Deep learning based Food Recognition using Tensorflow

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Abstract. Cutting edge profound learning models for food acknowledgment don’t permit information steady taking in and frequently experience the ill effects of cataclysmic impedance issues during the class gradual learning. This is a significant issue in food acknowledgment since certifiable food datasets are open-finished and dynamic, including a persistent expansion in food tests and food classes. Model retraining is frequently done to adapt to the powerful idea of the information, yet this requests very good quality computational assets and critical time. This paper proposes another open-finished ceaseless learning system by utilizing move learning on profound models for include extraction, Relief F for highlight determination, and a novel versatile decreased class steady portion extraordinary learning machine (ARCIELM) for characterization. Move learning is gainful because of the great speculation capacity of profound learning highlights. Alleviation F lessens computational intricacy by positioning and choosing the extricated highlights. The tale ARCIKELM classifier progressively changes network design to decrease calamitous neglect. It tends to space variation issues when new examples of the current class show up. To direct complete analyses, we thought about the model in contrast to four standard food benchmarks and an as of late gathered Pakistani food dataset. Test results show that the proposed structure learns new classes steadily with less calamitous induction and adjusts space changes while having serious characterization execution.

1. Introduction

1.1 Deep learning

Profound learning is important for a more extensive collection of AI techniques dependent on false neural organizations with portrayal learning. Learning can be administered, semi-managed, or solo.

Deep learning structures like profound neural organizations, profound conviction organizations, repetitive neural organizations, and convolutional neural organizations have been applied to fields including PC vision, machine vision, discourse acknowledgment, normal language handling, sound acknowledgment, informal community separating, machine interpretation, bioinformatics, drug plan, clinical picture examination, material investigation, and table game projects, where they have created results tantamount to and sometimes unbelievable human master execution [1-5].

Counterfeit neural organizations (ANNs) were enlivened by data preparation and circulated correspondence hubs in natural frameworks. ANNs have different contrasts from natural cerebrums. In
particular, neural organizations will in general be static and representative, while the natural cerebrum of most living organic entities is dynamic (plastic) and simple [6].

The descriptive word "profound" in profound learning alludes to the utilization of various layers in the organization. Early work showed that a straight perceptron can't be an all-inclusive classifier, and afterward that an organization with a non-polynomial actuation work with one secret layer of unbounded width can then again so be. As a unique yet significant instance of item acknowledgment, hand-held article acknowledgment assumes a significant part in knowledge innovation for its numerous applications, for example, visual inquiry noting, and thinking. In true situations, the datasets are open-finished and dynamic: new article tests and new item classes increment constantly. This requires the insight innovation to empower half and half gradual realizing, which upholds both data incremental and class-steady figuring out how to effectively get familiar with the new data. Notwithstanding, existing work essentially centers around one side of steady learning, either information gradual or class-gradual learning while doesn't deal with different sides of steady learning in a brought-together structure. To take care of the issue, we present a Hybrid Incremental Learning (HIL) technique dependent on the Support Vector Machine (SVM), which can gradually improve its acknowledgment capacity by learning new item tests and new article ideas during the association with people. To coordinate information gradually and class incremental learning into one bound together system, HIL adds the new arrangement planes and changes existing order planes under the setting of SVM. Accordingly, our framework can at the same time improve the acknowledgment nature of realized ideas by limiting the forecast mistake and move the past model to perceive obscure items. We apply the proposed strategy into hand-held item acknowledgment and the exploratory outcomes exhibited its benefit of HIL. Moreover, we directed broad investigations on the subset of ImageNet and the test results additionally approved the adequacy of the proposed technique.

[7] has proposed It was as of late shown that engineering, regularization, and practice methodologies can be utilized to prepare profound models successively on various disjoint assignments without neglecting recently procured information. Nonetheless, these techniques are as yet unsuitable if the errands are not disjoint yet comprise a solitary steady assignment (e.g., class-gradual learning). In this paper, we bring up the contrasts between perform multiple tasks and single-gradual undertaking situations and show that notable methodologies, for example, LWF, EWC, and SI are not ideal for steady errand situations. Another methodology, indicated as AR1, consolidating compositional and regularization systems is then explicitly proposed. AR1 overhead (as far as memory and calculation) is exceptionally little subsequently making it appropriate for web-based learning. At the point when tried on CORe50 and iCIFAR-100, AR1 outflanked existing regularization methodologies by a decent margin.

