AUTOMATIC CERAMIC TILES DEFECT RECOGNITION

BY

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This Report Presented in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Computer Science and Engineering

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APPROVAL

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DECLARATION

We hereby declare that this project has been done by us under the supervision of **Md. Tarek Habib, Assistant Professor, Department of CSE** Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for the award of any degree or diploma.

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ABSTRACT

The global market for ceramic tiles industry is highly competitive nowadays. Quality control in production process in ceramic tiles industry has been a key factor for retaining existence in such competitive market. Machine vision based ceramic tiles inspection systems are very useful in this respect, because manual inspection is time consuming and not accurate enough. Hence,machine vision based ceramic tiles inspection systems have been drawing plenty of attention of the researches of different countries in order to replace manual inspection. Two difficult problems are mainly posed by machine vision based ceramic tiles inspection systems. They are defect detection and defect detection classification. Even though there has been plenty of research addressing the defect detection problem, the research aiming at solving the classification problem is scarce. Moreover, scene analysis and feature selection play a very important role in defect detection process. If scene analysis is not properly done, a weak and inappropriate set of features will be selected. Selection of an inappropriate feature set makes the subsequent steps complicated and the classification task becomes harder. In this thesis, a possible appropriate set of features are confined to the spatial domain. We justify the features from viewpoint of discriminatory quality and defect difficulty. The features are extracted using a statistical defect extraction process. We perform defect detection on the applicability of convolutional neural network models by CV2 in the context of tiles defect. We observe the effect of tuning different network parameters and try to explain the reasons. We empirically find four types of defected tiles, including multi label defected tiles with OpenCV using mask image .Finally, we use accuracy metrics to evaluate the models and find out the accuracy of defected tiles detection.

Table of Contents

List of Figures

Figures

List of Tables

Tables

CHAPTER 1
INTRODUCTION

THE ceramic tiles assembling procedure has now been totally robotized except for the last phase of generation worried about visual investigation [1]. This mechanized grouping technique encourages us to get learning about the example of deformity inside a brief timeframe and furthermore to choose about the recuperation procedure so that the deserted tiles may not be blended in with the new tiles. This paper is worried about the issue of programmed investigation of fired tiles utilizing PC vision. It must be noticed that discovery of imperfection in finished surfaces is a significant territory of programmed modern assessment that has been to a great extent neglected by the ongoing influx of research in machine vision applications. People can discover such abandons without earlier learning of the defect free design. Imperfections are seen as in-homogeneities in normality and direction fields. Two particular however theoretically related methodologies are introduced. The initial one characterizes auxiliary abandons as districts of unexpectedly falling normality, the second one as irritations in the prevailing direction. Both techniques are general in the faculties that every one of them is pertinent to an assortment of examples and deformities. Human judgment is, not surprisingly, impacted by desires and earlier information. In any case, this issue isn't explicit to basic deformities. In numerous recognition errands for instance, edge identification, there is a continuous progress from nearness to nonappearance.

Any machine vision framework will never

Favorably supplant the visual review on the off chance that it is not ready to:

1. Dissect the shade of the item with unwavering quality.

2. Recognize each kind of assembling deserts, with in any event a similar precision as the human eye.

3. Measure with high accuracy the measurements of the tiles

1.1 Introduction

The defect identification activity actuates that the whole surface of each tile must be imaged and broke down. The objective of the assessment is to give a measurable examination of the generation clusters. Thus, all bunches of tiles will be imaged separately without any testing activity. The picture procurement accomplished straightforwardly on line, in the constant. The picture investigation calculation must be quick enough to pursue the creation rate. This paper expects to make a visual framework that is equipped for identifying the surface deformities for the terminated clay tiles. That guarantee the items are free from deserts for the characterizing procedure.

Characterizing procedure must be viably, equitably what's more, more than once, with adequate speed and low costs. It must be able to adjust independently to changes in materials. The procedures utilized range from Long break, Crack, Blob, Pin-gap and Spot identifiers calculations for plain, and surfaces tiles. This in this way decreases the quantity of grievances tiles. The introduced examination strategies have been actualized and tried on various tiles utilizing engineered and genuine imperfections. The outcomes recommended that the presentation is sufficient to give a premise to a reasonable business visual assessment framework which we will see it in the next segments. We for the most part have discovered all out eight kinds of surrenders from the current imperfection identification strategies. These sorts of imperfections are appeared in the accompanying Table 1.

