and related studies.

The embodiment of the present ~~invention~~innovation further provides a computer program for performing the above methods.

Figure 5 illustrates an example main user interface of the Fish Eye Image-based Formalin Detection System. In the particular embodiments, a main user interface 500 is visible to the user of the system, both the expert and the guest users. The main user interface ~~_may~~ includes the title of the system 502, a logo 504 and a closing button 512. The main user interface also comprises of three (3) links namely the train model 506, formalin detection 508 and about 510. The train model button 506 will open a sub window for the user to add new training sets in retraining the model. The formalin detection button 508, on the other hand, will enable the user to detect formalin-laced fishes automatically. Lastly, the About link 510 will launch a sub window containing the brief description of the technology.

Figure 6 illustrates the about section 600. The illustrated embodiment contains a header 602, a logo 604, a developer section 606 describing the authors and programmers of the system and the description section 608 for a
 1050 brief information and instruction about the system.

Figure 7 illustrates an example of the train model section. By way of example, in the illustrated embodiment, the main portion of the training section is a set of labels 704, 706, 708, 712, 714, 716, 718 which serves as guide on what information are asked from the user. The section also consist of set of
 1055 input fields 720, 722, 724, 728, 730 and 732 accepting critical inputs necessary for training the system namely the number of epoch, batch size, seed start, learning rate, image dimension and number of images for training. In one embodiment, the user needs to load the directory of the new images samples by clicking Load Image File Directory button 736. When the user triggers the
 1060 Load Image File Directory button 736, a folder dialog is prompted in order to locate the training dataset of the acquired images for training phase and the file path is displayed into the text field 734. The user ~~may starts~~ or ~~cancel~~s the training using the start training button 738 or cancel training button 742 respectively. After the start training button is triggered, the training process
 1065 begins following the patterning module used in a deep learning system using convolutional neural network-based image patterning according to an embodiment of the present ~~invention~~innovation 300. The current progress or the status of the training ~~is being~~can be monitored through a multiline textfield 740. This is for keeping track the on-going training and evaluating the best
 1070 model achieved of the CNN.

Figure 8 illustrates an example of the formalin detection section 800. In the illustrated embodiment, the user ~~may capture~~s and ~~load~~s an image into a picture box 804 using the Load Image button 806. Once the image is loaded, its file path will be displayed in label 812. This image is then resized to 256 x
 1075 256 and goes into series of filters of the Convolutional Neural Network extracting low level to high level features. The extracted features will then be the input of the backpropagation algorithm (*the pattern classifying unit*) in classifying whether the inputted fish eye image is formalin positive or negative. A tabular form 816 displays the prediction outcomes of the model on every class

1080 and emphasized that the class which obtained the highest probability value, is
the final classification of model on the uploaded or selected image displayed in
an output box 818.

| Another embodiment of the present ~~invention~~innovation provides not just
a computer program for performing the above methods but also a mobile-based
1085 program for easy and comfortable way of accessing and using the application.

The mobile application is only capable of classifying the fish eye image.
Training function is not available for it requires large memory size, faster CPU
and necessary installations that only computer-based system can handle.
1090 Figure 9 illustrates the main interface 900 of the mobile application. The main
user interface, most likely the same with the computer-based application,
includes the title of the system 902, a logo 904, a gallery button 906, camera
button 908 and about button 910.

The gallery button 906 will open a sub window for the user to select
1095 saved images from the phone gallery. Once an image has been selected, it will
be loaded to a picture box in a separate window (see Figure 10).

To capture fish eye samples to be classified, camera button 908 should
be pressed activating the camera of the device. The captured image will then
be loaded to a picture box in a separate window (see Figure 10).

1100 The About button 910 is for detailed description about the application
and its developer.

The classification of the loaded fish eye images is illustrated in Figure
10. Detection of formalin-laced fishes will automatically proceeded following the
steps of the embodiment 300 once the target image is loaded in the picture box
1105 1004. The prediction outcomes of the model on every class is displayed in a
table 1010 and the class which obtained the highest probability value and
considered the final classification of model is displayed in the output box 1008.
The Back button 1012 is added to go back to the main user interface of the
application.

1110 The embodiments and the accompanying drawings described in the
present specification are merely illustrative of some of the technical ideas
| included in the present ~~invention~~innovation. Accordingly, the embodiments
disclosed herein are for the purpose of describing rather than limiting the
| technical spirit of the present ~~invention~~innovation, and it is apparent that the
1115 scope of the technical idea of the present ~~invention~~innovation is not limited by
these embodiments. It will be understood by those of ordinary skill in the art
that various changes in form and details may be made therein without departing
| from the spirit and scope of the ~~invention~~innovation as defined by the appended
claims.

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