[8] has proposed Literature has demonstrated that precise dietary evaluation is vital for surveying the viability of weight reduction intercessions. Be that as it may, the majority of the current dietary appraisal techniques depend on memory. With the assistance of unavoidable cell phones and rich cloud administrations, it is presently conceivable to grow a new PC helped food acknowledgment framework for exact dietary evaluation. Nonetheless, empowering this future Internet of Things-based dietary appraisal forces a few essential difficulties on calculation improvement and framework plan. In this paper, we set to address these issues from the accompanying two angles: (1) to create novel profound learning-based visual food acknowledgment calculations to accomplish the top tier acknowledgment exactness; (2) to plan a food acknowledgment framework utilizing edge registering based help processing worldview to beat some natural issues of conventional portable distributed computing worldviews, like unsatisfactory framework inactivity and low battery life of cell phones. We have directed broad trials with genuine information. Our outcomes have shown that the proposed framework accomplished three destinations: (1) beating existing work regarding food acknowledgment precision; (2) decreasing reaction time that is identical to the base of the current methodologies; and (3) bringing down energy utilization which is near the base of the best in class.
[9] has proposed In this paper, we propose another profound convolutional neural organization (CNN) design to identify and perceive nearby food pictures. Different sorts of food with various tones and surfaces mirror the way that the food picture acknowledgment is viewed as a difficult assignment. In any case, profound learning has been generally utilized as a productive picture acknowledgment strategy, and CNN is the contemporary methodology for profound figuring out how to be carried out. CNN has been enhanced to the errands of food location and acknowledgment with few adjustments. We present another dataset of the most burned-through nearby Malaysian food things which was gathered from freely accessible Internet sources including however not restricted to, picture web crawlers. For assessment of acknowledgment execution, CNN accomplished fundamentally higher exactness than customary methodologies with physically removed highlights. Furthermore, it was discovered that convolution veils show that the highlights of food tone rule the highlights map. For the interaction of food discovery, CNN likewise showed impressively higher precision than other customary methods.

[10] has proposed Literature has demonstrated that precise dietary appraisal is vital for evaluating the viability of weight reduction intercessions. In any case, the greater part of the current dietary appraisal techniques depends on memory. With the assistance of unavoidable cell phones and rich cloud administrations, it is currently conceivable to grow a new PC-supported food acknowledgment framework for exact dietary appraisal. In any case, empowering this future Internet of Things-based dietary evaluation forces a few essential difficulties on calculation advancement and framework plan. In this paper, we set to address these issues from the accompanying two viewpoints: (1) to create novel profound learning-based visual food acknowledgment calculations to accomplish the top tier acknowledgment precision; (2) to plan a food acknowledgment framework utilizing edge figuring based assistance registering worldview to defeat some characteristic issues of customary portable distributed computing worldviews, like unsuitable framework inactivity and low battery life of cell phones. We have led broad analyses with certifiable information. Our outcomes have shown that the proposed framework accomplished three destinations: (1) beating existing work regarding food acknowledgment exactness; (2) decreasing reaction time that is comparable to the base of the current methodologies; and (3) bringing down energy utilization which is near the base of the best in class.