Table 1 Type of ceramic tiles defect

Name of defect	Description
Chipping	Side of the tiles get chipped
Crack	Break down of tiles
Pin hole	Scattered isolated black-white pinpoint spot
Iron	Discontinue of color sometimes black spot visible

Figure 1 pinhole

Figure 2 Chipping

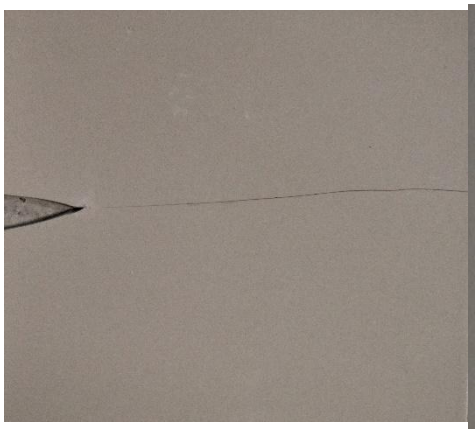

Figure 3 Crack

Figure 4 Iron

1.2 Motivation

Worker in an industry always have to find out the error of product manually in factories. But with machine they can automatically detect the error with much more efficient.

After checking a lot of product, there comes a tiredness which is a great problem of reducing the accuracy of checking out product and it also increases the work time. But a machine will never be tired of work which will not have impact on its work time and also accuracy will be just fine.

The accuracy of human can always have a probability of fault rate but a machine can have always the same accuracy that is programmed before.

When the error detection of tiles system is manual more labor is needed in an industry. But when it is automated by machine less labor will be needed but there will be only at a time cost.

1.3 Rationale of the Study

An automatic system is always better from a manual system. Manual system take too much time to prepare the result and not give the accurate result sometimes the result is totally wrong on the other hand automatic system take short time and show the more accurate result.

People become tired when they working for a long time sometimes they lost their attention from work but a machine will never be tired it will work at same speed.

If we manually detect the accuracy of tiles it will not give the best result but when we use a machine to calculate the accuracy it will always give us the more accurate result[2].

1.4 Research Questions

This paper is worried about the issue of programmed examination of artistic tiles utilizing PC vision. It must be noticed that the location of deformities in finished surfaces is a significant territory of programmed mechanical examination that has been generally neglected by the ongoing influx of research in machine vision applications. At first, we diagram the advantages to the tile producing industry. This is trailed by a categorization of run of the mill tile absconds. Next, we audit various systems as of late created to identify different sorts of imperfections in plain and finished tiles.

1.5 Expected Output

- Computer Vision Approach that successfully recognize defect.
- Can detect various types of defects effectively
- A large data set of images of defective ceramic tiles. Can provide as a huge collection of data set
- One or more articles in international journal/conference

CHAPTER2

Background

2.1 Introduction

In our thesis, we mainly tried to focus and analyze the manufacturing defect that occurs during production, that is still identify by human eye and can occurs may harms. This process can be seedless and effective.Moreover detecting defect have become a new industrial utilization of computing technologies.

Moreover, this thesis also includes the practical applications and real business value for computing technology. As Industries are becoming for machine dependent this technology can improve their interest and also improvise the way of production for further development in the future.

2.2 Related Works

Programmed assessment and imperfection discovery utilizing picture handling is a territory of machine vision that is as a rule generally embraced in numerous ventures. It is utilized for high throughput quality control underway frameworks, for example, the identification of imperfections on produced surfaces.

There are some related work in this field such as color correction, surface defect detection etc.Ceramic Tile Inspection for Color and Structural Defects [3].Machine Vision Applications, to appear January 1995 [4].Deep convolutional neural 282 networks for detection of rail surface defects [5].Supervised Machine Learning: A Review of Classification Techniques [7].Ceramic Tiles Surface Defect Detection Using Image ProcessingPublisher [9].

2.3 Research Summary

Assembling is a very important part in our modern world. The more it built up the more success it can relay. Manufactured merchandise are critical for the administration businesses. That is, the wages from assembling workers are re-spent in different pieces of the economy, since assembling enhances the economy.