[11] has proposed Feature determination assumes a basic part in biomedical information mining, driven by expanding highlight dimensionality in target issues and developing interest in cutting edge however computationally costly procedures ready to show complex affiliations. In particular, there is a requirement for highlight determination strategies that are computationally productive, yet delicate to complex examples of affiliation, for example, communications, so instructive highlights are not erroneously disposed of before downstream displaying. This paper centers around Relief-based calculations (RBAs), a special group of channel style include choice calculations that have acquired allure by finding some kind of harmony between these targets while deftly adjusting to different information attributes, for example, grouping versus relapse. In the first place, this work comprehensively analyzes sorts of highlight determination and characterizes RBAs inside that specific circumstance. Then, we present the first Relief calculation and related ideas, stressing the instinct behind how it functions, how highlight loads produced by the calculation can be deciphered, and why it is touchy to include connections without assessing blends of highlights. In conclusion, we incorporate a far-reaching survey of RBA's methodological exploration past Relief and its mainstream relative, ReliefF. Specifically, we describe parts of RBA research and give near outlines of RBA calculations including commitments, procedures, usefulness, time intricacy, transformation to key information attributes, and programming availability.

[12], has proposed neural organizations are utilized in many cutting-edge frameworks for machine discernment. When an organization is prepared to do a particular assignment, e.g., bird characterization, it can only with significant effort be prepared to do new errands, e.g., gradually figuring out how to perceive extra bird species or learning an extraordinary undertaking, for example,
bloom acknowledgment. At the point when new assignments are added, normal profound neural organizations are inclined to calamitously fail to remember past undertakings. Organizations that are fit for absorbing new data steadily, similar to how people structure new recollections after some time, will be more productive than retraining the model without any preparation each time another errand should be learned. There have been various endeavors to create plans that alleviate disastrous neglecting, yet these techniques have not been straightforwardly thought about, the tests used to assess them change impressively, and these strategies have just been assessed on limited scope issues (e.g., MNIST). In this paper, we present new measurements and benchmarks for straightforwardly contrasting five distinct systems planned with moderate disastrous forgetting in neural organizations: regularization, ensembling, practice, double memory, and scanty coding. Our trials on certifiable pictures and sounds show that the mechanism(s) that are basic for ideal execution fluctuate dependent on the steady preparing worldview and sort of information being utilized, however, they all exhibit that the calamitous failing to remember issue still can't seem to be settled.

[13] has proposed This paper reflects the matter of concurrent café and dish acknowledgment from food pictures. Since the eateries are known due to their some extraordinary dishes (e.g., the dish "burger" in the eatery "KFC"), the dish semantics from the food picture gives incomplete proof to the café personality. Consequently, rather than abusing the paired relationship between's food pictures and dish marks by existing work, we model food pictures, their dish names, and café data mutually, which is relied upon to empower novel applications, for example, food picture based eatery representation and proposal. For arrangement, we propose a model, to be specific Partially Asymmetric MultiTask Convolutional Neural Network (PAMT-CNN), which incorporates the dish pathway and the eatery pathway to become familiar with the dish semantics and the café personality, individually. Considering the reliance of the café personality on the dish semantics, PAMT-CNN is fit for learning the eatery's character under the direction of the dish pathway utilizing incompletely deviated shared organization design. To assess our model, we develop one food picture dataset with 24,690 food pictures, 100 classes of eateries, and 100 classes of dishes. The assessment results on this dataset have approved the adequacy of the proposed approach.

[14] has proposed Food is perhaps the main issue for human wellbeing. To deal with the sound dietary life, we will build up an auto food-log record framework, which depends on auto food acknowledgment advancements. To understand this framework, we intend to propose a segregated food picture portrayal that can perform successful recognizable proof of food pictures in this paper. The traditional picture portrayal incorporates shading and surface conveyances (histogram), which are the measurable data dependent on the consistently quantized tone or surface levels. Be that as it may, these customary strategies utilizing uniform quantization of the close by shading and surface in the picture lead to a lot of data misfortune for dependably developing the picture. Therefore, this investigation proposes to describe the tone and surface data by joining the technique of fix based sack of highlights model. This strategy can adaptively get familiar with the agent tone or surface (models) from the food pictures for food acknowledgment, and it is feasible to recuperate a more solid picture utilizing the learned models. The examinations utilizing our proposed approaches show that the acknowledgment rate can be extraordinarily improved contrasted and the customary strategy.

[15] have proposed Food is an indivisible piece of individuals' lives. Food picture acknowledgment has been drawing in expanding consideration because of the advances of the Internet, imaging strategies, and online media. Approaches for food picture acknowledgment are essentially centered around two fundamental headings: low-level methodologies and mid-level methodologies. Low-level methodologies extricate low-level nearby highlights, like SIFT or SURF, following element encoding procedures. Mid-level methodologies extricate more elevated-level picture parts and have shown promising outcomes in numerous acknowledgment issues. Contrast and other picture acknowledgment issues, food pictures are exceptionally deformable with an enormous intra-class difference and little between-class change. In this paper, taking into account that midlevel approaches'
boss exhibition and superpixel division techniques' capacity to effectively fragment food parts, we propose a superpixel-based food picture acknowledgment structure to mine mid-level superpixel food parts-to-class comparability. We assess the proposed system on the UEC Food dataset and show promising outcomes when contrasted and existing best-in-class strategies.

Food picture acknowledgment is progressively significant for e-wellbeing applications. Yet, this is a difficult theme because of the variety of food, and shading, light, see points' impact on food pictures. Given observational and exploratory investigations, we propose to utilize SIFT(Scale Invariant Feature Transform) and Gabor descriptors as food picture highlights and KMeans calculation for include grouping. We likewise propose to utilize an inescapable distributed computing worldview to improve the presentation of food picture acknowledgment because of the hefty registering prerequisite for an enormous number of simultaneous acknowledgment demands. Assessments show that the proposed approach can give an adequate acknowledgment rate, and MapReduce programming can give a promising execution advantage contrasted with the conventional customer worker approach.

The scale-invariant element change (SIFT) is an element recognition calculation in PC vision to distinguish and portray neighborhood highlights in pictures. It was distributed by David Lowe in 1999. Applications incorporate item acknowledgment, automated planning, and route, picture sewing, 3D demonstrating, signal acknowledgment, video following, the singular ID of natural life, and match moving.

Filter key points of items are first extricated from a bunch of reference images and put away in an information base. An item is perceived in another picture by exclusively contrasting each component from the new picture to this information base and discovering applicant coordinating with highlights dependent on Euclidean distance of their element vectors. From the full arrangement of matches, subsets of keypoints that concede to the article and its area, scale, and direction in the new picture are distinguished to sift through great matches. The assurance of reliable bunches is performed quickly by utilizing a productive hash table execution of the summed-up Hough change. Each bunch of at least 3 highlights that concede to an item and its posture is then liable to additional nitty gritty model confirmation and hence exceptions are disposed of. At long last the likelihood that a specific arrangement of highlights shows the presence of an article is figured, given the exactness of fit and number of plausible bogus matches. Article coordinates with that finish every one of these assessments can be recognized as right with high certainty.

Heftiness has become an extreme medical condition in created nations, and a quality food admission has been perceived as the critical factor for stoutness anticipation. This paper presents a cell phone-based framework, DietCam, to help evaluate food admissions with few human intercessions. DietCam just expects clients to take three pictures or a short video around the feast, at that point it will wrap up. The investigations of DietCam in genuine cafés check the chance of food acknowledgment with vision procedures.

In this paper, we address the issue of naturally perceiving envisioned dishes. To this end, we acquaint a novel strategy with mine discriminative parts utilizing Random Forests (rf), which permits us to dig for parts at the same time for all classes and to divide information between them. To improve the proficiency of mining and characterization, we just consider patches that are lined up with picture superpixels, which we call parts. To quantify the presence of our rf segment digging for food acknowledgment, we present a novel and testing dataset of 101 food classifications, with 101'000 pictures. With a normal precision of 50.76%, our model outflanks elective arrangement strategies aside from CNN, including SVM characterization on Improved Fisher Vectors and existing discriminative part-mining calculations by 11.88% and 8.13%, separately. On the difficult MIT-Indoor dataset, our strategy analyzes pleasantly to other s-o-a part-based order strategies.
This paper considers the issue of a concurrent eatery and dish acknowledgment from food pictures. Since the cafés are known due to their some unique dishes e.g., the dish "cheeseburger" in the eatery "KFC", the dish semantics from the food picture give incomplete proof to the café personality. Along these lines, rather than abusing the twofold connection between's food pictures and dish names by existing work, we prototype food pictures, their food names, and eatery spot with the original class. If they are from pre-defined classes, it invigorates the prototype successively by our projected tactic and simply adds new concealed neurons when required. data together, which is relied upon to empower novel applications, for example, food picture-based café perception and suggestion.