Our postulation is a little attempt to build up this development. We combine computing science and manufacturing defaults to make a batter production through our research project.

2.4 Scope of the Problem

Zero Defects, a term begat by Mr. Philip Crosby in his book "Absolutes of Quality Management" has risen as a mainstream and profoundly respected idea in quality administration – to such an extent that Six Sigma is receiving it as one of its significant hypotheses. Completely coordinated activities are steadily outfitting IoT innovations using:

- coordinated design and programming
- associated sensor advancements
- Incredible information examination getting ready for distributed storage and edge figuring arrangements – at machine and venture level.

2.5 Challenges

There are many challenges we faced during this process. The very fast issue we faced is for collecting a huge data set. It is challenging and at the same time the time consuming as all the manufacturing industries are outside of the town. However we get to connect with the great wall and collect our desired data.

Moreover theirwe faced difficulties for using algorithm as we are new to this and we have to check as many algorithm as possible to find the right choice of it.

CHAPTER 3
RESEARCH METHODOLOGY

3.1 Introduction

Gradually machines are driving a greater amount of the information investigation and remedial or precaution activities, so information handling will turn out to be increasingly similar to:

Information accumulation from machines, creation lines and production lines

>Information molding

>Mix of information from dissimilar streams

>Information investigation and displaying from such union

>Information understanding and activity by machines

> checked by people

> rehash.

AI and Artificial Intelligence advancements can:

Break down information at a rate a long ways past that of people. Break down data that people don't approach or information they wouldn't think about significant. Associate apparently random variables, for instance, relating X and Y occasion with a specific kind of item imperfection or disappointment .Raise admonitions or recommend remedial activities dependent on complex examples and prescient models

3.2 Research Subject and Instrumentation

This undertaking expects to make a visual framework that is fit for identifying the surface deserts for the terminated artistic tiles. That guarantee the items are free from abandons for the characterizing procedure. Ordering procedure must be viably, equitably and more than once, with adequate speed and low costs. It must be able to adjust self-rousingly to changes in materials. The flowchart of my strategy is demonstrated as follows:

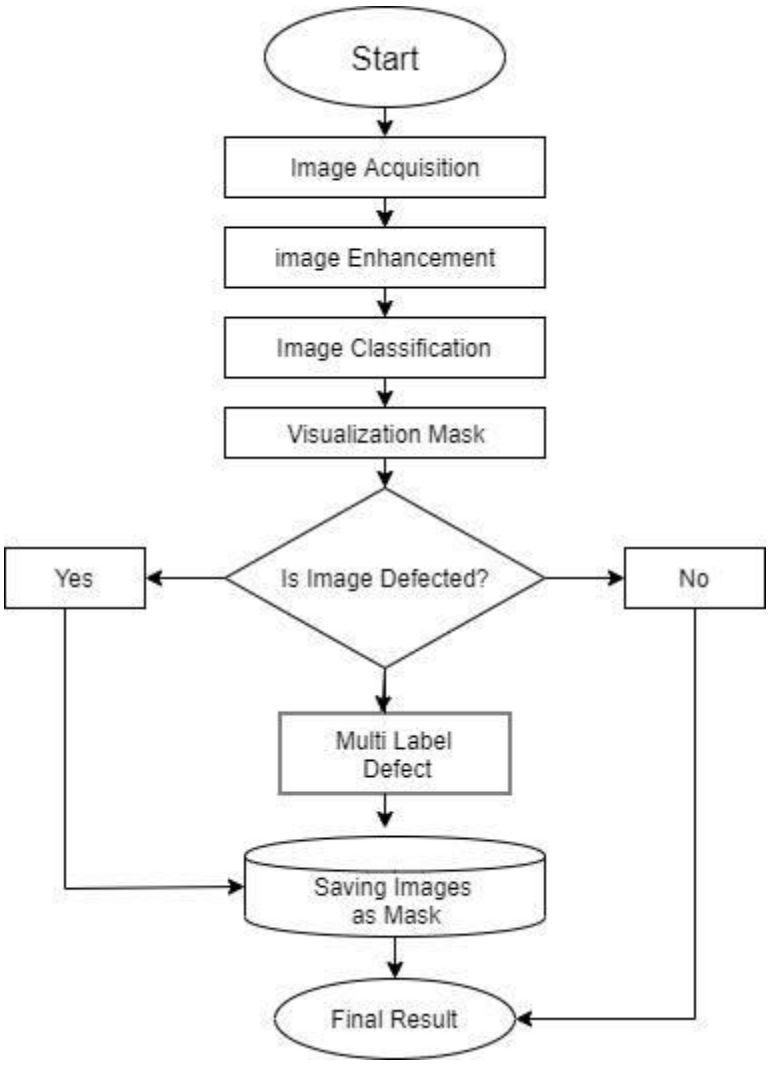

Figure 5: Strategy of work

3.3 Data Collection Procedure

Picture procurement is the way toward acquiring a digitized picture from a true source. Each step in the procurement procedure may present irregular changes into the estimations of pixels in the picture which is alluded to as commotion. Aceramic tile picture is caught and put away into the PC for further handling. This might be accomplished by snapping a picture with a traditional camera, having the film made into a print and examining the print into a PC. We proposed to make pictures that are more appropriate the human visual discernment object recognition what's more, target acknowledgment. We utilized the standards of Picture handling and morphological activities on the ceramic tiles pictures.

In this manner, we get new pictures that contain the surface imperfection just to make simpler for the distinguishing procedure and order activity through the judgment of the administrator.