For arrangement, we propose a model, to be specific Partially Asymmetric Multi-Task Convolutional Neural Network PAMT-CNN, which incorporates the dish pathway and the eatery pathway to gain proficiency with the dish semantics and the café character, individually. Considering the reliance of the café personality on the dish semantics, PAMT-CNN is equipped for learning the eatery's character under the direction of the dish pathway utilizing incompletely awry shared organization design. To assess our model, we build one food picture dataset with 24,690 food pictures, 100 classes of eateries, and 100 classes of dishes. The assessment results on this dataset have approved the adequacy of the proposed approach.

2. Proposed methodology

The proposed structure considers two credits of open-completed the process of learning Class consistent learning Data consistent learning. the stream diagram of the proposed plan. During a readiness period, each moving toward picture is particular to the picked significant component extractor unit that isolates the features. After which they are situated using the Relief F calculation, additionally, the finest structures are picked subject to our projected procedure. The picked features from the Relief F technique are concluded as the last depiction of the image. Notwithstanding the way that, the isolated features from the significant model have extraordinary theory limits. The static class designing softmax for the last request doesn't abuse this limit.

3. Machine learning model

Late investigations have investigated outrageous learning machines for food characterization because of quick preparation time and great execution. Regulated Extreme Learning Committee, utilizes numerous pieces of outrageous learning as council individuals. It takes highlights of shadings, shape, surface, and anticipates different outcomes. The Structured SVM, which goes about as a manager, gives the last yield. Their strategy utilizes a full part framework and group learning and doesn't address issues of open-finished persistent learning. A broad writing audit has set up the way that a large portion of the current techniques for food acknowledgment utilized fixed class datasets, can't gradually learn new classes. Their design has limits as they need to remove certain features from the previous data and have to train the model again. The figuring cost related to training the model again is vast which in turn which brands their tactic less great. The agenda projected in this examination adds to the current composition by watching out for these troubles.

4. Feature extraction

Significant learning prototypes for food affirmation can acquire capability with the finest picture depictions and abstain from the prerequisite for handcraft incorporate extraction measure which relies upon prior data. Our projected structure relates move learning with an online pre-arranged picture net significant model which is then used to remove features. In move learning a model made for one task is used again as the base point momentarily task. While exhibiting the ensuing task, it enables for snappy progress and redesigned results. It is recognizable in significant learning for remembering extraction for the grounds that the planning of the model without any planning requires specific computational resources, for instance, GPU and long getting ready time. This is the huge square for nonstop continuous learning. Regardless, various assessments have shown a high hypothesis limit of
significant features from pre-arranged models on nonexclusive datasets like ImageNet. It is also productive for learning a novel class.

5. **Data augmentation**

Data development produces changed forms of pictures that are incomparable categories as the basic image in the getting ready. Changes join a combination of pictures dealing with practices like zoom, level move, turn, etc. The goal is to add new, reliable cases to the planning. This induces, making different varieties of setting up that the prototype is practically sure to perceive. For instance, the level flipping of food is a possible circumstance because the image could be taken in one way or the other. Regardless, the vertical flip of food would make a trivial result as a picture of food turned upside down doesn't look good. The examination has applied 'moving', flip, zoom range, Channel Shift Range, and fill mode. In moving, picture pixels are moved in the level or vertical bearing. The social affair of pixels that are eradicated in one region is repeated into another region of the image. This examination uses both even and vertical developments. Flipping fuses changing the lines or areas of pixels.