Figure 6 tiles

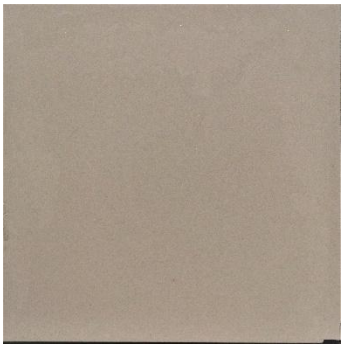

Figure 7 Chipped tiles

Figure 8 Crack tiles

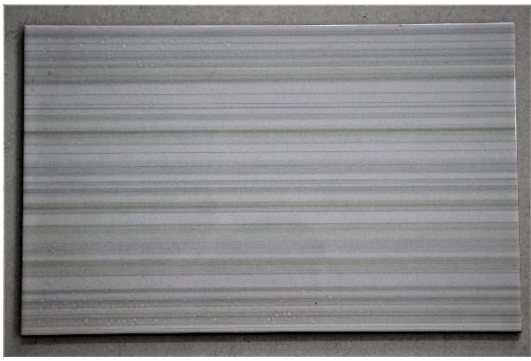

Figure 9 pin hole

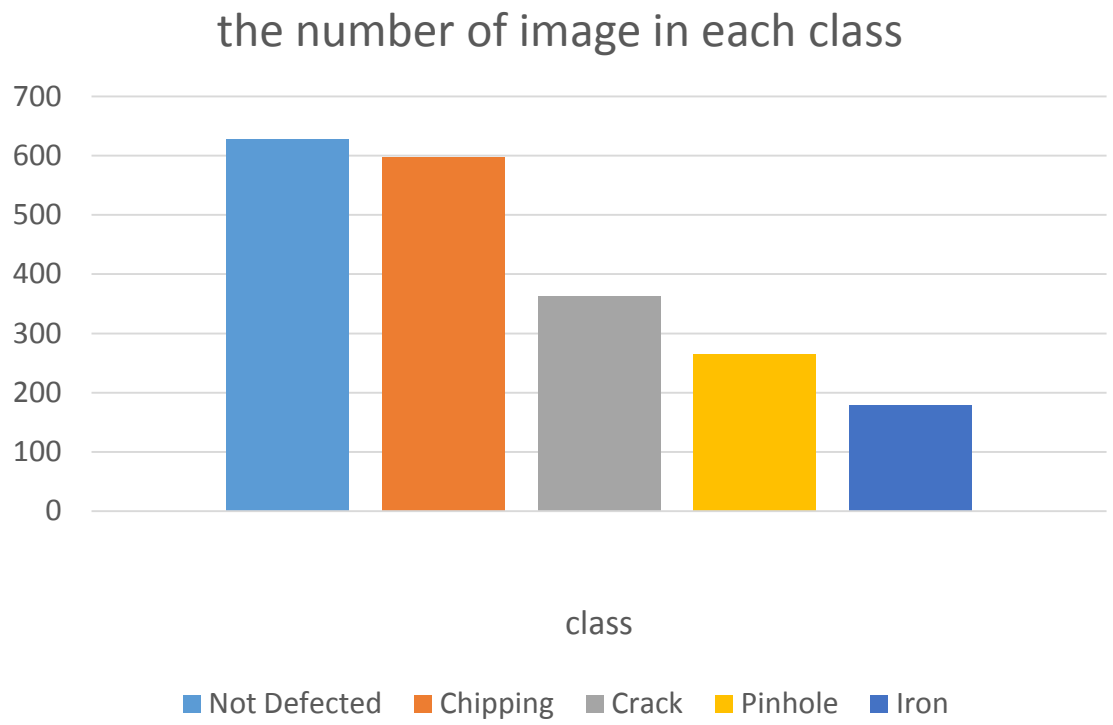

Figure 10: Dataset overview

3.4 Implementation Requirements

The ceramic tiles have been caught through the online camera hung hanging in the balance generation at the industry. So as to improve the proficiency of the activity, a progression of coordinated picture handling will be led ahead of time to encourage the learning of the AI model. It comprises of three layers of handling, the main layer is Median channel, the subsequent layer is canny edge finder, and the third layer is Thresholding. The calculation of the AI incorporates the convolution neural systems, piece max pooling is utilized to prepare the program, and the engineering of GAN-based examples producer is utilized to tackle the issue of little data sets for ceramic tiles.

3.5 Testing procedure

The Python language is utilized to compose the program and execute the testing techniques in request to viably recognize the work piece surface deformities, the design of convolutional neural system is picked in testing methods. The flowchart of testing strategies for deformity location framework is

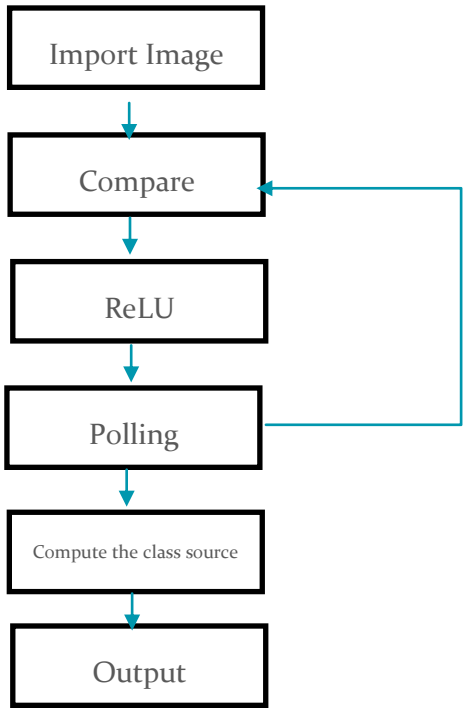

Table 2: Testing process

CHAPTER 4
EXPERIMENTAL RESULTS AND DISCUSSION

4.1 Introduction

This part will depict the strategy that has been created and a portion of the outcomes discovered during test runs. Generally hardly any testing was done as it was anything but an objective of this theory to decide the abilities of ideal parameters of the DETECT system. Most choices depended on straightforward visual examination of results as it was difficult to utilize any scientific exhibition number.

A couple of recorded successions of covariance pictures were utilized to test up-and-comer arrangements during the advancement of the handling method. In a later stage the proposed methods was actualized on the model framework so as to examine the ongoing performance and vigor of the strategy.

The technique has been created with different deformities, for example, break or chipping or stick opening or iron.

4.2 Experimental Results

We had portrayed in the past area ideal Crack, Pin-Hole, Chipping, and iron recognition calculations utilized freely additionally as present handling stages on our different systems. It is a very precise methodology however it is computationally requesting. We apply these calculations on a few number of tiles, which are plain tiles and finished tiles. What's more, we apply these calculations on a dozen of tiles pictures. These tiles pictures have the same sort of imperfection while the working conditions were like genuine conditions. That is for calculated motivations to check whether the calculation give the equivalent result or not and see the distinctions. When applying the individual calculations for deformity discovery we discovered the outcomes.And the accuracy is 96 percent.

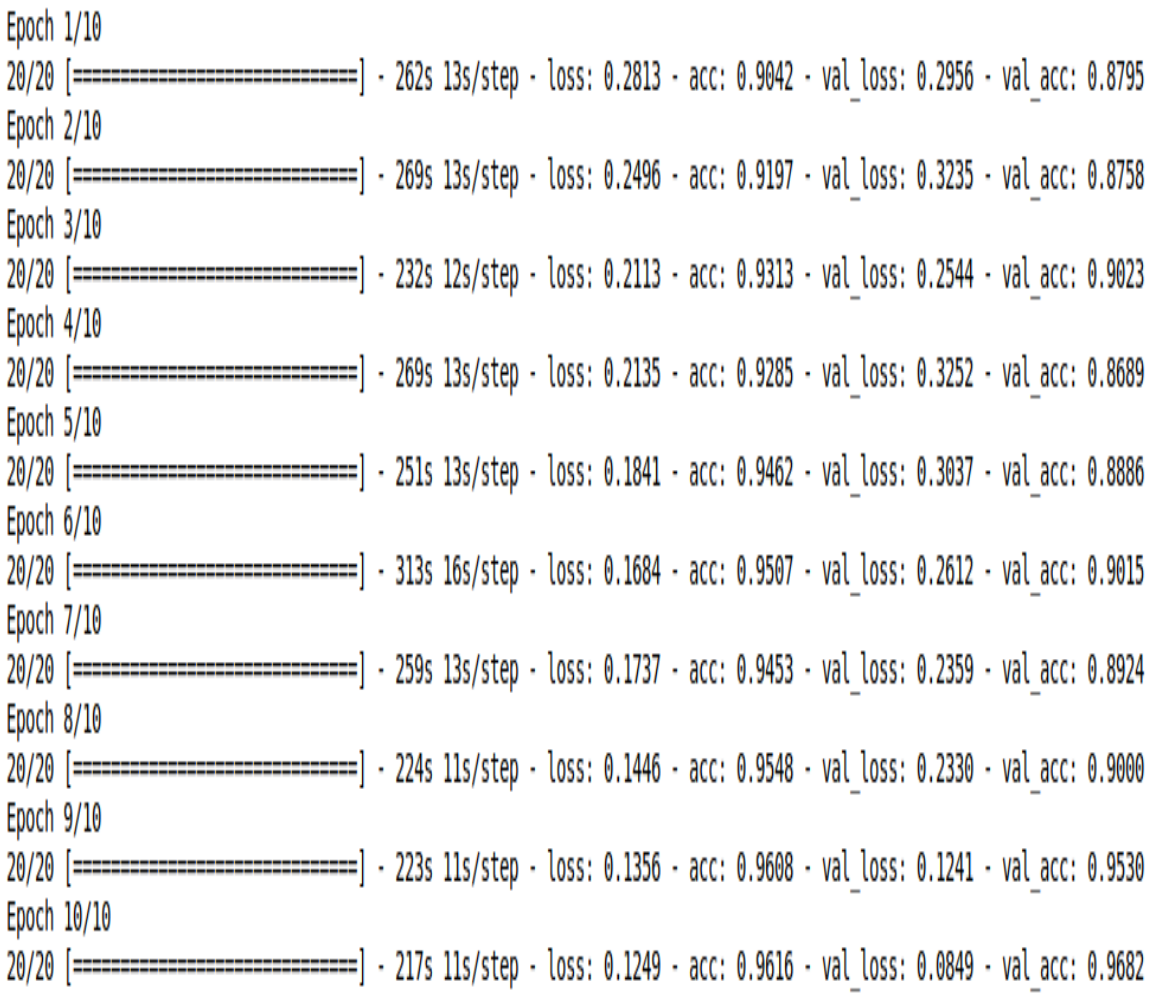

Figure 11: Experimental Result

4.3 Descriptive Analysis

The examples of normal pictures and defect pictures are the preparation datasets for CNN. Also, the testing tests of ordinary surface pictures and surface deformities

Pictures are the legitimate datasets. In request to make CNN function admirably, we have to prepare and alter the setup of system a few times to get a moderately exact system design. The precision correlations of the deformity recognition can be utilized to examine the consequences of various hyper parameters for convolutional neural system. There are eight setup for convolutional neural system. The contrasts between the eight designs are the quantity of layers of convolutional layer and the pooling layer, CNN preparing ages and learning rate. The parameter layer position speaks to the request for the layers is situated in the CNN. The parameter "conv_nb_filter" speaks to the quantity of convolutional channels. The parameter "conv_filter_size" speaks to the Size of convolutional channels. The parameter "pl_kernel_size" speaks to the Pooling portion size. The parameter "fc_n_units" speaks to the quantity of units for completely associated layer. Furthermore, the acknowledgment impact of CNN with the canny edge identifier pre-preparing was tried.