6. **Classification**

The last development in our proposed model is consistent realizing what's a more, affirmation. By far most of the current assessments use bunch learning approaches for the portrayal of food, which requires fixed classes, making them forbidden for continuous settings. builds up the data close by limit learning machines for relentless affirmation of food dishes. Hence, this assessment has proposed a novel procedure that adjusts consistently with less planning time, higher precision, additionally, better theory limit. This part has discussed the fundamentals of class-consistent cut-off learning machines, trailed by our proposed method.

7. **Dataset used**

7.1 **Food101**

It consists of 101,000 real-world images divided into 101 food classes. There are visually and semantically similar food classes such as Apple pie, bread pudding, baklava, carrot cake Discriminative Components with Mussels, Onion rings, Paella, Edamame, Risotto, Bibimbap, Omelets, Lobster bisque, Eggs benedict, Macarons and much, etc. Besides domain adaptation, it poses a challenge for incremental learning due to a large number of food categories.

8. **Input data**

Figure 1 shows the sample hamburger input to our model
9. Architecture diagram

![Architecture Diagram]

**Figure 2. Architecture diagram**

Figure 2 depicts our architecture diagram of our model.

10. Output result

![Output Image]

**Figure 3. Output image**

Figure 3 shows the output hamburger image from our model.

11. Experimental results

In this part, this assessment discusses food datasets, execution, and close by the nuances examination of every time of the proposed framework on these datasets. The proposed structure has three modules. A) Feature extraction B) Feature Determination C) Classification. Considering, that the examinations are masterminded into three critical parts. In the primary investigation, the assessment chooses the best part extractor for food datasets from forefront significant learning associations besides, choose the impact of online data development during move learning. The ensuing test is to look at the lessening in portrayal time by using Relief F for feature assurance.

We can find that ALNS demonstrates select in general execution in elite measurement sets. For example, the scope of taxicabs settled on through method of methods for ALNS diminishes utilizing the method of methods for however much 28% on regular when contrasted with the decent answer accomplish utilizing a method of methods for LNS in D1. Notwithstanding, the general presentation of ALNS handiest improves roughly 5% in D2. Likewise, the strolling season of ALNS is bounty enormous than others, because of the reality ALNS iteratively looks through additional companions utilizing a method of methods for the close by look for structure. For the LNS (e.g., BDBI-SR), it forthright stops the journey in expressions of forestalling basis as it traps in close by optima. When all is said in done, ALNS can find a higher solution and its miles additional solid than LNS in restrictive circumstances, because of the reality the versatile component in ALNS is equipped to find a
reasonable arrangement of loads. Notice that the strolling season of ALNS in our tests is bounty huge because of the reality all examinations had been executed at the regular PC. In genuine applications, we can remember to apply distributed processing to accomplish replies as fast as reasonable in expressions of time execution for dinners conveyance.

12. Conclusion

The Food acknowledgment dataset is open-finished and dynamic. There is a constant expansion in food tests and classes. Existing profound learning models for food acknowledgment accept that all the food classes and varieties inside the food classes exist at first. They experience the ill effects of disastrous forgetting during class-gradual learning. This examination study tends to these difficulties by proposing another system of open-finished nonstop learning for food acknowledgment. It utilizes cutting-edge profound learning organizations to remove highlights, Relief F for include positioning and choice, and ARCIKELM for arrangement. To include extraction, this paper considers the incredible speculation capacity of profound model highlights. It has assessed three conditions of-theart profound organizations and established that Inception-Resnet-V2 has better execution as analyzed than others. Be that as it may, highlights extricated from profound learning models have an exceptionally high measurement and expands grouping time.

13. Futurework

In future work, we intend to decrease disastrous forgetting by utilizing a half and half plan for open-finished consistent learning. The internet grouping strategy such as self-sorting out steady neural organization can be utilized to choose the planning hubs which best address the class for help to select the closest hubs during characterization. This can lessen cataclysmic neglect and is commotion invariant when the info for an arrangement is far away from existing neurons. The other heading is the auto-scaling of computational assets in a cloud climate. As the novel classes and new pictures show up, the computational assets required increments. Additionally, during the order, the client's demands change at various periods. This necessitates that the open-finished persistent learning framework should have the option to auto-scale its computational assets in a cloud climate.

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