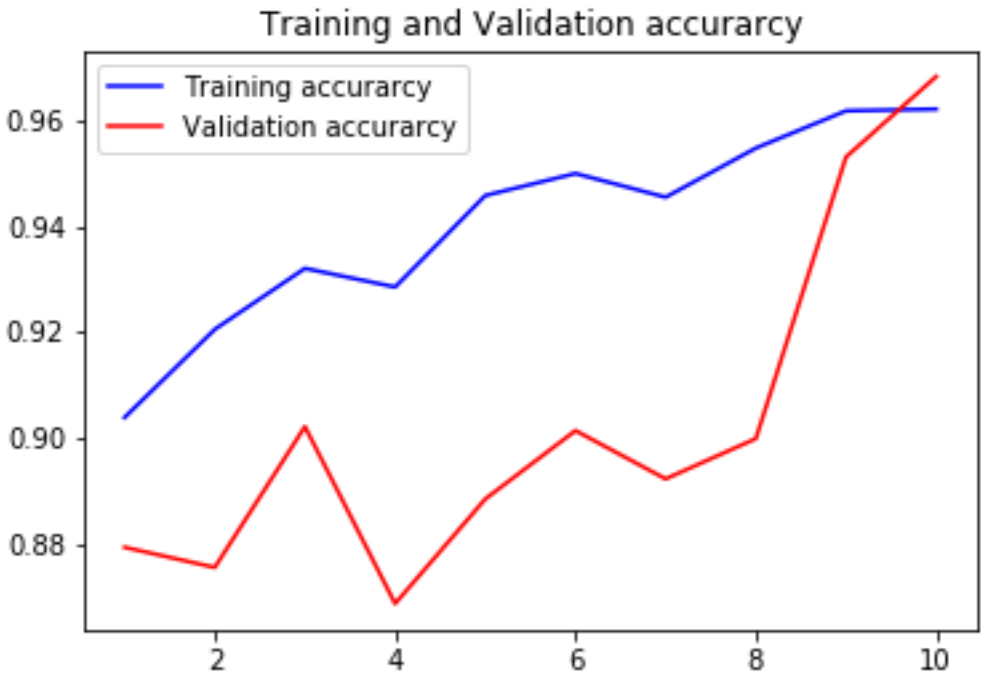

Figure 12: Training and Validation Accuracy

Figure 13: Training and Validation Loss

4.4 Summary

In enterprises, gathering preparing dataset is normally expensive and related techniques are exceptionally dataset-subordinate. So most organizations can't give Big-information to be broke down or applied. By the test results, the acknowledgment precision can be clearly improved as expanding information growth It implies it will be a decent answer for tackle the issue of little dataset later on. To summarize, the improvement of an AI based keen imperfection location framework will add to mechanical advancement, industry, national advancement and different applications

(1) The utilization of wise AI innovation will make the business innovation progressively modern.

(2) It will make the improvement of hardware industry be better by the AI applications.

(3) It will expand the financial matters and efficiency of nations for the maturing of the populace by AI

CHAPTER 5

5.1 Summary of the Study

Foundry is an old enchantment encompassed movement that has developed to become one of the key bits of the entire society as we probably am aware it. Since foundry supplies key pieces to other significant and basic divisions like flight related or car ventures where the smallest imperfection may get lethal. In this paper, we proposed another framework dependent on machine vision and AI so as to recognize and arrange absconds in the outside of iron castings. This methodology begins by recovering pictures from the tried castings. At that point, the division technique recognizes all the potential deformities inside the castings. At last, AI models are utilized to order the conceivable deformity into incorporation, cold lap, misran or on the other hand right. We assessed our methodology as far as inclusion of the proposed division strategy and exactness of the categorization of the areas. The trial results appeared that, though our accuracy in categorization is extremely high, the inclusion of the framework ought to be improved.

Future work is situated in 2 principle ways. To start with, we are going to grow new division techniques so as to upgrade our inclusion results. Second, we will utilize various highlights to improve the categorization procedure.

5.2 Conclusions

This paper discussing about the issue of identification terminated ceramic tiles utilizing the image processing and Deep learning. By utilizing this method we can build up the arranging framework in the ceramic tiles enterprises from contingent upon the human which recognizes the imperfections physically upon his experience and abilities which changes from balanced to the robotized framework contingent upon the PC vision. That influence mostly in the order or arranging activity which additionally done by human in the business. Individuals can work viably for brief periods and a wide range of administrators are associated with checking a similar clump of tiles. Congruity after some time isn't ensured and may bring about generally speaking low quality, which may cause clients to whine or even to dismiss the cluster. Miss-arranging is kept at an amazingly low level. We accomplishment in separating various types of imperfection in artistic tiles pictures. Computerized arranging frameworks would carry various advantages to the whole area with major monetary preferences, likewise ensure item quality, increment plant productivity and diminish fixed and occasional speculations. The consistent estimation of surface deformities gives line generation administrators to upgrade temperature profile, speed and other working parameters.

5.4 Implication for Further Study

No case is made here that the displayed strategy in general or its constituents are ideal in any sense. An ideal arrangement is beyond the realm of imagination to expect to decide since the notice is unknown.However, themethods seems to work acceptable the situation being what it is of the test arrangement used. Many imperfections were found during trials that couldn't be seen with the bare eye. Those discoveries have not been explored and are not really pores.

During evolution of techniques care was taken to guarantee that the piece of the preparing that expected to occur continuously was basic and could be optimised.the usage in the model later demonstrated that palatable execution was conceivable with the proposed method. Although the post handling could be made progressively intricate and time consuming, simple direct channels were found to deliver great results and made the assignment of implementing the program less complex.

In the event that later trials on surfaces with pores of realized volume show that the estimation of the covariance is nor proportional to the volume of the pore at that point utilizing the technique for time averaging may the covariance, discussed in previous, not be reasonable for assessing pore volume. A conceivable option could be to check the occasions during the information social event time interim that the covariance is not exactly a threshold.In different words saving to what extent time vanishing goes on instead of how solid the fluctuation are.

References

1. Vincent LEBRUN, “Quality Control of Ceramic Tiles by Machine Vision”, Flaw Master 3000, Surface Inspection Ltd. 2001.

2. Richard Bridge, “Computer Image Processing”. Tessellate Support Services PLC, Oxon, England, Issue V1.R2.M0, June, 2003.

3. C. Boukouvalas, J. Kittler, R. Mari, M. Mir Mehdi and M. Petrous, “Ceramic Tile Inspection for Color and Structural Defects”. I.E.E.E. Transactions on Pattern Analysis and Machine Intelligence, 14(1), March 1998.

4. Song K Y, Petrous M, and Kittler J, Texture crack detection, Machine Vision Applications, to appear January 1995

5. S. Faghih-Roohi, S. Hajizadeh, A. Núñez, R. Babuska and B. De Schutter, "Deep convolutional neural 282 networks for detection of rail surface defects," 2016 International Joint Conference on Neural Networks 283 (IJCNN), Vancouver, BC, 2016, pp. 2584-2589. DOI: 10.1109/IJCNN.2016.7727522

6. . C. Huang, D. Chen and X. Tang, "Implementation of Work piece Recognition and Location Based on 301 Opencv," 2015 8th International Symposium on Computational Intelligence and Design (ISCID), 302 Hangzhou, 2015, pp. 228-232. DOI: 10.1109/ISCID.2015.143

7. S. Kotsiantis, “Supervised Machine Learning: A Review of Classification Techniques,” in Proceeding of the 2007 conference on Emerging Artificial Intelligence Applications in Computer Engineering: Real Word AI Systems with Applications in health, HCI, Information Retrieval and Pervasive Technologies, 2007,

8. Y. Singh, A. Kaur, and R. Malhotra, “Comparative analysis of regression and machine learning methods for predicting fault proneness models,” International Journal of Computer Applications in Technology

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